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Renewable Energy through Public Private Partnerships in South Africa

Lalla, Rekha

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Renewable Energy through Public Private Partnerships in South Africa

Rekha Lalla

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2012

ABSTRACT

The magnificence of South Africa is its immense natural beauty and abundant natural resources. An energy intensive fossil-fuel powered economy makes South Africa vulnerable to the impact of climate change. South Africa's commitment to environmentally sustainable energy utilisation, rural electrification needs and energy security is the driving force to venture into renewable energy options.

This study investigates the renewable energy options available in South Africa to ascertain which are the most viable to implement. It identifies the obstacles preventing the implementation of renewable energy options and seeks to find solutions to overcome them. This study considered the role of public private partnerships in transforming renewable energy in South Africa through effective public private partnering.

A qualitative approach was adopted for this study. Primary data was collected through direct communication in the form of personal 'face-to-face' and telephonic interviews and content analysis of documentary materials.

This study confirmed that South African conditions were favourable for the implementation of a wide range of renewable technologies. Legislative barriers, grid access and infrastructure, tariff structures and lack of information were identified as some of the major obstacles delaying the implementation process. Regulatory reform was required to overcome some of these hurdles. The study found that instead of public private partnerships serving to transform the renewable industry, independent power producers proved more effective.

DECLARATION

I, Rekha Lalla, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

REKHA LALLA

Signed at Springs

On the 28th day of March 2012

DEDICATION

To my four pillars of strength: God, my husband Ramesh and my two daughters Avenia and Tanisha.

Thank you Dear Lord for the faith and belief I have in You which has guided me through this journey.

Ramesh, my soul mate, through your inspiration I have embarked on this journey, your love and unwavering support gave me the courage to persevere to the end.

To Avenia and Tanisha, your love, support and will to succeed were an inspiration to me.

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I would like to express my profound gratitude to my Dear Lord for helping me reach my goals. My dear husband and life partner, thank you from the bottom of my heart for believing in me and for your unconditional love, support and patience throughout my MBA studies. To my daughter Avenia, thank you for your love, support and confidence. To my daughter Tanisha, thank you for your love, support and dedication, more especially for keeping me on my toes throughout my MBA.

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To my MBA classmates, Anjue Hirachand and Ismail Lambat, thank you for your friendship, critical feedback on my report and for the challenge to reach the finish line.

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CHAPTER 1: INTRODUCTION

1.1. Purpose of the Study

The purpose of this research was to assess the transition by South Africa to renewable energy through public private partnerships, the opportunities presented and obstacles encountered in the process. This report discusses the renewable energy resource options available in South Africa and the potential to overcome the barriers to implementation through partnerships in the public and private sectors thereby maximising the benefits of moving towards renewable energy.

1.2. Context of the Study

The adverse effects of global climate change on the natural ecosystems and humankind is one of the biggest concerns facing the world today. Climate change, otherwise referred to as 'global warming' as defined by the United Nations Framework Convention on Climate Change (UNFCCC), is the result of human activity changing the composition of global atmosphere. This change, directly or indirectly, is to the extent that disruptions in weather and climate patterns result in extreme weather incidences and a rise in sea level (UNFCCC, 1992).

The Department of Environmental Affairs and Tourism reported that the sub-continental global warming forecast for South Africa, a semi-arid country, are temperature increases ranging between 1% and 3% particularly in the dry regions of the country. There are also decreases in rainfall patterns in the summer rainfall regions with marginal increases in the winter rainfall regions accompanied by droughts and heavy rains prompting a need for a national climate change policy (DEAT, 2004).

According to the Intergovernmental Panel on Climate Change (IPCC), Greenhouse Gas (GHG) emissions play a dominant role in altering the energy

balance of the climate system posing a threat to sustainable development thus motivating the adoption of the Kyoto Protocol in 1997 by the UNFCCC with the objective to stabilise the concentration of GHGs (IPCC, 2007).

South Africa, a developing country, is committed to economic growth but faces the risk of negatively affecting the environment by increasing GHG emissions through the growing demand for energy produced largely from fossil fuels.

Eskom, a state owned electricity utility, produces and supplies 95% of South Africa's energy needs largely through coal-fired power stations. Sasol, a listed company, is another significant carbon dioxide emitter producing liquids from coals and gas through high energy intensive processes (Beck, Surridge, Liebenberg, & Gilder, 2011).

The abundance of coal reserves in South Africa does little to discourage this heavy reliance on coal. Instead the need for economic and social development increases the contribution of high carbon dioxide emissions in the energy-intensive economy adversely impacting the environment, necessitating the transition to renewable energy (Randall, 2003).

Renewable energy is energy that does not disturb the natural balance of the earth (van Niekerk, 2008). The alternative sources of energy are primarily solar, wind, hydro, ocean, wave, biomass and waste energy. South Africa has abundant solar radiation and an established infrastructure of manufacturing solar water heaters (SWHs) (Visagie & Prasad, 2006). The authors have identified bio-fuels technology as fast becoming a developing industry in South Africa with the potential to fulfil energy and environment needs, creating job opportunities, profits for investors and a positive balance of payment impact through increased exports and reduced imports.

In an effort to commit to the global drive towards a sustainable environment, the South African Department of Minerals and Energy (DME) issued a White Paper on the renewable energy policy to ensure that the abundant renewable energy resources are optimised (DME, 2003). It further highlights the need for South Africa's industrial and financial sectors to lead the way with government support through the development of appropriate policies and frameworks to encourage

and guide the private sector. The White Paper acknowledges that renewable energy development in South Africa is still blossoming and comes with high start-up costs whilst fossil fuels, in contrast, are well established and have relatively low cost.

These barriers can be broken by encouraging private and public bankers, government subsidies, micro-lenders and international funders to finance these operations to achieve economic benefits and in so doing also make contributions towards corporate social investments.

Government has revised the integrated resource plan for electricity for 2010 to 2030 (IRP) to include a medium term risk mitigation project (MTRMP) for 2010 to 2016 to fast track implementation. The focus of which is to consider all energy supply alternatives to meet the demand requirements over the short-term risk of capacity shortages (DoE, 2011). It is encouraging that government has emphasised that this project will be implemented through partnerships encompassing all the stakeholders in the public and private sectors.

This study assesses the viability of renewable energy options available in South Africa to ascertain which are the most practical to implement. It also highlights the opportunities and benefits of moving towards clean energy, identifies the obstacles preventing the implementation of renewable energy options and examines the solutions to overcome them. This study has considered the role of public private partnerships (PPPs) and how they contribute towards translating the implementation plan into action through effective public private partnering.

1.3. Problem Statement

1.3.1. Main Problem

Analyse and evaluate the role of public private partnerships in the transition to viable renewable energy resource options in South Africa by identifying the obstacles facing them and finding solutions to overcome them.

1.3.2. Sub-Problems

i) To assess the viable renewable energy resource options available in South Africa and the plans for their implementation.
ii) To identify the obstacles preventing the implementation of renewable energy resource options in South Africa and propose ways to overcome them.
iii) To analyse and evaluate the role that public private partnerships can play in the transition to renewable energy resource options in South Africa.

1.4. Significance of the Study

The study fills a gap between policy and implementation of renewable energy resource options through public private partnerships. The South African government is committed to sustainable development and hence issued the White Paper to ensure that renewable energy resources are used optimally, demonstrating clear intent towards implementing renewable energy solutions. In reality, this has not materialised. In fact, the progress has been so slow that it has necessitated a revision of the White Paper to include a MTRMP to be implemented in partnership between government, business, labour, civil society and Eskom (DoE, 2011).

The study provides guidance to the public and private sectors on the opportunities and benefits of implementing renewable energy solutions. It encourages the speedy implementation of the revised integrated resource plan (IRP) by government and key stakeholders alike.

Private investors are encouraged to look at the investment opportunities created with the implementation of the IRP to provide the necessary funding which in turn will boost the employment rate and result in a boom in the economy.

The general public are made aware of the cost savings opportunities presented by these alternative energy solutions. The benefits are twofold for the disadvantaged rural communities. Firstly, the creation of jobs which will improve the general welfare of households and secondly, giving them access to electricity.

1.5. Delimitations of the Study

This study discusses the viable renewable energy resource options and the practicality of their implementation through public private sector partnering.

This study does not focus on the technical details and implementation of the renewable energy resource options.

This study does not focus on the positive impact that renewable energy implementation will have on the emission levels and the environment as a whole.

1.6. Definition of Terms

Co-generation – combined heat and power – the concurrent production of electricity and heat from a single fuel source such as natural gas, biomass, biogas, coal, waste heat, or oil (USEPA, 2012).

Environmental sustainability - the ability of an activity to continue indefinitely at current and projected levels, without depleting the social, cultural and natural resources required to meet present and future needs (DME, 2003, p v).

GHGs - Greenhouse Gases - gases primarily carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) in the earth's lower atmosphere that trap heat,

thus causing an increase in the earth's temperature and leading towards the phenomenon of global warming (DME, 2003, p v).

Grid - the generic term used to describe both the National Electricity Grid; being all electricity networks of licensed electricity distributors and transmitters within South Africa, and the Eskom transmission system (DME, 2003, p v).

GWh - Gigawatt hour - energy unit in which electricity consumption is measured (1 GWh = 3600 GJ (Gigajoule) (Joule, unit of energy) (DME, 2003, p v).

IEP – Integrated Energy Plan - purpose is to balance energy demand with supply resources in concert with safety, health and environmental considerations and provides a framework within which specific energy development decisions can be made (DME, 2003, p viii).

IPPs - Independent Power Producers – producers of power (electricity), who sell their power to electricity distributors for supplying to the national electricity grid (DME, 2003, p v).

IRP - Integrated Resource Plan for Electricity 2010-2030 – proposed generation of renewable energy option to ensure security in supply and fulfilling commitments to mitigate climate change (DoE, 2011).

Landfill gas - is the harvesting of methane from capped landfills and converted to electricity using a gas engine or turbine (van Niekerk, 2008, p 46).

PPA – Power Purchase Agreement - means the power purchase agreement entered into between Buyer and the Seller (NERSA, 2009b, p. 13).

PPP – Public Private Partnership - means a commercial transaction between an institution and a private party in terms of which the private party –

a) performs an institutional function on behalf of the institution; and / or
b) acquires the use of state property for its own commercial purposes; and

c) assumes substantial financial, technical and operational risks in connection with the performance of the institutional function and/or use of state property; and
d) receives a benefit for performing the institutional function or from utilising the state property, either by way of:
    (i) consideration to be paid by the institution which derives from a revenue fund or, where the institution is a national government business enterprise or a provincial government business enterprise, from the revenues of such institution; or
    (ii) charges or fees to be collected by the private party from users or customers of a service provided to them; or
    (iii) a combination of such consideration and such charges or fees; (National Treasury, 2005, pp. 43, 44)

PPP Unit - the unit at the National Treasury responsible for regulating and facilitating PPPs (National Treasury).

REFIT - Renewable Energy Feed-In Tariff - a mechanism to promote the deployment of renewable energy that places an obligation on specific entities to purchase the output from qualifying renewable energy generators at pre-determined prices (NERSA, 2009a, p. 14).

Renewable energy sources - sun, wind, biomass, water (hydro), waves, tides, ocean current, geothermal, and any other natural phenomena which are cyclical and non-depletable (DME, 2003, p v).

Renewable technology - the technology that converts a primary renewable source of energy or energy resource to the desired form of energy service (DME, 2003, p v).

SO – Standard Offer - The standard offer is a mechanism to acquire demand-side resources (energy efficiency/load reduction) under which a utility purchases resources based on a predetermined rate (e.g., R/kWh or R/kW) (DOE, 2010, p. 7)

Watt (W) = 1 Joule **per second** of **energy** consumption or dissipation (MW = 1000 000 W) (DME, 2003, p v).

Wind farms - Wind farms are created when multiple wind turbines are placed in the same location for the purpose of generating large amounts of electric power (DME, 2003).

White Paper - **White Paper on the renewable energy policy of South Africa** gazetted in 2003 – Government Gazetted document intended to drive renewable energy (DME, 2003).

1.7. Abbreviations

BBBEE - Broad Based Black Economic Empowerment

BEE - Black Economic Empowerment

CCS – Carbon Capture and Storage

CSIR - Council for Scientific and Industrial Research

CSP - Concentrating Solar Power

DoE - Department of Energy

EIA – Environment Impact Assessment

ESI - Electricity Supply Industry

IPCC - Intergovernmental Panel on Climate Change

LTMS - Long Term Mitigation Strategy

MFMA – Local Government: Municipal Finance Management Act (No. 56 of 2003)

MSA – Municipal Systems Act (No. 32 of 2000 as amended)

MTRMP - Medium Term Risk Mitigation Project

NERSA - National Energy Regulator of South Africa; alternatively the Regulator

NGOs – Non-governmental organisations

PV - Solar photovoltaic

REFIT - Renewable Energy Feed-in Tariff

SWH - Solar water heaters - renewable energy technology

UNFCCC - United Nations Framework Convention on Climate Change

1.8. Assumptions

The sample will be able to share information on the benefits of renewable energy options.

The total number of respondents will be sufficient to gain adequate data.

The respondent sample will have reasonable knowledge of renewable energy and the benefits thereof.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

South Africa is endowed with energy producing natural resources that can offer balanced solutions to the energy shortages and heavy carbon footprint. A viable renewable energy industry will require a focused renewable energy strategy outlining clear energy generation options and targets with specific timelines taking into account human and financial resource capacities inclusive of stakeholder participation (Sebitosi & Pillay, 2008a). The renewable energy strategy has the potential to improve socio-economic conditions in the midst of the challenges it faces. In that light, this study will assess the benefits and barriers to find a way forward towards a successful renewable energy industry in South Africa.

A literature review of the areas related to the study is covered under this section. The first part will look at the renewable energy resource options available in South Africa. The second part looks at the opportunities created and obstacles that are encountered in this path. Lastly, it will look at the potential to maximise these renewable energy resource options through partnerships in the public and private sectors. In conclusion, this section will highlight the key learning points.

2.2. Background Discussion

South Africa is not an innocent bystander in the global climate change arena, in fact it is a contributor to the global greenhouse gas emissions. Abundant coal reserves available at a cheap rate as a source of energy supply together with rising energy demands due to economic growth are increasing the emission levels at an alarming rate. The South African government is targeting universal access to electricity by 2012 further raising the intensity of emissions (Pegels, 2010). Eskom is the dominant producer of South African electricity (95%) through coal (86%) (ESKOM, 2011). These factors are rapidly increasing

carbon emission levels posing a threat to the environment and challenging the South African government to respond by promoting renewable energy technology solutions.

The World Summit on Sustainable Development, hosted by South Africa in 2002 was the trigger for the South African government to introduce renewable energy into the energy sector contributing towards sustainable development (DME, 2003). The adoption of the White Paper on Renewable Energy Policy in November 2003 and the Integrated Resource Plan for Electricity 2010-2030 (IRP) in May 2011 are stepping stones to the giant leap that needs to take place towards actual implementation. This paper will seek to address the gap in policy making and execution and how to leverage public private partnerships to transform policies into action. In doing so, it will consider the revised IRP which accommodates a MTRMP with a focus on achieving short-term goals through building local industry clusters in an attempt to fast track the process to mitigate the risk of short-term lack of capacity (DoE, 2011).

The availability of cheap electricity through fossil fuels together with structural, economical and legislative barriers has contributed to the lack of urgency in the transformation. The shift from one dominant supplier of energy to a deregulated market with an even playing field for public and private sector operators can realise a sustainable renewable energy industry in South Africa (Sebitosi & Pillay, 2008a).

2.3. Renewable Energy Resource Options in South Africa

South Africa has amongst the highest solar radiation levels in the world which extends into the winter season and the long duration of sunshine makes it a reliable free source of energy (CSIR, 2009). Good wind regimes also make wind energy an attractive complement to solar energy (Sebitosi & Pillay, 2008b). Biomass, a primeval source of energy freely available, is still used by many as a primary source of energy particularly in the un-electrified rural areas (Kimemia & Annegarn, 2011). South Africa's hydropower is sourced through

small hydro-electricity stations, pumped water storage schemes and imported electricity from neighbouring countries' hydropower stations (DoE). The potential of wave energy in South Africa is still under investigation with ongoing research at Stellenbosch University on a wave energy converter (Joubert & van Niekerk, 2011).

The objective of Integrated Resource Plan (IRP) for South Africa, initiated by the Department of Energy (DoE) for the period 2010 to 2030 was to put the White Paper into action. After due consultation with the public, the DoE's policy adjusted IRP was accepted with modelling changes to renewable energy technologies which include solar photovoltaic (PV) with the concentrated solar power (CSP), solar water heaters (SWH) and wind options the installation of which have been brought forward in order to accelerate a local industry and to manage electricity demand (DoE, 2011).

Research was carried out for the United Nations Environment Programme (UNEP) Research Project on developing South Africa's renewable energy policy roadmaps with the aim to project the impact different renewable energy policy options will have in South Africa focussing on a feed-in-tariff coupled with a renewable electricity generation target and solar water heater rollout targets (Edkins, Marquard, & Winkler, 2010).

The authors assessed four renewable energy technologies expected to cover a broad spectrum of the renewable energy supply of South Africa: SWH, electricity generated from wind farms, CSP and large-scale solar PV systems.

2.3.1 Solar Options

The expansive land mass of South Africa is opportune for high solar radiation offering the best prospects for renewable energy resources in South Africa (Bugaje, 2006). Solar photovoltaic, solar thermal power generation and solar water heating technologies have the most potential to produce electricity from solar radiation (Zawilska & Brooks, 2011).

(Pegels, 2010, p. 4948) defines the CSP or solar thermal power generation process as one that "uses mirrors to concentrate the thermal energy of the sun

and heat a transfer fluid. The heat energy is then used to produce steam, with which electricity is generated in conventional turbines. Photovoltaic panels normally use silicon to convert the solar radiation directly into electricity."

In South Africa, only small scale PV systems are used for rural applications such as schools, health centres and households where access to the national electricity grid is costly (Edkins, et al., 2010). The authors point out that South African regulations have not yet been updated to include electricity generation from PV thus preventing the uptake of large-scale implementations. In addition to the regulatory and institutional constraints, they draw attention to the high initial capital outlay for the PV panels and that there are no incentives in place to support the development of these installations. The high costs of PV systems can be managed through well informed practices, such as incorporating PV in new building construction and eliminating certain roofing materials which are substituted directly by the PV panels (Sebitosi & Pillay, 2008a). Another method of reducing the cost of solar PV installations is through "accurate energy resource assessment and competent system design. Climate data software as well as solar design software was used to aid this process" (Munzhedzi & Sebitosi, 2009, p. 165).

CSP technology is appropriate for large-scale plants that can generate dependable power to consistently meet demand and has the potential to store heat more easily and cost effectively than solar PV systems (Pegels, 2010). The author notes that although the electricity produced is at a cheaper price, the drawback is the high initial investment in solar-thermal power stations.

"There are three different types of SWHs currently available on the South African market: unglazed, flat plate glazed and evacuated tube SWHs" (Edkins, et al., 2010, p. 2). The authors point out that water heating, generally through the use of a geyser, constitutes an estimated 40% of residential electricity consumption. They add that this offers major growth opportunities for the SWH industry in South Africa, particularly if the necessary financial support is given to consumers to switch from electric water geysers to SWHs and create awareness that the payback period of the initial cost is 4 – 7 years depending on the type of SWH.

The IRP target for SWH implementation is 1 million SWH units by 2014 through the introduction if a subsidy programme (DoE, 2011).

2.3.2 Wind Options

Wind power is an established renewable energy technology used throughout the world and still growing rapidly. The short lead time of approximately two years for large scale wind farms and low production cost electricity from wind technologies makes it a lucrative option (Edkins, et al., 2010). The authors further point out that the low risk, tried and tested technology are advantages of implementing a wind programme in South Africa supported by proper infrastructure an adequate training to develop local expertise.

South Africa has demonstrated the viability of wind energy resources along the coastal areas which are in close proximity to the load centres ensuring minimal loss of energy delivered to the grid (Sebitosi & Pillay, 2008b). The authors point out that the added advantage is that no upgrades to the grid infrastructure are required whilst the downside is that South Africa has yet to capitalise on these resources.

Wind farms connected to the grid could supplement the electricity grid through distributed generation and to store excess capacity for peak time power supply (DME, 2003). The White Paper also looks at moderate wind systems that can be used as a stand-alone option or to supplement power provided by PV and/or diesel generator as a hybrid solution.

2.3.3 Biomass

Biomass technology involves the burning of biological material such as agricultural and forestry residues (Dasappa, 2011). Biomass is a readily available primary energy source for many people around the world and is “more reliable and environmentally friendlier than finite fossil fuels” (Kimemia & Annegarn, 2011, p. 382). The authors highlight the importance of the development of cost-effective technology to promote the efficient use of this resource for a carbon neutral emission contribution.

Biomass is used by majority of the poor households in South Africa as an alternative energy source to coal for cooking and thermal uses (Dasappa, 2011). The author suggests that a clean renewable energy solution using biomass can be provided through biological and thermo-chemical conversion technologies that produce gas used to generate power. In this way biomass gasification can meet rural and urban energy demand needs by providing grid quality electricity ensuring a well-balanced energy mix.

The author further points out that there have been few installations of this gasification technology in South Africa by a private company. However, the primary limitation to implementing biomass technology on a large scale is the availability of data on the electrification process and usage patterns.

2.3.4 Wave

Wave energy technology is not commonly used even though its potential is estimated at the same level of the electrical energy consumption of the World (Angelis-Dimakis et al., 2011). The authors point out that the best wave climates are influenced by temperature and trade winds rendering wave energy inconsistent and varies by location and time.

The authors reported that some wave conversion technologies have shown the ability to convert and harness the energy from the ocean waves, however, there are other factors such as wave climate and weather forecasts that influence the amount of wave resources that can be converted to energy. A mechanism to achieve optimal wave energy conversion is still being developed. In addition to the technological limitations, the authors raise concerns about the environmental impact on marine life, the logistical constraints and the high cost of transmitting power to the electricity network.

Stellenbosch University's Centre for Renewable and Sustainable Energy Studies have developed a unique device, the Stellenbosch Wave Energy Converter, specifically for the coastal and wave conditions pertinent to South Africa but is still being researched (van Niekerk, 2008).

2.3.5 Hydro

Hydropower plants, both large and small 'run-of-river' operations, convert water pressure to produce electrical power and have the best capability of providing clean renewable energy throughout the world (Paish, 2002). Hydropower is a "proven and well advanced technology" with the most efficient energy conversion process (Bartle, 2002, p. 1231). The author emphasises that the "lowest operating cost and longest plant life" of hydropower plants bears a superior return on initial investment compared to other similar sized generation plants.

Small-scale hydropower is a more concentrated energy resource compared to solar and wind energy, reliable and available on demand and has virtually no environmental impact (Paish, 2002). The author draws attention to the long life span and low maintenance requirements of the technology to point out that it is ideally suited to serve the needs of the less developed countries. The author suggests that to harness this potential, significant resources and efforts need to be allocated towards the financing of these operations, technology development and support and operational skills development. At the same time, the author understands the lack of interest by investors who find the costs of new installations to be too expensive to earn a return on investments in the shorter term.

South Africa has existing hydroelectric power stations at Gariep (360 MW), Vanderkloof (240 MW), Caharo Bassa in Mozambique and the Grand Inga (40 GW) in the Democratic Republic of Congo (DRC) in the pipeline. There are also some small installations with less than 100 KW capacity (van Niekerk, 2008).

2.3.6 Research Question 1

What are the most viable renewable energy resource options for South Africa and the plans for their implementation?

2.4. Obstacles Preventing the Implementation of Renewable Energy Options in South Africa

The White Paper supported by the IRP is an encouraging start to the road to cleaner energy in South Africa. The abundant resources available to make this a reality needs to be optimally managed to provide the energy mix necessary to address the recent energy shortages and to respond to global climate change (DME, 2003).

South Africa has much more at stake to transform to renewable energy technology than purely making a contribution to the environment. Implementation of this programme will benefit the economy through job creation thus making a contribution to the South African society as a whole (Edkins, et al., 2010). The authors found that there has been a shift in opinion, and the transition to renewable energy is now seen as an opportunity to build a more stable economy with a higher employment rate benefiting society rather than an economic burden.

This choked start by South Africa needs to be boosted by identifying the limitations and finding ways to overcome them. A renewable energy strategy addressing these issues with clear timelines is essential to move towards the end goal. Legislative barriers, lack of cost and financing structures to support investors and human capacity development are preventing progress to the renewable energy initiative (Sebitosi & Pillay, 2008a).

2.4.1 Legislative Barriers

There has been a consistent view from numerous authors that one of the biggest obstacles in the path to renewable energy is the national utility Eskom (Krupa & Burch, 2011; Pegels, 2010; Sebitosi & Pillay, 2008a; Tsikata & Sebitosi, 2010). They agree that this parastatal enjoys military style protection with legislation in its favour to the extent that it will constantly deter efforts to attract serious investors in the power supply industry unless this legislation is fundamentally changed. This is evident in that Eskom is not obliged to disclose energy related information such as market related statistics and tariff costing

models that would be so vital for a prospective investor to make an informed decision. A further concern is the ongoing conflict of interest of Eskom's involvement in policy making decisions to move in the direction of active independent power producer industry and the lack of involvement of marginalised stakeholders, community groups and non-governmental organizations (NGOs).

The White Paper on Energy Policy seeks to reform the electricity sector by restricting Eskom power generation into separate companies. The DME will coordinate all stakeholder activities and regulate market access through licensing of all producers transmitters, distributors and sellers of energy. They will approve electricity tariffs and regulate the prices at which power is purchased from all generators including Eskom and Independent Power Producers (IPPs) (DME, 2003).

The Medium Term Risk Mitigation Project (MTRMP) broken down into two project phases will focus on the deliverables for the next six years. The spotlight of Phase 2 of this plan will be the development and promulgation of the legal framework to promote power generation from entities other than Eskom and to regulate licensing and tariffs (DoE, 2011).

2.4.2 Lack of Cost and Financing Risk Structures

The climate for investing in renewable energy technology in South Africa is opportune: the increasing cost of fossil fuel energy, drive towards green technology and abundant natural resources are tempting conditions for investors (Foster-Pedley & Hertzog, 2006).

However, (Wüstenhagen & Menichetti, 2012) caution that investors normally weigh up the risks involved against the returns to be gained before making any investment commitments. The deterrent as they point out is that in the case of emerging renewable energy investments the information available at the disposal of investors is very limited. The authors suggest that to attract investors, policy makers need to find a balance in lowering actual risk and increasing returns to manage expectations.

Another major barrier related to the economics of renewable energy technologies is their cost and risk structures limiting investor interest. Frequent policy changes, vague deliverables and timelines breed negative perceptions whilst on the other hand, green public procurement strategies have the opposite effect and offer a credible perspective to renewable energy technologies (Wüstenhagen & Menichetti, 2012). The authors recommend that policy makers can also try to address barriers by investing in education and training for financial decision-makers.

In response to this, the South African government introduced the feed-in tariff to guarantee renewable energy power producers fixed tariffs over a certain period of time, in most cases 10–20 years encouraging long-term investment (Pegels, 2010). The uptake of these tariffs has been low due to scepticism from investors.

Access to international funding for local developers is inconsistent simply because South Africa is viewed as an emerging market and a third-world country creating an imbalance in the access to credit (Krupa & Burch, 2011). Other problem areas identified by the authors are corruption and lack of transparency resulting in conflict of interest and biased decision making.

2.4.3 Human Capacity Development

South Africa is gifted with a combination of minerals, solar, wind and human resources. Policy makers can optimise the potential of these valuable resources through a strategic plan that will benefit the South African society and economy. Market entry for renewable energy resources will require the intellectual capacity to implement and maintain these technological opportunities in the electricity supply industry (Tsikata & Sebitosi, 2010).

The authors suggest that a human development strategy in support of this move towards renewable energy is essential. An assessment of the capacity and skills base in the fields of project design, financing, installation and maintenance and management has to be conducted. They recommend technical and practical training through institutions to support the project developers by skilling

staff to deal with mistakes, supervision, monitoring and feedback. Lemaire (2011) concurs with this view of capacity building to strengthen local capability and knowledge to allow small enterprises to manage their businesses effectively.

2.4.4 Research Question 2

What are the obstacles preventing the implementation of renewable energy resource options available in South Africa and how can we rise above them?

2.5. The Role of Public Private Partnerships in the Transition to Renewable Energy

Emerging from a divided country, the South African people have embraced a culture of a shared future through diversity, inspiring South Africans to harness the country's resources together for the collective good. This ‘ubuntu’ culture and an established regulatory framework for public private partnership contracting pave the way for successful projects (PPP Unit, 2007).

South African law defines a public private partnership (PPP) as a contract between a public sector institution/municipality and a private party, “in which the private party assumes substantial financial, technical and operational risk in the design, financing, building and operation of a project. Two types of PPPs are specifically defined:

- where the private party performs a municipal function; or
- where the private party acquires the use of municipal property for its own commercial purposes; or
- a hybrid of these types” (PPP Unit, 2007, p. 6).

The public sector receives quality cost-effective services and the private sector is awarded with the business opportunities, both contributing to the development of the nation. To this end, the South African Treasury have published the PPP manual as a best practice guide for both public and private

parties to assist them through the different stages of the PPP project cycle (PPP Unit, 2004a).

The PPP manual provides guidelines for a variety of transactions such as long term concession contracts for the provision of electricity, short term consulting contracts and joint ventures where there is sharing of ownership (Grimsey & Lewis, 2005). The authors view a PPP as a mechanism that caters for a solution between the traditional procurement of goods and services by government and full privatisation where government sells assets to the private sector. The authors further emphasise that PPPs are not merely to be used as a once-off arrangement but rather for long-term projects to "build-operate-transfer (BOT) or design-build-finance-operate (DBFO)" supported by concessions (Grimsey & Lewis, 2005, p. 346).

There are clear indications that the South African government view PPPs as long-term business partners in finding competitive solutions to deliver on the promises to eradicate poverty and drive development in all spheres of nation building. Although the South African PPP market is young, government's commitment to the role of PPPs in service delivery has prompted them to put tools in place to facilitate PPP participation in the procurement process.

The National Treasury has built on the experience of PPPs in the past decade and established a firm regulatory framework that enables municipal, provincial and national government institutions to enter into PPP agreements (Farlam, 2011).

At inception, the municipality concerned must carry out a thorough needs analysis and feasibility study based on the provisions of the Municipal Finance Management Act (MFMA) and where applicable the Municipal Systems Act (No. 32 of 2000 as amended) (MSA) to determine whether an external mechanism including a PPP is the best option to serve the interests of the municipality (PPP Unit, 2007).

Once a decision is made, the PPP is subject to three strict tests:

- “Can the municipality afford the deal?
- Is this a value-for-money solution?
- Is substantial technical, operational and financial risk transferred to the private party?”(PPP Unit, 2007, p. 9)

The PPP financing structure depends on the project type and funding source secured. Without being prescriptive, the PPP manual suggests that the majority of PPP’s raise own debt and equity to capitalise the project or alternatively arrange corporate financing based on the strength of their financial position. It also points out that in some cases municipalities make a capital contribution towards the initial cost of the project.

The PPP manual makes provision for the procurement process to take effect with the issuance of the bid documentation guided by the MFMA and the Municipal Supply Chain Regulations. It clearly states that all bidders are given an equal chance to compete whereby a bid evaluation panel will evaluate all the bids based on the criteria set out in the bid package through a transparent process.

The selection criteria used is not as simplistic as choosing a partner that offers the best price and who conforms to the technical requirements (Farlam, 2011). The author suggests that bids are also judged on optimal design specifications, technical support offering, proposed financial arrangements and operational sustainability given the long duration of the concessions.

As part of the overall growth strategy, the South African government have adopted a Black Economic Empowerment (BEE) policy to redress the inequalities of the apartheid era (PPP Unit, 2007). The PPP manual provides for BEE criteria to form 10% of the bid evaluation weighting whereby the bidder must achieve at least 60% of the total BEE scoring failing which will be excluded from the selection process.

The PPP manual guides the next phase of the process where a value assessment report is completed and submitted to the National Treasury for

input and recommendations. As part of the procurement phase, it highlights the start of the negotiations process between the government body and the preferred bidder. Once consensus is received, the PPP manual identifies the role of the accounting officer as key to commencing the contracting process with the successful party and thereafter to manage the agreement including the implementation, enforcement, monitoring and reporting thereof.

A case study of eight PPPs across various sectors such as tolls roads, ports, prisons, telecommunications, eco-tourism, and water and electricity provision in Africa confirms that "thorough planning, good communication, strong commitment from both parties and effective monitoring, regulation and enforcement by government" are essential for successful PPPs (Farlam, 2011, p. ii). At the same time, the author cautions against the vulnerability of governments to corruption, unsolicited bids, higher prices and rising unemployment resulting in failed outcomes.

Farlam (2011) uses two case studies specific to utility provision to display the reasons for the conflicting results of PPP contracting:

- A 20-year concession contract signed in July 1997 for the provision of water and electricity services by a French multinational to the government of Gabon produced encouraging results. This was largely attributed to the commitment of government paving the way for lengthy preparations, transparency in the process, organisational transformation and allowing for a transition phase to finalise contract negotiations.

- On the other hand, a 20 year power purchase agreement signed by the Tanzanian government's state-owned electricity company and an Independent Power Company proved to be wasteful. This case demonstrates everything that should be avoided, from the alleged corruption to the lack of an appropriate feasibility study without stakeholder consultation and paying high costs for electricity that was not required. If a thorough needs analysis was done it would have surfaced that the actual problem was that there were not enough gridlines and not the requirement for more electricity generation.

Closer to home, in early 1999, South Africa piloted an off-grid solar electrification programme with fee-for-service concessions. Starting out as small-scale utilities, small companies specialising in installation and maintenance obtain loans from the government to buy systems and then operate like a small utility and charge a low installation cost and receive a monthly fee for delivery of electricity covering maintenance and battery replacement costs facilitating large scale solar home systems implementation (Lemaire, 2011).

The author also points out that the success of this programme carried out in South Africa is testament to productive public–private partnerships delivering cost-effective energy services. They state that in spite of the adversities, solar fee-for-service companies in South Africa have been running for more than a decade managing to continue operations on very large concessions with significantly lesser grants than initially scheduled increasing their risk of survival. These small businesses have proven their ability to thrive amidst uncertainties and minimal state support.

The monopoly that Eskom enjoys has had some detrimental effects on the South African society. Marred by power shortages, Eskom sought grants from the government to invest in additional power generation plants. However since the utility is protected from divulging any details of its operations Eskom makes it difficult for the government and private investors to make any investment decisions on energy generation (Tsikata & Sebitosi, 2010).

In contrast, the country's domestic aviation industry transformed from one dominant state-owned operator to a mix of private and public operators (Sebitosi & Pillay, 2008b). The authors express that there is merit in replicating the model from evidence of the almost overnight overwhelming growth in the industry. They point out that the benefits of the growth are the drastic reductions in fares even with the ever increasing fuel prices. They reason that differentiating factor between the two industries is that the aviation sector operates in a level playing field secured by the Domestic Air Travel Deregulation Act.

The authors argue that on the other hand, a completely privatized business model in South Africa is also problematic as seen in the banking and insurance industries where collusion and price fixing are rife and where the customers bargaining power is compromised. A similar problem exists in the deregulated liquid gas petroleum industry where the government is considering reintroducing price controls.

The authors conclude that the most appropriate model for the sustainable renewable energy industry in South Africa would be a combination of public private sector businesses operating in a deregulated market with a level playing field.

It would be prudent for the South African government to engage PPPs in the implementation of the MTRP given the significant role that PPPs can play in speeding up the implementation process, resource management, technical expertise and optimal risk management.

2.5.1 Research Question 3:

What role can public private partnerships play in the transition to renewable energy resource options in South Africa?

2.6. Conclusion of Literature Review

The literature review has emphasised the abundance of resources available in South Africa and the potential to find an optimal mix of energy generation for the country. The high solar radiation levels make solar energy an obvious choice whilst wind energy is proposed along the coastal regions where wind factors are high.

Government has shown some commitment in the implementation of renewable energy technologies by gazetting the White Paper and promulgating the IRP. The progress has been insignificant. This can be attributed to legislative barriers, lack of cost and financing risk structures and human resource

development. Eskom enjoys the monopoly in electricity supply and protection of non-disclosure thereby preventing other investors from entering this market. The ripple effect of this is that investors are not able to assess the balance between risk and return and prefer not to get involved. The introduction of a REFIT structure was meant to provide some relief but has failed to lure the investors more so when policy makers have continued to effect changes. Another deterrent is the lack of knowledge and expertise in the renewable energy industry which can be addressed through training programs. These limitations can be overcome and managed to proceed with transformation as planned.

The literature review has presented evidence that public private partnerships can make the transition to renewable energy. The fee-for-service concessions scheme used by small scale business has proved to be successful. Another method of engaging public private partnerships is through deregulated markets offering an even playing field as proven by the aviation industry.

2.6.1 Research Question 1

What are the most viable renewable energy resource options for South Africa and the plans for their implementation?

2.6.2 Research Question 2

What are the obstacles preventing the implementation of renewable energy resource options available in South Africa and how can we rise above them?

2.6.3 Research Question 3:

What role can public private partnerships play in the transition to renewable energy resource options in South Africa?

CHAPTER 3: RESEARCH METHODOLOGY

This section charts the methodology used to conduct this research. A qualitative approach was used and the literature around this discussed. This is followed by a review of the research design and research instrument used. Data collection issues and analysis with respect to this study are provided. A discussion on the internal and external validities and reliability of the data ends this chapter.

3.1 Research Methodology /Paradigm

Qualitative research is intended to approach the world to understand, describe or explain social phenomena through analysing individual or group experiences, meanings of social interactions or historically constructed documents, with the purpose of developing a model, theory or pattern (Flick, 2007). These exploratory type investigations also use in-depth interviewing usually unstructured, participant observation, ethnography, grounded theory studies, or case studies (Cooper & Schindler, 2001).

Qualitative techniques are used to gain an insider perspective to get a deep understanding of the issue at hand with the ability to capture complex scenarios. The four types of exploratory techniques described by Cooper and Schindler (2001, p. 140) are:

i. "Secondary data analysis" - involves looking at data archives, reports of prior studies, published documents, books and periodicals. This data source provides an excellent basis for insight into the background of the study and guides the way forward.

ii. "Experience surveys – involves interviewing individuals experienced in the area of study, tapping into their collective memories and experiences" to bring out information not necessarily captured in written records.

iii. "Focus groups" – a group of people guided by a facilitator are encouraged to discuss the study topic in order to gather a spectrum of ideas, feelings and experiences.

iv. "Two-stage design" – used in the case where the research project is not clear. The first stage is exploratory aimed to determine the research question and to develop the research design before any further efforts and costs are input into the project.

The choice of approach is based on the research problem, personal experiences and the audience to whom the research is reported to (Creswell, 2003). The author suggests qualitative research to be the best approach to use when the researcher does not know the important variables to examine particularly when a topic is relatively new. It also highlights the tendency for familiarity with a literary form of writing and experience in conducting open-ended interviews and observations rather than statistical methods. This style draws influence to select the qualitative approach. Lastly, the author advises that consideration be given to the people that the report talks to and their preferences.

The subjective nature of this study validates the adoption of a qualitative approach as the research methodology. The aim of this study is to analyse the attitudes, opinions and behaviours of participants through open-ended interviewing techniques and exploratory inquiry that are best achieved through the qualitative approach (Kothari, 2009). The author explains that the subject matter of this study is theoretical and the flexibility of this research method is designed to gather data of an explanatory nature and allows for managing unpredictable situations. A simple interpretive design type that involves in-depth interviews facilitates data collection beyond the surface.

Creswell (2003) concurs with the view that open-ended, emerging data is collected to seek to unravel how people construct the world around them.

3.2 Research Design

The choice of research design was guided by the research questions which determine the suitable method of data collection and data analysis (Anon, 2008). Based on the issues in the study, the research design required more than one design type to get quality from a qualitative research by minimising and managing subjectivity through triangulation (Flick, 2007).

Triangulation offers credibility to the findings through its multi-method approach to data collection and data analysis. A triangulation of data sources such as interviews to gain multiple perspectives from participants with different interests, written documents, historical and archival documents, regulatory documents and case studies are best suited to this study (Anon, 2008).

Data was collected through library research, analysis of documents and field research (Kothari, 2009). Data was compiled from content analyses of historical research from library material and from the analysis of organisation documents specifically related to sub-problems one and two. Field research involved personal in-depth interviews with a sample of respondents representing the various sectors of interest outlined in the population.

A non-experimental research design in the form of interview questionnaires that assess interviewee opinion is most appropriate for this type of study (McBurney & White, 2007). The in-depth interviews are conducted by asking open-ended questions designed to get a free response to the true feelings, attitudes, meanings and understanding related to the study (Kothari, 2009). Data collected through this method is rich in detail and gives the interviewer a deep understanding of the inquiry.

A semi-structured interview method is typically a combination of structured and open interviews which asks all individuals in a selected sample the same open-ended questions facilitated through a written interview guide prepared in advance addressing the subject of the study giving the researcher more control over the theme of the interview although the responses may vary thereby allowing similar or divergent patterns to emerge (Anon, 2008).

The advantages of semi-structured interviewing is the flexibility and objectivity of the questioning process giving respondents the freedom to express their views, making it possible to discuss complex situations, the compatibility with several data analysis methods and that they are much easier to arrange (Willig, 2008).

The disadvantages of this type of questioning model is the difficulty in analysing open-ended questions as they are not easy to replicate from one respondent to the next making comparability difficult. Researcher bias may creep in and objectivity might be compromised raising problems of interpretation (Kothari, 2009).

The theory on semi-structured interviewing suggests that it is the most appropriate data collection method for this study. Interviews are conducted in a semi-structured manner using a detailed interview guide made up of structured and open-ended questions lasting for 1 – 2 hours each (Kothari, 2009).

3.3 Population and Sample

3.3.1 Population

The population is made up of major South African businesses (producers and users of energy), relevant government departments and public organizations. These interviewees represent key policymakers, organisations that are promoters of green energy, members of the Energy Intensive Users Group (EIUG) and crucial producers of the renewable energy discourse in South Africa. The interviewees are all experts in this field of study and have the relevant experience to add value to the study.

3.3.2 Sample and Sampling Method

A sample from the population defined above was chosen to represent the population as a whole. The non-probability sampling method based on judgement sampling was used to guide the selection of respondents that were good prospects for serving the purpose of this study and had the ability to meet specific criteria for providing accurate information (Anon, 2008).

A sample of respondents was selected on the judgemental sampling basis and represents the population for this study. These representatives are experts in the sustainability divisions of that organisation holding senior positions.

The selected respondents were contacted by telephone and email to request interviews. Relevant respondents from the selected organisations were available for the interviews as the sample was selected to cover a wide spectrum of stakeholders. In situations where these individuals were not available suitable alternatives were found.

The representative sample of ten respondents selected cover areas of influence relevant to this study and are important players on the road to renewable energy. This study is very relevant to the country and is fast becoming an area of interest. Participants were actively involved in stakeholder forums to work together to transform the energy industry in South Africa and needed little persuasion to participate in this study.

Table 1: Profile of Respondents

ORGANISATION	Minimum no. to be sampled	RESPONDENT TYPE/INDUSTRY
Eskom	1	Major power producer
DoE	1	Government - Department of Energy
Sasol	1	Major energy user
Anglo American	1	Major energy user
IDC (Industrial Development Corporation)	1	Development Finance Institution
Investec	1	Corporate/Funder - Green energy promoter
Nedbank	1	Corporate/Funder–Green energy promoter
EIUG	1	Energy Intensive User Group - NGO
GreenCape	1	Sector Development Agency in the Western Cape - NGO
EDC (Energy Development Corporation) a division of CEF Group (Pty) Ltd	1	Private business-pursues commercially viable investments in renewable energy
TOTAL	**10**	

3.4 The Research Instrument

The semi-structured interview questionnaire presented in Appendix A intended to address the research questions that were derived after the literature review was completed. This type of interview was very interactive and spontaneous and proved useful to the interviewer to get an understanding and insight into the subject (Anon, 2008). The first two interview questions addressed the research question from sub-problem 1. The next three interview questions dealt with the question coming out of sub-problem 2. The last two interview questions focused on sub-problem 3 and the way forward.

Semi-structured interviews not only assist in gathering data but are advantageous in that they stimulate a flow of discussion through flexibility and probing, increasing the scope of the discussion material. Disadvantages of this method are the concerns around confidentiality which restricts conversation when the respondents choose to withhold their positions on the discussion at hand. The added risk is that the interpretation of the discussion is skewed because of the interviewer's bias (Anon, 2008).

3.5 Procedure for Data Collection

The collection of primary data was through direct communication in the form of personal 'face-to-face' or in some cases telephonic interviews and content analysis of documentary materials (Kothari, 2009).

The interviews were scheduled according to the availability of the selected respondents. Personal interviews took place at the respondent's offices which were opportune to observe the environment that the respondent was operating in. Telephonic interviews were arranged as preferred by the participant. Interviews were recorded and hand written notes were also taken.

Content analysis is interpretive and involves the close reading of official reports and policies of the organisations. Company documents disclose the objectives and priorities of the organisation as stated explicitly or by giving an implied view

thus exposing it to subjectivity (Anon, 2008). Therefore, the author cautions that the results should make sense and resonate with the producers of the documents.

Secondary data, data that is already available from various sources such as government documents, published journal articles, books, reports and publications, technical journals and case studies were used subject to reliability, suitability and adequacy of data (Kothari, 2009).

3.6 Data Analysis and Interpretation

Analysis of data in various forms is a challenging process. Initial data gathering was used as a basis to enhance future interviews and memos were taken in the form of field notes and transcripts of interviews (Anon, 2008). As the author suggested, the write up of data commenced immediately after reflection of ideas and concepts of collected data was done to capture thoughts while they were still fresh in the mind.

A data management system was used to streamline the data analysis procedure by using a coding system to identify key terms and themes most commonly used during the data collection process. This assisted in the forming a descriptive analysis using matrices to assist interpretation (Kothari, 2009).

Conclusions were drawn from these comparisons which were supported by triangulation with alternative data sources, namely library references, government and company documents.

3.7 Limitations of the Study

This study was dependent upon the willingness and availability of a small sample of individuals. Scheduled interviews stood the risk of being cancelled and this was managed through constant contact with the respondents and

maintaining a high level of flexibility. A limitation to this study will be the lack of quantitative findings.

3.8 Validity and Reliability

Validity is the extent to which a study measures what it claims to measure and reliability is the accuracy and precision of the measurement procedure to accomplish sound measurement (Kothari, 2009). Validity and reliability are two interrelated concepts. Whilst "validity highlights the need to eliminate or minimise the effects of extraneous influences, variables and explanations that might detract from a study's ultimate findings" (Marczyk, DeMatteo, & Festinger, 2010, p. 158), reliability refers to the soundness of the measurement technique and constancy of the result received there from.

3.8.1 External Validity

External validity is the likelihood that the findings of a research represented by the study's sample can be generalised to a larger population or other situations (McBurney & White, 2007). Qualitative researchers cannot assume the same for their studies simply because of the small sample sizes that are not necessarily randomly selected (Anon, 2008). The author cautions that the use of triangulation which involves looking at multiple data sources might also not produce consistent results and advise the researcher to rather try to make sense of the different realities. In fact, the author brings attention to the new concept of 'transferability' introduced by qualitative researchers which assumes that all research findings are working hypotheses about what is likely to happen when similar things are done all things being the same.

The nature of this study involves descriptive research context with the ability to generalise thus assuming the concept of transferability. The researcher selected participants that were actively involved in this field of study and were experts on the topic to ensure the credibility of the external validity of this study was maintained.

3.8.2 Internal Validity

The internal validity of research design is its ability to measure what it aims to measure, in other words the consistency of the results drawn from the data with that in reality (Anon, 2008).

Although, the semi-structure questionnaire type was used allowing flexibility, the interviewer ensured that the internal validity of the study was not challenged. The survey questions in this study were aimed to measure what the researcher wanted to know without distortion by other factors.

In a qualitative study like this, the researcher has to accept the responses of the participants at face value. This study ensured internal validity through replication of the interview processes and triangulation techniques. Interview data was validated with multi data sources such as company documents and newsletters, company annual reports and government documents.

3.8.3 Reliability

Reliability is another test of the soundness of the measurement and checks the dependability and consistency of the data collected and whether the repeated measurement will yield the same results (Marczyk, et al., 2010). Qualitative researchers on the other hand used participants based on a set of criteria established for the purpose of the study and are not representative of the population therefore qualitative study can be judged on its credibility, reasonability, transparency of process, responsiveness of the researcher and its usefulness (Anon, 2008).

The reliability of a qualitative researcher report depends on the researchers' backgrounds, interests, skills, and biases which play a role in the framing of studies and in the collection, analysis, and interpretation of data.

Reasonable steps were taken to increase the reliability of this study to support the credibility of this research. The researcher explained the aim of the study to the participants and outlined the interview process which required the answering of a predetermined set of questions to maintain consistency. The

participants were encouraged to answer any other questions that came up as the interviews were semi-structured in order to gain in-depth information about the experiences of the interviewees. Lastly, the researcher made every effort to record, compile and analyse the data accurately.

CHAPTER 4: PRESENTATION OF RESULTS

4.1. Introduction

This chapter presents the findings and analysis of data gathered through interviews, written documents, historical and archival documents and regulatory documents of respondents. The presentation of the results is structured such that it is directly linked to the research questions and follows the logical steps as set out in the literature review. The data presented in this chapter is organised in the body of the text and uses direct citations and analysed interpretations of the multiple data sources used.

4.2. Demographic Profile of Respondents

As described in Chapter Three, the respondents were chosen by means of a judgement sampling technique. The original sample selected comprised major South African businesses (producers and users of energy), relevant government departments and non-government organizations. These interviewees represent key policymakers, organisations that are promoters of green energy, members of the EIUG and crucial producers of the renewable energy discourse in South Africa.

The respondents interviewed were involved in current renewable energy projects and provided up-to-date insights into the research questions.

The selected respondents from the major energy user category are members of EIUG which represents 32 members representing 40% of South Africa's total energy demand. Therefore, the interview with the representative of the EIUG and one major energy user was sufficient to represent the other major energy user respondents making it acceptable to replace the other respondents selected from this representative group.

The interview with the representative of the Energy Development Corporation (EDC) led to the inclusion of the Industrial Development Corporation (IDC) as a respondent from a funding perspective. The Sector Development Agency in the Western Cape was also selected. This Agency was established to grow the manufacturing and employment potential in the green economy in partnership with the Western Cape Investment and Trade Promotion Agency (WESGRO), the provincial government and academia.

4.3. Viable Renewable Energy Options and Implementation Plans

The first research question was: “What are the most viable renewable energy resource options for South Africa and the plans for their implementation?”

This question was tackled by trying to establish what renewable energy resource options were going to offer the best energy mix solution given that South Africa is richly endowed with natural resources and then probing the respondents to give some detail on their plans for the implementation of these technologies.

4.3.1 Renewable Energy Options Offering the Best Energy Mix Solution for South Africa

In terms of the IRP, renewable energy technologies such as wind, solar, biomass, biogas and hydro are to be introduced as cleaner supply side options whilst energy efficient options include solar water heating, industrial and commercial energy savings to complement the demand side (DoE, 2011).

Most respondents supported this plan and gave their input into what they considered to be the renewable energy options that would offer the best energy mix solution for South Africa. The technologies suggested were wind, solar, biomass and to a limited extent hydro. Solar options included SWHs, CSP, PV

and solar pumps. Co-generation and landfill gas by the industrial sector were also put forward as options.

One of the respondents suggested a clean energy mix that best suited South African conditions as follows:

> *"We have good wind and solar sources, limited hydro although cheapest and biomass less significant. Wind is the first option with 65% of RE produced by this source and second is solar because of cost with 35% RE production."*

Another respondent touched on energy efficiency as a solution together with a mix of renewable energy options as follows:

> "*A combination of solar water heating and industrial energy efficiencies, through behaviour change can be part of the solution. Energy partners are able to make energy savings of 20%, supply chain non-generation wins and lifestyle change – generation type solution. Current split of* renewable energy *options is 25% wind and 35% photovoltaic – the plan is to increase wind to 35%."*

Some respondents were actively involved in implementing renewable energy solutions and noted the progress that they had made and highlighted their preferences for the energy mix as outlined below by one of the respondents:

> *"We are constantly investigating other forms of energy and renewable energy sources to expand the current plant mix. Various research projects have been initiated to look at wind, solar and biomass."*

Respondents from the EIUG were conscious of the damaging contributions their organisations make towards GHG emissions and were committed to reduce these carbon emission levels. Many of them have set up a separate department in the organisation to explore technologies to mitigate the harmful effects of fossil fuels, one such example is the following:

"Our New Energy division was created to focus on new technologies that can be integrated with our core technologies to reduce our GHG footprint. As part of our commitment to reduce production of carbon dioxide in our operations and integrate new technology into our FT processes this division will look into renewable and lower-carbon energy options such as solar, bio-fuels and biomass, as well as nuclear, hydro and natural gas."

4.3.2 Strategies for the Implementation of Renewable Energy Technologies

Government has set out the following targets in the IRP for renewable energy generation:

- "Rollout of 1 million SWH
- Non-Eskom co-generation, own generation and renewable energy generation target for next 3 - 5 years of over 2300 MW, 277 already signed up.
- Medium term (10 year) target is 10 000 GWh to be produced mainly from biomass, wind, solar, small scale hydro."

Achieving these targets will require a phased, flexible strategy. The programme started with low cost technologies such as biomass and large scale application of SWHs to yield quick return on investments. Wind and small-scale hydro are included with the focus on building institutional framework. Funding is to be obtained through international sources, bi-lateral assistance and private investments (DoE, 2011).

Many respondents have discussed their current and long-term plans for the implementation of renewable energy options. They highlighted the progress made on energy efficiency options, renewable energy technology options or even in some cases the funding of thereof. Here are some of the responses in this regard:

i) Current and long-term plans for the implementation of renewable energy options

This organisation has made considerable progress on Wind and CSP projects and highlighted some of the achievements below:

> *"We have a portfolio of wind projects and other renewable energy projects (including wind, and concentrating solar power) at various stages of development in line with national renewable objectives and our own renewable energy strategy. The CSP project will produce around 516GWh yearly. Project Sere – a 100 MW wind power project on the West Coast – is under way with the first units expected to be turning in the second half of 2012 and is scheduled to be fully operational by October 2013."*

Electricity costs for High Energy Users spiralled due to the electricity shortages experienced in 2008 encouraging own generation to supplement higher energy requirements. This high energy user added the following renewable energy options to their energy mix:

> *"In association with High Energy User Group member we have implemented wind turbine blades and PV panels. Motivating factor is that since the 2008/2009 higher demand, costs of usage above 95% increased to R2,50 - R2,80 compared to R0,20 – R0,80. PV panels are easily available and less complicated to connect to the grid and also technically less challenging. Also, small scale turbines are easier than bigger turbines."*

ii) Energy efficiency strategies

Whilst some organisations concentrated on renewable energy projects, other organisations particularly those that are high energy users thought it more appropriate to focus on energy efficiencies. One such organisation outlined their energy efficiency strategy below:

> *"The South African businesses are in the process of installing heat pumps in the mine change houses to replace conventional boilers and have begun to install SWHs as part of the hostel conversion*

project. Heat pumps are also considered as the preferred technology for geysers instead of SWHs.

Other initiatives include energy efficiency projects:

- *Energy efficiency lamps at all mines*
- *Optimisation of air compressors*
- *Ventilation fan optimisation"*

The same organisation is looking at renewable energy technology options to produce energy for their own use in the future:

"We are also investigating proposals from IPPs to build a 20 MW PV plant, 15 MW biomass plant and several wind generation options."

iii) Combination of renewable energy projects and energy efficient strategies

Depending on the industry, capabilities and energy requirements of the various energy intensive organisations, the renewable energy mix has been varied. As an example the following organisation has included CSP, hydroelectric power, biomass and biogas as their energy mix at the same time as being energy efficient:

"The New Energy division aims to grow investments in carbon capture and storage (CCS), renewable energy and low-carbon ventures. Energy efficiency related projects with the potential to position the company in promising new technologies have been implemented. We are making good progress in exploring potential growth opportunities in renewable and lower-carbon energy options such as solar and hydroelectric power, natural gas-based prospect, biofuels and biomass. We have obtained approval to construct a 140 MW electricity generation plant and considering a demonstration CSP plant".

iv) Funding of renewable energy projects

Funding organisations are optimistic about the implementation of renewable energy technology options in South Africa and have already provided financial support for some of the current projects. This is what one funder had to say:

> *"There are a number of projects undertaken, namely the wind project in Cape Town, hydro project from 2009 in Bethlehem and landfill gas on a small scale. We pulled out of the hydro project due to regulatory uncertainties – water use rights and access. We have been using donor funding to fund projects from 2005 – 2009 in the form of equity partners contributing between 20% - 49% and the private partner contributes the balance. We look at small technology implementations to invest in with minimal risk."*

Another funder gave an indication of their monetary commitment to renewable energy projects:

> *"R25b in funding has been made available to invest in renewable energy either in the form of equity provider or debt provider. We make investments in technology and projects and also advise government. We are working together with Eskom on the SWH project."*

One funder mentioned that they were already financing a project outside the borders of South Africa and were excited to look at funding opportunities within South Africa provided that government supported long-term PPAs for the investments to be viable.

4.3.3 Conclusion

Clean supply side renewable energy technology options that were universally recommended by respondents were wind, solar, biomass and to a limited extent hydro. Wind and solar options were supported because these resources were abundantly available in South Africa. Biomass was considered as a readily available resource and less expensive to implement. Small scale hydro projects

have been initiated with more projects in the pipeline. Solar options such as SWHs, PV panels and solar pumps serve as energy efficiency options for demand management.

There has been a general commitment from all respondents for the implementation of renewable energy technology options as guided by both supply and demand side needs. Wind farms and turbine projects are already in operation and plans for more have been set in motion. There are numerous solar projects underway including a CSP plant for clean energy supply, SWH programmes and PV panel installations to generate energy efficiencies. Two conventional hydroelectric power stations, two hydro pumped storage schemes with a combined capacity of 2000 MW form part of the energy mix of the national utility. In addition, there are other smaller hydro systems operating around South Africa and potential growth for more being explored.

It is encouraging that funders are keen to finance renewable energy projects. They are very optimistic about the future of renewable energy in South Africa with high expectations for their success.

4.4. Obstacles Preventing the Implementation of Renewable Energy Options

The second research question was: “What are the obstacles preventing the implementation of renewable energy resource options available in South Africa and how can we rise above them?”

Respondents were asked to give their experiences on the obstacles faced by them and the renewable energy industry at large in implementing renewable energy technologies. The researcher highlighted to them the commitment by government given the targets laid out in the IRP and MTRMP and that these have not materialised. They were requested to give input into factors hampering this progress and to recommend any further changes that policy makers need to make to ease the progress. They were also encouraged to give

their views on how to rise above these limitations to transform South Africa's energy industry. The outcomes of the discussions are categorised below.

4.4.1 Obstacles Preventing Transformation

The DoE is cognisant of the many barriers facing the implementation of renewable technologies in South Africa that need to be addressed. Similar obstacles have been identified by other respondents as well. These are listed and discussed in detail below:

4.4.1.1 Legislative Barriers

The DoE is fully aware of the financial, legal, regulatory and organisational barriers need to be overcome in order to implement renewable energy technologies and develop markets.

Several respondents raised legislative/regulatory drawbacks as an obstacle. This respondent was concerned that the uncertainty surrounding regulatory issues is dissuading investment decisions in renewable energy:

> *"Regulatory uncertainty: Making decisions regarding investment into new technologies, the design of operations, the purchasing of equipment, etc, amid regulatory uncertainty is extremely difficult."*

Another respondent felt that government departments were working in silos to achieve their own targets and did not have the capacity or time to engage on universal topics like climate change that are interlinked between departments. The respondent raises the question of liability in the statement below:

> *"Policy still has a long way to go, although progress has been made on carbon taxes. There needs to be alignment of policy regarding carbon taxes, renewable energy, air quality act, climate change and the like. Legislative framework - interdepartmental issues between government departments, struggling towards achieving own goals and not working together on common goals."*

The respondent representing the high energy users was of the opinion that regulatory uncertainties are also impacting on own generation costs for their members:

> *"Currently the regulatory regime in terms of bilateral procurement of renewable energy is in-determinant, in other words, if you want to buy renewable energy from one of our members, you can't buy that energy because there's no framework for it, as it's got to be wheeled across Eskom's network which incurs massive charges and is completely uneconomical. That means renewable energy will be sold directly into Eskom and form a portion of the total energy mix."*

This is a valid concern raised because the energy produced by high energy users for their own use may result in surplus energy production. Since there is no framework that allows them to store or sell the energy this remains a disincentive for them as it is not cost-effective.

This leads into several respondents concern that tariff setting is a significant barrier to implementation as explained hereunder by one:

> *"There are outstanding issues with regards to the renewable energy feed-in tariff (REFIT) 1 and 2 programmes which need to be addressed before the utility can implement. These programmes were aimed at facilitating private sector participation in the renewable energy generation industry."*

The following respondent felt strongly about the REFIT tariffs that have not yet been bedded down. This impacts the procurement of renewable energy and the process after generation:

> *"IRP is clear, the bid programme has gone out but the biggest challenge was the finalisation of the issue of REFIT tariffs versus bid. The things holding up the procurement are on clarification of who the buyer will be, if it's Eskom then it's fine because access to grid are determined but the question always remains who is going*

to fund this. Government doesn't fund electricity or projects. Electricity is tariff funded.

A significant stumbling block is the municipal control of electricity, the fact that we don't have policies relating to net metering and the fact that municipalities see electricity as a source of revenue as opposed to a source of economic growth. Reducing reliance on the Eskom grid is not something the municipalities will take lightly to as it's a massive source of their revenue so they don't want households producing their own energy."

Further to that, respondents were concerned that the administration processes were bogged down by too much of bureaucracy relating to contracting specifically with IPPs. Questions were raised about the practicality of enforcing these contracts.

4.4.1.2 Lack of Cost and Financing Risk Structures

The DoE points out that many renewable energy technologies remain expensive, on account of higher capital costs, compared to conventional energy supplies for bulk energy supply to urban areas or major industries. In turn, the implementation of renewable energy technologies needs significant initial investment and support for relatively long periods before gaining return on investments.

Respondents further commented on the impact of these from investment and user perspectives respectively,

i) Investor:

"We have a low cost electricity base – energy from coal is cheap whilst renewable energies are expensive. There's a premium. Cost of production is high. Need big pockets to invest."

ii) Energy user:

> *"For high energy users renewable energy represents a significant premium on the price, that's the first issue. Already in terms of the IRP, for the country there is an implicit price on carbons based on the increased costs for renewable above coal which references above R120 per tonne of CO_2, so that's the implicit premium for carbon taxes that's already been paid to fund for renewable energy in the current IRP. That obviously has significant economic drawbacks – the percentage of electricity costs vs operating costs for all high energy users have increased significantly since early 2000 and in some cases they are reaching over 40% of operating costs which is just not sustainable so increasing electricity costs are going to have a significantly negative impact on the extraction and beneficiation sectors."*

A respondent concluded that cost remains a problem for renewable energy. The challenge facing the industry is to increase the momentum in implementation at a larger scale in the next few years to make renewable energy more feasible and affordable in the future.

4.4.1.3 Human Capacity Development

Generally respondents agreed that there was a lack of technical expertise in renewable energy in South Africa.

4.4.1.4 Centralised Infrastructure/Grid and National utility

The economic and social system of energy services is based on centralised development around conventional sources of energy, specifically electricity generation, gas supplies and, to some extent, liquid fuel provision. The DoE is wary that this results in a lack of non-discriminatory open access to key energy infrastructure such as the national electricity grid, certain liquid fuels and gas infrastructure. This also dictated the market power of utilities.

Many respondents shared the same view about access to the national electricity grid and the impact it has on current renewable energy producers and their ability to trade energy or in industry terms called 'wheeling'. Wheeling is a problem between IPPs, Eskom and the Municipalities. In addition, they felt that as the owner of the grid systems, Eskom poses the biggest obstacle. The following example given by one of the respondents illustrates this:

> *"The obstacles for heavy users like Impala Clothing (Factory) are that they use the roof PV panels which connect to grid. However, they require energy during the day, weekdays, and the energy generated over the weekends is lost. They do not get credits for this. They have 24/7 operation constraints and do not benefit from this but have to bear the additional costs incurred during the week."*

On the other hand, two respondents were very positive towards Eskom's efforts with regards to the grid and backed up this view with the following statements:

> *"Grid lines, infrastructure are a problem but Eskom has done extensive studies on this to say how much each line can accommodate."*

> *"Eskom is very supportive of the process and trying to make renewable energy happen. The problem they are faced with is that they want to build new lines but don't know where. The limitations are that of lack of information. Information constraint is that of not knowing where to build the grid lines and this hampers the planning."*

4.4.1.5 Lack of Information

The lack of consumer awareness on benefits and opportunities of renewable energy forms a barrier to entry into these markets points out the DoE. Another respondent pointed out that information is lacking for manufacturers as well.

On a positive note, funders were very optimistic and did not experience any obstacles during their due diligent processes and added that:

"No obstacles from the perspective of providing funding. All the necessary requirements are met based on the documentation for the IPP programme."

4.4.2 Progress Report

Generally, respondents were of the view that the progress made by government is reasonable. In fact, there was an overwhelming positive response from interviewees about the efforts made by government thus far.

The Minister of Energy, Ms Dipuo Peters, in her Annual Report 2010/2011, highlighted some achievements on key focus areas as identified by the DoE in its first strategic planning session in August 2009: "The need for South Africa to focus on security of energy supply through an integrated energy planning approach while strengthening the regulatory framework within the energy sector."

With regards to Energy Planning, the following achievements impacting on renewable energy initiatives were highlighted:

- *"We have been able to mobilise stakeholders from labour, business and civil society to make various contributions to address this problem collaboratively. The National Stakeholder Advisory Council on Electricity has been able to find common ground around the country's energy mix." This guided the finalisation of the Integrated Resource Plan (2010-2030) for electricity which was approved by Cabinet in March 2011."*

- *"Development of the Integrated Energy Plan (IEP) was initiated in parallel to the IRP with focus on long-term alternatives for energy as a whole."*

- *"We have also started with the review of the regulatory environment to facilitate the introduction of power generation*

through IPPs. It is expected that the procurement of co-generation, the renewable energy IPPs, certain gas projects and some coal projects will begin in 2011. Accordingly, the Electricity Regulation Second Amendment Bill and the National Energy Regulation Amendment Bill are being introduced to facilitate the non-Eskom generators."

The progress achieved in respect of electricity, nuclear and clean energy is as follows:

- *"Restructuring the Electricity Distribution Industry and review of the entire electricity value chain with a focus on energy security and determining the implications of the capital investment required for the entire value chain.*

- *Energy Efficiency Demand-Side Management (EEDSM) and SWHs was partially achieved. The EEDSM Incentive Scheme (SO) policy was promulgated and signed off, resulting in 115 000 of the targeted 200 000 SWH installations through the rebate system. However, high capital costs and depletion of funds in the rebate scheme has limited the progress.*

- *In March 2011, Cabinet also approved legislation related to the establishment of the Independent Systems and Market Operator (ISMO) as a public entity. The ISMO Bill will provide the institutional structure towards levelling the playing field and resolve Eskom's conflict as both buyer and seller of electricity.*

- *The mapping of reliable transmission and distribution networks was completed.*

- *Partial progress was achieved on REFIT and fossil-fired power generation. Renewable Energy Finance and Subsidy Office (REFSO) was envisaged for supporting renewable energy project developers. The inception of REFIT necessitated a*

review of the allocation of subsidies to support renewable energy projects to avoid misallocation of scarce resources, making REFSO in appropriate to use and delaying this programme.

- *The nuclear programme deadline was not met due to the delay in adopting the IRP."*

The following Energy Efficiency measures have been taken:

- *"Last year, we institutionalised the South African National Energy Development Institute (SANEDI) as an independent public entity, resulting from the merger of SANERI and the NEEA. That set the stage for coordinated research and energy-efficiency and demand-side management interventions. SANEDI be the champion for energy efficiency in the country."*

The respondents overwhelmingly echoed the progress highlighted in the DoE's Annual Report.

Implementation of renewable energy is a mammoth task requiring commitment and alignment from all the role players. This respondent is realistic about the renewable energy implementation challenges and does not consider government to be slow:

"Government is not slow at all considering that this is an enormous task. It took 15 years to implement in Europe. Renewable energy is also very costly to implement. There is also an education process that needs to take place, for users, manufacturers and suppliers. Government has been good in asking for input from all the stakeholders. The South African economy is a transforming economy and there are many factors that need to be weighed up to find the best solution."

This following respondent reiterated the above view and is confident that the platform is set for take-off:

> *"Government is not really slow, it takes time to build the framework. Eskom is signing the PPAs as dictated by government. Departments are all working together – task teams in place. Renewable energy is on track."*

This respondent was impressed with the progress made by government and is confident that the process is steering ahead at a faster pace.

> *"Actually, impressed with the way government is moving ahead with renewable energy implementation. There were a few areas that were slowing down the process but since the announcement of the IPP programme momentum has picked up. The payment structure needs to be defined / finalised."*

Another respondent has expressed satisfaction with the progress shown by government:

> *"With the deregulation of power generation plants in South Africa allowing the establishment of IPPs, combined with various government incentives on renewable energy, government has shown progress."*

This respondent thought it pertinent to highlight some of the accomplishments to demonstrate the progress made by government.

> *"Contrary to this a lot of progress has been made by government although it is true that is not matched with the timeframes per IRP. It's about one and half years out. Already producing 1300 MW, and from 5th March 2012 the second window starts for the generation of additional 400 MW."*

4.4.3 Breaking through the Barriers

The DoE believe that creating an enabling environment through the development of fiscal, financial and legislative instruments will be necessary to stimulate utilisation of renewable energy technologies. Government support is essential for renewable energy to establish a market share and non-discriminatory open access the national electricity grid supported by infrastructure and an appropriate wheeling arrangement. The DoE suggested the following measures be taken to overcome the obstacles:

4.4.3.1 Legislative barriers

"Legal and Regulatory measures that need to be taken are:

- *Generation or refining licenses; White Paper on renewable energy;*
- *Introduction of a grid-connection code which governs the minimum requirements of connecting to the Grid;*
- *New infrastructure to link renewable energy supplies into the existing transport infrastructure, which will need appropriate mechanisms to facilitate this;*
- *The procedure and charges for wheeling the power from the generator to a customer through the national electricity grid needs to be defined and regulated in order to keep transport (wheeling) tariffs for renewable electricity low where existing infrastructure is used, and similarly for petroleum products;*
- *Open access to the national electricity grid infrastructure. This needs to be legally defined and regulated by government;*
- *PPAs of sufficient duration between the generator and purchaser of the electricity;*
- *The development of a system to compensate for the cost of electricity generated from different technologies and from different geographic locations; and*
- *Minimum contributions to the national energy supply from renewable energy resources."*

Similar recommendations for changes at policy level to create an environment conducive to the private sector were also made by one of the respondents:

- *"Pricing and incentives;*
- *Non-discriminatory access to grid owned by Eskom;*
- *Seamless approval of environmental processes*
- *Licence approvals – NERSA has a defined process but there are delays in granting permits; and*
- *Support mechanism in the form of financing, tax relief and subsidies. National Treasury initiatives e.g. renewable energy fund for IPPs."*

This respondent gave suggestions on ways to implement the renewable energy programme as outlined below:

> *"In terms of the new generation regulations, the following are needed to implement these programmes:*
>
> - *The evaluation criteria to be applied in pre-qualification and bid selection by NERSA need to be finalised;*
> - *The proposed PPAs and standard risk allocation need to be finalised;*
> - *A ministerial determination of the buyer and licensing of such buyer is required; and*
> - *The targeted MW for each REFIT technology needs to be confirmed."*

The DoE and National Treasury have initiated an implementation process for an IPP renewable energy programme. The NERSA is currently initiating consultations to review REFIT 1 and 2. Significant changes have been proposed to the tariffs for identified renewable energy technologies.

Respondents were of the opinion that integrated public policies that are economically efficient and share costs equitably are required and that certain changes aimed at encouraging participation can make a difference to speed up the progress. One respondent commented that:

"Per the New Generation Regulations, the 'buyer' can only procure energy in accordance with IRP. While a policy vacuum currently exists in respect of unsolicited offers (i.e. those proposals which are outside the scope and timeframe of particular programmes under the IRP but present a unique opportunity which could leverage strategic and economic benefit for the country), work is being undertaken to establish a framework and process to consider such proposals. This will be discussed within the utility, DoE and NERSA."

The concept of integrating policies was clarified in detail by the respondent below:

In South Africa, where the bulk of our GHG emissions occur, we welcome the government's initiative to develop a national policy aimed at ensuring a coordinated, coherent, efficient and effective response to the global climate change challenge. South Africa must make the transition to a lower-carbon economy while remaining sensitive to the urgent developmental needs of the country and retaining global competitiveness. We understand that this can only be achieved through an integrated policy that is appropriate to the unique circumstances of South Africa, and that seeks to find an appropriate balance between environmental effectiveness, economic efficiency and social equity, while addressing the immediate challenge of job creation."

4.4.3.2. Lack of Cost and Financing Risk structures

The DoE suggested funding by government financial and fiscal measures, donor funding and public/private sector funding and commercialising renewable energy technologies.

4.4.3.3. Centralised Infrastructure/Grid and National Utility

The DoE recognises the need to move away from one power producer through institutional arrangements.

4.4.3.4. Lack of Information

A respondent was of the view that this should be tackled by the relevant parties as follows:

> *"Project development applies to Eskom, National Treasury and DoE. They need to put the loop together."*

The respondent also added that:

> *"Single buyer offers and IPPs – until this happens no progress can be made."*

Respondents named several other factors that can ease the progress and encourage participation in the renewable energy programme as follows:

- *"Encourage manufacturing associations with some commitment for continuous contracts for wind turbines to give them some certainty before investing in setting up the manufacturing."*
- *"Need to develop intellectual property. The unit has to have programmes for skill development."*
- *"Special priorities for renewable energy implementation to support processes and speed them up."*

4.4.3.5. Conclusion

Renewable energy technology options require high initial investments to fund the start-up capital costs. As a result, renewable energy is far more expensive than energy generated by coal. When competing against this low cost base, the return on renewable energy investments has to be secured by long-term commitments from the purchasers of energy. Administration processes around contracting with Independent Power Producers are time consuming.

Investment decisions are further hampered by Regulatory uncertainties. The legislative frameworks for renewable energy programmes need to be finalised through the alignment of policies by governmental departments impacted by the various Acts.

Access to the national electricity grid owned by Eskom is a major obstacle. The related issue of wheeling i.e. the buying and selling of energy through the grid via a net metering system which reverses when energy is sold to the grid and the costing thereof are also not addressed. It was, however, noted that Eskom is in the process of assessing the current grid capacities but information is lacking in terms of knowing where to build new grid lines. Tariff setting delays have added to the pressures of implementation.

Manufacturers have to overcome issues of lack of information and expertise in renewable energy technologies in South Africa. There is also a lack of consumer awareness.

Many of these obstacles can be overcome if Eskom, National Treasury and DoE put the process together. Grid connection, wheeling and tariff setting arrangements need to be addressed by these parties. In addition, the issuing of licences to IPPs and concluding of PPAs will move the process forward. In fact this will also take care of the investment mechanism because funders will be more enthusiastic about investing in these programmes.

There was consensus amongst the respondents that government has made progress considering the huge task at hand. It was also commendable that

government has engaged all the stakeholders to overcome some hurdles that were pulling the process back.

There was a general feeling that integrating public policies will ease the pressure. Finalising the REFIT and incentive structures will also encourage participation.

4.5. Role of Public Private Partnerships in the Transition to Renewable Energy

The third question was “What role can Public Private Partnerships play in the transition to Renewable Energy resource options in South Africa?”

The main aim of the White Paper on renewable energy is to create conditions for the development and commercial implementation of renewable technologies. The DoE indicated that government will use a phased, managed and partnership approach to renewable energy projects that are well conceived and show the potential to provide acceptable social, environmental and financial returns for all investors and stakeholders. This will lessen the strain on fiscal resources and hold greater potential for successful implementation.

Other respondents were optimistic about the involvement of the private sector in South Africa’s transformation to renewable energy. The following view was shared on private sector involvement:

> *“It is crucial that the private sector plays a role in addressing the future electricity needs of the country. This will reduce the funding burden on government, relieve the borrowing requirements of the utility and introduce generation technologies that the utility may not consider part of its core function which may play a vital role in the future electricity supply options, in particular off-grid, distributed generation, co-generation and small-scale renewable projects.*
>
> *The introduction of private sector generation thus has multiple benefits. It will contribute greatly to the diversification of both the*

supply and nature of energy production, assist in the introduction of new skills and capital into the industry, and enable the benchmarking of performance and pricing."

This respondent organisation has set aside funds to promote green projects by assisting private entrepreneurs as outlined below:

"We have recently launched a new Green Fund within our flagship enterprise development programme. We have committed an investment amount of R100 million (US $14 million) to the fund, which aims to empower and encourage entrepreneurs to operate in the green economy in South Africa. We also have two pilot projects examining how we can use carbon markets to fund community development projects. These involve the retrofitting of government provided housing in our mine communities with SWHs and better insulation, and the production of biochar to store carbon and improve soil productivity."

Some respondents felt the PPPs could work only in limited situations since state-owned resources will not necessarily be used in the transition to renewable energy. Here are the motivations supporting their views:

- *"State-owned resources for PPPs can work for landfill gas type projects, waste energy, e.g. co-investing with the City of Johannesburg for waste to produce electricity."*

- "*The international players have shown interest, specifically the Spanish developers. They are forming partnerships with the local private producers as it is a legislated requirement that at least 40% of the contracts are awarded to SA companies."*

- *"The most crucial one is of social discount rates, in other words, in a PPP commercial rates can be significantly lessened by government backing which means that the levels of return and tariffs have to be sociable and there is a greater social involvement in those environments in that it is not purely*

a commercial transaction. There is a greater social awareness but the reality of that situation is that either private have to build and operate backed by government guarantees for procurement or if government is going to build and operate it has to be project funded through private partnerships, whichever model it needs to be just needs to ensure that the price path is mitigated and that plants operates efficiently."

- *"PPPs can work with developers and DoE. PPPs to look at Treasury's role in the project. When the feed-in tariff was announced in 2008/2009, the banks got involved (IDC, standard Bank/African bank) and went to Eskom, pointed out that the credit risk is too high. They asked National Treasury to underwrite the risk. Treasury is driving the boat, since they got involved things are moving forward, expediting process, however, on the one hand they are minimising risk and on the other hand they are removing government risk in the event that the programme fails. This needs to be designed differently so that developer can get paid anyway."*

Many respondents were of the opinion that IPPs are the solution for South Africa to move towards renewable energy resource options. Here are some of the responses to that effect:

- *"IPPs are being used to move to renewable energy."*

- *"There is the energy industry dominated by IPPs and this does not correspond to the definition of PPPs. IPPs can play the role."*

- *"The Department of Minerals and Energy will promote a partnership approach and an integrated focus for national renewable energy initiatives. Key stakeholders in these partnerships will include: the renewable energy industry, industry in general, electricity utilities, independent power producers, provincial governments and local governments (as*

provided for in the Constitution), state owned enterprises and institutions, communities, non-governmental organisations and consumer forums."

- *"From 2016 – 2030 the plan is to increase by 400 MW per year but the procurement is not clear and DoE needs to firm up policy for 2016 – 2030. It is not clear what happens after 2016. Putting a procurement programme in place for IPPs can help. Eskom's new power stations will not render the energy produced by IPPs as not required because currently there are 44 GW stored and 42 used, meaning the system is operation above the threshold of 75%. What this means is that if there is the smallest uptake in the economy the energy usage increases there will be no reserves left therefore energy produced by IPPs have to be considered."*

- *"We support the introduction of independent power producers, which have an important role to play in addressing South Africa's energy needs. They will contribute to diversifying the source and nature of energy production, introduce new skills and capital into the industry, and enable the benchmarking of pricing and performance."*

Some funding respondents have already initiated funding projects to work with IPPs to produce:

- *"We are investigating proposals from potential IPPs. These include a 20 MW photo-voltaic plant, a 15 MW biomass plant and several wind-generation options."*

- *"We are very receptive to IPPs, in terms of funding their renewable energy projects, as long as the project finance teams are comfortable with the requests meeting the requirements for funding."*

This NGOs preferred partner in working towards renewable energy is the private sector for various reasons:

- *“Equity partner.*
- *“The close relationship with state helps to facilitate a leading role, preparing environmental impact assessments, getting licences.”*
- *“Significant budget to participate.”*
- *“Development financiers like IDC, development bank of SA.”*

4.5.1. Conclusion

Respondents were supportive of the involvement of the private sector in South Africa’s transformation to renewable energy. The burden of government to fund these expensive projects will be alleviated. The targets set for the various renewable energy technologies in the IRP will be easier to meet through the private sector arrangement and it will create a more competitive environment.

The PPP arrangement was restrictive in that state-owned resources will not necessarily be used in the transition to renewable energy and could only work for landfill gas type projects and waste to produce electricity by co-investing with local municipalities. Alternatively, government could provide guarantees for procurement where the private partner builds and operates or if government builds and operates then the private partner will provide funding.

The model that most respondents felt would be appropriate as the solution for South Africa to move towards renewable energy resources is the involvement of IPPs. Some have already been piloted with international players forming partnerships with local private producers benefiting both parties in terms of funding, expertise and return on investments. Government is also encouraging partnerships with the renewable energy industry, industry in general, electricity utilities, IPPs, provincial and local governments, NGOs, state-owned enterprises and the communities at large.

4.6. Summary of the Results

Renewable energy technology options considered to be the most suitable energy mix for South Africa are wind, solar, biomass and to a limited extent hydro. Solar options include SWHs, PV panels CSP and solar pumps. The implementation of these renewable energy technology options will serve to complement both supply and demand side needs. Wind farms, wind turbine projects, two conventional hydroelectric power stations, two hydro pumped storage schemes and smaller hydro systems are already in operation and plans for more such projects have been set in motion. There are numerous solar projects underway including a CSP plant, SWH programmes and PV panel installations to generate energy efficiencies. Funders are also keen to invest in these technologies.

Renewable energy technology is far more expensive than energy generated by coal. In order to encourage investments, producers need to sign up long-term contract commitments with purchasers. Regulatory uncertainties and contradictory policies need to be addressed through alignment of government departments and Acts. Legislative frameworks need to be finalised to ensure smooth administration processes enabling faster turnaround times in respect of contracting with IPPs.

Access to the national electricity grid owned by Eskom, issues of wheeling and the costing thereof are problem areas. Tariff setting delays, lack of information, lack of expertise in renewable energy technologies and lack of consumer awareness are the obstacles faced by South Africa.

Many of these obstacles can be overcome if Eskom, the National Treasury and the DoE iron out issues relating to grid connection, wheeling and tariffs, issuing of licences to IPPs and concluding of PPAs to move the process forward. IPPs will also address the funding mechanism burden. Integrating public policies and finalising the REFIT and incentive structures will ease the pressure and encourage progress.

Private sector involvement was supported for the transformation to renewable energy. Targets set for the various renewable energy technologies in the IRP

will be easier to meet through this arrangement and it will create a more competitive environment.

The PPP arrangement is limited to state-owned resources involving waste energy programmes. Alternative arrangements could include government guarantees for procurement where the private sector builds and operates or funding by private sector where government builds and operates. These are not ideal arrangements.

The model that is recommended is one with private sector arrangement involving IPPs. These have been piloted and are proving to be the medium through which South Africa transforms the energy industry.

CHAPTER 5: DISCUSSION OF THE RESULTS

5.1. Introduction

This chapter interprets the results presented in the previous chapter and evaluates them against the backdrop of the data gathered in the literature review to form a link between concepts and findings. The structure is analogous to having conversation with the literature, thus corresponding with the three questions. This chapter concludes the way forward for South Africa to meet renewable energy targets to form part of the energy mix and contribute to a cleaner, sustainable environment.

5.2. Demographic Profile of Respondents

The sample interviewed represented major South African businesses (producers and users of energy), relevant government departments and Non-Government Organizations (NGOs). The interviewees were involved in current renewable energy projects that included all the stakeholders and made significant contributions to the research.

The inclusion of the Independent Development Corporation (IDC) and the Sector Development Agency in the Western Cape proved worthwhile. Both these organisations represented members from the private sector in the business of generating and/or supplying renewable energy and thus provided the researcher with a more complete representation of the sample.

5.3. Viable Renewable Energy Options and Implementation Plans

The first research question was developed to firstly determine what renewable energy options are viable given that South Africa is richly endowed with natural resources and secondly to establish if there are any strategies in place to implement these.

5.3.1. Renewable Energy Options Offering the best Energy Mix Solution for South Africa

The research confirms Pegels's (2010) view that solar energy has the greatest potential as a renewable energy resource for South Africa with the two main technologies for producing energy from solar radiation being CSP and PV. It also acknowledges that the initial costs of these technologies especially CSP are high but the electricity produced is at the cheapest rate. This being the case, high energy users that have the funds to invest in large scale CSP plants find this an attractive technology for own generation, more so because they are able to store the energy for future use.

In addition, majority of the respondents corroborated with authors Edkins et al. (2010) that the market for SWHs in South Africa is huge considering the drive to manage demand. To this end, high energy users have rolled out the SWH programme on a large scale as part of their hostel conversion projects as well as at their operational facilities to reduce demand and generate efficiencies.

Wind power is one of the most mature renewable energy technologies available, tried and tested with minimal risk. The wind projects already in operation along the coastal areas in South Africa are testament to that. The research substantiated that wind energy forms an integral part of the energy mix.

Dasappa (2011) recommends that biomass can provide clean renewable energy through biological and thermo-chemical conversion technologies that produce gas used to generate power to form part of the energy mix. Biomass was an option suggested by respondents as it is a readily available resource.

Although hydro technology is proven and cost efficient over the long-term, the initial high costs to set up a hydroelectric power plant and the limited access to waters resources is a deterrent and not recommended by many of the respondents who believe that small scale projects were more suitable and convenient to connect to the grid.

Research fully supported the theory that wave energy technology was not considered as a source to form part of the energy mix in South Africa, more so because it is still under development.

It therefore appears that the major drive for renewable energy should come from solar and wind power.

5.3.2. Strategies for the Implementation of Renewable Energy Technologies

It was encouraging to note from the research that many respondent organisations had included renewable energy as part of their environmental and sustainability planning strategies over the long and short term in order to align with the strategies outlined in the IRP and the MTRMP by the DoE. The plans are structured to meet both supply and demand side targets through own or co-generation and energy efficient applications. Even funding organisations have set aside funds to assist power producers to contribute towards the National goals.

i) Current and long-term plans for the implementation of RE options

The theory highlights South Africa's experience in wind energy resources along the Western coastal areas. It was confirmed by the research that a number of wind turbines are already operational and some wind projects are at various stages of development. Some units are expected to be functioning around mid 2012 and the balance towards the end of 2013. CSP projects producing 516 MWh per year are in the pipeline.

The utility's battle to meet the high energy demands of our growing economy has prompted high energy users to mitigate energy shortages with own

generation projects. Some of the technologies planned are the construction of a 140 MW electricity generation plant, small scale wind turbines, building a 20 MW PV plant, 15 MW biomass plant and several wind generation options. All these planned activities endorse the viability of wind, solar, hydro and biomass technologies for South Africa.

ii) Energy efficiency strategies

Theory suggests that at least 40% of the electricity consumption in an average household is used from geysers, for water heating. The SWH market has huge potential in South Africa and the success thereof will result in huge energy savings. From the research it is apparent that most high energy users have already implemented the SWH programme as part of their energy efficient strategy and supported this by PV panel installations. Some have also started using energy efficiency lamps and optimised their operational equipment.

iii) Combination of renewable energy projects and energy efficient strategies

Implementation strategies in some cases were made up of combination of energy generation and energy efficient projects. Respondents were committed to lowering their carbon emission levels and therefore actively pursuing promising new technologies in solar, hydroelectric power, biomass and natural gas.

iv) Funding of renewable energy projects

In as much as organisations are proactively working towards renewable energy implementation projects, funding organisations are confident about investing in these technology implementations. Funding mechanisms made available are in the form of equity partners, private partner funding or as debt providers. The recipients are mainly independent developers. Some international developers have also partnered with local developers on the larger projects.

5.3.3. Conclusion

The research confirms that in a resource endowed country like South Africa, the renewable energy technology opportunities are wide-ranging. In fact, all the options discussed in theory are being adopted in practice except for wave technology. This was pointed out as an option that was still developing and quite rightly not ready for implementation. The options that are part of the energy mix for South Africa are wind, solar, biomass and to a limited extent hydro. Solar options include CSP, SWHs and PV.

The commitment from all respondents for the implementation of renewable energy technology options in some form or other was overwhelming. These range from wind farms and turbine projects, CSP, PV panels, SWH and other solar projects, hydroelectric power stations, hydro pump storage schemes and small hydro systems operating around South Africa. Equally the commitment from funders to finance renewable energy projects through various mechanisms is uplifting. They predict that renewable energy has a big role to play in the energy supply of South Africa and expect a good return on investment.

The research proved to be a revelation that there is an increasing appetite for renewable energy technologies to shape the future of South Africa's energy mix.

5.4. Obstacles Preventing the Implementation of Renewable Energy Options

The second question was developed to investigate the setbacks experienced by stakeholders preventing the implementation of renewable energy resource technologies in South Africa and the factors slowing down the process. The questioning was extended to gain an understanding of any further policy changes that need to take place and to get suggestions from respondents on how to rise above the limitations.

5.4.1. Obstacles Preventing Transformation

5.4.1.1. Legislative Barriers

There has been resounding consensus that a number of legislative issues has led to frustration and setbacks on this road to renewable energy. As suggested in the theory, some of the major issues stem from the single utility model which is deterring investors and independent power producers alike. This was confirmed by the research which highlighted numerous related issues such as the licensing of IPPs, access to the national grid, wheeling of electricity and tariff setting. Amidst all of this is the regulatory uncertainty relating to policy issues across other affected government departments. An example of this conflict is where a hydro project was under threat due to regulatory uncertainties with regards to water use rights and access. Unless interdepartmental alignment is forthcoming high impact renewable energy projects remain unattractive to investors.

Further to this, there have been strong suggestions that the legal framework needs serious reform to promote power generation through sources other than Eskom. This goes hand in hand with the electricity tariffs and the REFIT programme that has yet to be finalised. The unresolved issues on the REFIT programme are the identity of the buyer, the procurement process, the role of the IRP, risk allocation in the PPA and connection to the grid. To explain further, there is no clarity of who the buyer of power under the REFIT PPA will be, or whether there will be more than one buyer. As it stands, the PPA currently favours the buyer whilst the seller's rights are undermined. Lender considerations such as termination rights and guaranteed access to the grid are also underprovided in the PPA. Unless these issues are dealt with, there is no incentive for power producers or lenders to enter into these arrangements.

Another concern highlighted through the research is that businesses that are generating power for own use are also affected by the lack of tariff setting because there is no mechanism to sell the access energy that they produce. This renders the own generation operation futile as it is more expensive than the energy produced from coal.

5.4.1.2. Lack of Cost and Financing Structures

Wüstenhagen and Menichetti (2012) identified cost and risk structures as a barrier for the economics of renewable energy technologies thus limiting investor interest. They suggest that policy makers need to align policy to make investments lucrative by minimising risk and securing income at a higher rate. The same concern was established through the research that renewable energy technologies require high initial investments and guaranteed income over long periods to achieve a positive rate of return on investments. The risk investors face is that energy from coal is far cheaper than that produced by renewable energy technologies. This was reverberated by high energy users for own generation that cost remains a problem for renewable energy.

5.4.1.3. Human Capacity Development

In as much as theory suggests that human capacity development is an important element to the transformation to renewable energy, the research made mention that this is lacking and needs to be addressed. This was not as burning an issue as the regulatory and financial issues

5.4.1.4. Centralised Infrastructure / Grid and National Utility

Although the theory was centred on the national utility Eskom as being the biggest obstacle in the path of renewable energy, the underlying reasons did not surface in the theory.

The study established that the national electricity grid was a stumbling block for renewable energy producers and own generation producers. In some cases where connection to grid was possible, energy generated during non-business hours was lost because there is no mechanism in place to cater for the credits. This wheeling of energy is not backed up by a net metering system which allows for the meter to reverse when excess energy is released into the grid. Thus the investments made to generate energy do not bear fruit and prove to be costly.

There were mixed reactions to Eskom, where some respondents gave Eskom credit for extensive studies carried out on the grid line to establish the load capacities. They feel that Eskom is working towards renewable energy goals but what is limiting them is the lack of information of not knowing where to build more grid lines.

5.4.1.5. Lack of Information

Research found that information for manufacturers is lacking and this was partly supported in theory where it was highlighted that Eskom was not obligated to disseminate market statistics and tariff costing model data. The other downside to manufacturers is the lack of technical information and support centres for technology development. These are essential for sustainable renewable energy generation with the aim to reduce costs and increase efficiency.

An obstacle not covered in the theory but stood out in the research was that the consumer awareness of the existence of renewable energy or its economic, environmental and social benefits is lacking. Consumers need to be made aware of the renewable energy products and services available together with a detailed comparative analysis to enable customers to make an informed decision. This issue cannot be taken lightly because the successful uptake of renewable energy technologies in South Africa depends on market penetration. This is turn will increase demand and reduce costs rendering renewable energy more lucrative.

5.4.2. Progress Report

Contrary to the observation made by Sebitosi and Pillay (2008a) that the barriers identified were preventing progress of the green energy initiative, majority of the respondents were very optimistic about the progress made by government. They point out that the task at hand is colossal with a long term implementation timeframe supported by coordinated and dedicated efforts from all stakeholders. Government have also confirmed that they have engaged all the role players to finalise the IRP, started development of the IEP and begun with the review of the regulatory environment to facilitate IPPs. This was

confirmed with the launch of the IPP programme in August 2011. On the regulatory front the introduction of the Electricity Regulation Second Amendment Bill and the National Energy Regulation Amendment Bill are positive strides for non-Eskom generators to lunge ahead. Certainly, government has demonstrated that they are working vigorously to create an enabling environment.

Partial progress was noted on the SWH programme and positive steps have been taken towards resolving electricity wheeling, access to grid and tariff issues. Energy efficiency initiatives have actively been promoted.

Research has shown that government has made huge inroads by dealing with contentious issues and drawn support from all the stakeholders. The IPP programme in particular is set to increase the momentum of renewable energy generation and stepping up the progress to achieve targets laid out in the IRP.

5.4.3. Breaking through the Barriers

The DoE is committed to removing barriers to edge ahead with renewable energy implementation. Although positive steps have been taken as pointed out above, efforts need to be put into overturning more stumbling blocks.

5.4.3.1. Legislative Barriers

Further reform measures suggested by the respondents that coincided with the literature to enable the electricity sector to move forward are the seamless issuing of licences to all producers, establishing a formal procedure and costing for wheeling the power from generator to customer through the national grid and the development of a tariff structure.

Additional measures highlighted by the research are the need to build new infrastructure to accommodate independent access to grid and the introduction of a grid-connection code. PPAs must be of a reasonable duration for the benefit of all. The respondents also recommended that incentives should be granted to developers to encourage the uptake of projects. In addition, financial support in the form of financing, tax relief and subsidies should be considered.

It was suggested that legislative barriers could be broken down by integrating public policies and the seamless approval of changes required to transcend to the next level.

5.4.3.2. Lack of Cost and Financing Structures

Investor funding can be encouraged through providing the relevant information that can ease decision making. Theory suggests that educating and training financial decision-makers on the technical aspects of renewable energy can provide reassurance on the viability of renewable energy technologies and their ability to make profits over the long term. The research proved that funders were quite clued up on all aspects of renewable energy technologies and were comfortable in providing the necessary funding to IPPs.

Pegels (2010) raised the scepticism of investors with regard to tariffs and long-term PPAs but until these are finalised they will still remain a cause for concern for investors as confirmed by the research. Government is doing everything in their power to bed these issues to encourage private sector funding.

5.4.3.3. Centralised Infrastructure/Grid and national Utility

Moving away from the one power producer model to multiple power producers will make it compulsory to make the grid accessible to non-Eskom generators. The breaking down of legislative barriers related to infrastructure and grid access will ease this process.

5.4.3.4. Lack of Information

Research suggested that government play a big role in disseminating information to the all the stakeholders. A training strategy needs to be formulated to encourage private and public sector involvement in the renewable energy market. Targeted campaigns and energy project across the country will achieve widespread awareness.

5.4.3.5. Conclusion

The major obstacles experienced by respondents to implement renewable energy technology options and confirmed in theory were the following: Legislative barriers, lack of financing and costs structures and a centralised infrastructure controlled by the National utility, Eskom. Lack of information was an additional barrier identified by the respondents. It was evident from the discussion that these barriers were interdependent.

Both theory and research unanimously identified legislative setbacks and regulatory uncertainty as a challenge the renewable energy industry had to contend with. Through the research it has come to light that despite the stumbling blocks government has made some breakthroughs. The IRP approved early in 2011 and the IPP programme launched in August 2011 paved the way for kick-starting multiple renewable energy projects. The Electricity Regulation Second Amendment Bill and the National Energy Regulation Amendment Bill were introduced to ease the process for highly contentious issues relating to licensing of IPPs, open access to the national grid, wheeling of electricity and tariff setting. These regulatory changes are a step in the right direction to diminish the stronghold of Eskom on the grid infrastructure and pricing.

Regulatory uncertainties are hampering investment decisions. Investors remain cautious until the legal framework for renewable energy programmes is finalised because their projects are under threat of overlapping policies. Aligning interdepartmental strategies is a key to resolving conflicting boundaries to smooth the transition to renewable energy.

The national electricity grid owned by Eskom is an obvious problem for power producers and own generation businesses. In order for them to run viable renewable energy projects they need mechanisms to support the buying and selling of energy through the grid. A definitive tariff structure and grid connection code will encourage participation in renewable energy implementation. As pointed out in section 2.4.1. of the literature review, Eskom is seen to be obstructing the process but on the contrary research has shown that Eskom is working together with government and other stakeholders to get

renewable energy projects off the ground. They are also in the process of assessing the current grid capacities but are struggling to get information that will guide them as to where to build new grid lines.

The research has brought to light the impact that lack of information has on the process. Manufacturers are vigilant of embarking on renewable energy projects in the absence of market information, tariff costing models and technical expertise. This slows down the uptake in renewable energy investments. Lack of consumer awareness has similar implications for the industry. Market penetration is limited because consumers are not informed about the benefits of renewable energy options.

The researcher can conclude that government has made progress considering the enormity of the task at hand. The policy changes that have been implemented have recorded some success. Further policy changes relating to REFIT, PPAs and incentive structures will increase the momentum and interest in the programme.

5.5. Role of Public Private Partnerships in the Transition to Renewable Energy

The third question attempts to understand the role of Public Private Partnerships in the transition to renewable energy resource options in South Africa and how these partnerships will contribute to the implementation of renewable energy projects.

The National Treasury states that the South African law defines a public private partnership as a contract between a public sector institution and a private party, in which the private party assumes substantial financial, technical and operational risk in the design, financing, building and operation of the project.

The DoE in the White Paper on renewable energy indicated that a partnership approach to renewable energy projects will benefit all stakeholders and ease the financial burden from government with the potential to succeed.

Respondents were equally optimistic about the involvement of the private sector in the renewable energy programme and felt that it will also relieve the borrowing requirements of the utility. Research confirmed that the private sector can introduce technologies that are not the core function of the utility thereby incorporating more options to the pool. Added benefit will be the introduction of large sums of capital and new skill to the industry.

Lemaire (2011) discusses an off-grid solar electrification programme with fee-for-service concessions that was piloted in 1999. In this instance, small companies obtained loans from government to buy systems and operated like a small utility. The success of this programme through public private partnerships forms the basis of this theory. However, respondents felt that PPPs could work only in limited situations for landfill gas type projects where there is a co-investment arrangement with a municipality to produce electricity from waste.

Research has shown that twelve years down the line, the partnering vehicle that government has opted to use is not a public private partnership per se but rather an arrangement with the private sector to achieve the IRP objective of 42% electricity generated in South Africa from renewable resources. It must be noted that in comparison with a public private partnership, this arrangement will not make use of state-owned resources. Government's role in these partnerships is to facilitate PPAs with the national utility and to regulate pricing. Unless government guarantees the long-term contracts or underwrites the financial risk in the event the project fails, the relationship with private sector cannot be viewed as a public private partnership.

The launch of the IPP programme in August 2011 was a step by government to commit to the implementation of the approved IRP. This programme is set to stimulate the renewable energy industry and stands to benefit job creation objectives principally in rural areas where these IPPs will be located to boost economic activities in those regions. The DoE stated that the terms of the IPP Procurement Programme require bidders to bid on tariff and on the identified socio-economic objectives of the department. This tariff will be paid by the buyer pursuant to the PPA entered into between the two parties. The RFP must include the generation capacity of the technology in accordance with the IPP

Programme guidelines and commercial operation timelines set out in RFP must be achieved. In addition, BEE structures must be in place and international consortiums must include local content. .

The DoE pointed out that the renewable IPP Programme is not a replacement for the REFIT Programme. The REFIT Programme was delayed because the current Act did not provide the necessary requirements for its implementation. Government thought it sensible to proceed with an alternative programme whilst dealing with legal challenges surrounding REFIT without closing the door for its implementation in due course.

The funder respondents have confirmed that they have concluded funding arrangements with IPPs and worked closely with them in their bid submissions to government that were delivered on the 5th March 2012.

The research firmly indicates that IPPs are the immediate solution for South Africa to spear ahead towards renewable energy resource options. Since the energy industry is dominated by IPPs, they can play a vital role in this transformation.

5.5.1. Conclusion

The research tried to establish whether South Africa could transform to renewable energy through public private partnerships. It emerged that partnerships were not necessarily formed with the public sector but rather with local power producers and international developers. Government awarded contracts to these consortiums to produce renewable energy to meet their renewable energy generation targets as outlined in the IRP.

It was evidenced by theory that PPPs were successfully piloted as the vehicle to implement renewable energy technology options in South Africa. Although this programme proved successful for small scale utilities, in practice, operating a large scale implementation was marred by legislative complications.

Government did not want to be seen as dragging its feet and pursued an alternative option to PPPs. The IPP model was preferred as the medium through which renewable energy implementation targets set out in the IRP were

to be achieved. IPPs were awarded contracts that met the specific requirements laid out in the programme guidelines.

Until the legislative issues delaying REFIT programme are finalised, the IPP programme will be the means to transform the renewable energy industry. Government is confident that targets set out in the IRP will be met through IPPs.

5.6. Conclusion

The magnificence of South Africa is its immense natural beauty and abundant natural resources. An energy intensive fossil-fuel powered economy makes South Africa vulnerable to the impact of climate change. South Africa's commitment to environmentally sustainable energy utilisation, rural electrification needs and energy security is the driving force to venture into renewable energy options.

The research has confirmed that the spectrum of options covered in the theory forms part of the energy mix for South Africa. These are wind, solar, biomass and to a limited extent hydro. Solar options include CSP, SWHs and PV. It was encouraging to find that renewable energy projects across these options have been implemented or underway. Funders are displaying their confidence by backing renewable energy businesses with expectations that they will churn a good return on investment. This is an indication that renewable energy technologies are making a mark in the future of South Africa's energy mix.

Theory was strongly supported by research that legislative barriers, lack of financing and costs structures and a centralised infrastructure controlled by the National utility, Eskom were some of the reasons for the renewable energy implementation delays experienced. A further obstacle noted from the research was the lack of information for consumers and manufacturers.

There was consensus that the legal framework needs to be established to create an enabling environment for producers and investors alike. The interest in renewable energy projects will be limited in the absence of this framework.

The research has brought to light that it is not all ‘doom and gloom’ in fact government has made considerable progress in the past year. The approval of IRP, introduction of the Electricity Regulation Second Amendment Bill and the National Energy Regulation Amendment Bill and the IPP programme are set to pave the way to eliminating obstacles. It was found that Interdepartmental alignment was necessary to resolve overlapping policy issues. Regulatory reforms required to stimulate the progress are REFIT, PPAs and incentive structures.

Non-discriminatory access to Eskom’s grid remains a dilemma for power producers and high energy users generating power for own use. They are willing to implement renewable energy projects subject to the costly technologies producing a reasonable return on investment. This can be achieved by maximising energy supply and demand through trading energy via the grid. Finalising the tariff structure and grid connection code will increase the rate of participation in renewable energy implementation. Contrary to the literature, respondents indicated that Eskom is cooperating with government and other stakeholders on current renewable energy projects and have implemented some of their own. They have started estimating available capacities on the existing grid lines to accommodate power from renewable energy sources. The challenge for Eskom is to get collate data that will guide them as to where to build new grid lines.

Research has highlighted that market information, tariff costing models and technical information is lacking for manufacturers limiting their abilities to assess project feasibility thereby discouraging investments. In addition, lack of consumer awareness is another factor that is slowing down market penetration.

Government has committed to mitigate climate change and the promulgation of the IRP was a major step towards achieving a balance between economic growth, job creation, security of energy supply and sustainable development. The aim is to roll-out renewable energy technology options by enhancing local industry clusters.

The theory suggested that this industry could be transformed through a public private partnership mechanism given that some pilot projects proved successful

for small scale utilities. However, research has illustrated that since then public sector involvement has been encouraged through the IPP Programme for large scale applications to overcome legislative challenges. Government took this step to spear ahead to endeavour to meet RE implementation targets set out in the IRP. During the first phase of the IPP programme, contracts were awarded to IPPs in November 2011 in line with the RE generation targets set out in the bid process.

The proposed REFIT programme conducive to PPPs will play a role in the transformation to renewable energy once all the legislative setbacks are resolved. In the meantime, IPPs are set to deliver the targets set out in the IRP.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The introduction of this study was to understand the role of public private partnerships in the transformation to renewable energy in South Africa and the hurdles experienced in the process. This chapter reveals the results of the study in deliberation with published context. The researcher summarises the findings and concludes the research specifying any obvious dissimilarities. The researcher aptly provides recommendations to the relevant audience based on the results of the research. This chapter ends with questions to spark future research ideas are raised to probe this area of interest.

6.2 Conclusions of the Study

The introduction to this study emphasises South Africa's harmful contribution to global warming through a fossil fuel powered economy. It is against this context harnessing South Africa's clean energy resources optimally became necessary.

Renewable energy is fast becoming a worldwide trend as an environmentally friendly energy source and South Africa is no exception. This study confirmed that South African conditions were favourable to the implementation of a wide range of renewable technologies including wind, biomass, small scale hydro and solar options such as CSP, SWHs and PV.

The study identified several obstacles in the path to renewable energy. First and foremost was the absence of an established legal framework. This was evidenced by the ambiguities in policies across government departments that left projects stranded. Secondly, there was no finality on the tariff structure which meant that power producers were unable to evaluate viability of their investments and consequently lacked support of financiers. Thirdly, a

centralised infrastructure controlled by Eskom and uncertainty regarding access to the national grid. Lastly, the lack of information for manufacturers and lack of consumer awareness of the benefits of renewable energy restricted market penetration.

The study found that obstacles on the legal front can be overcome through aligning public policies and the prompt approval of proposed changes concerning tariff structures and grid connection. It also identified a need for new infrastructure to be built to accommodate power generated by independent producers.

The study established that cost and financing structures can be strengthened through the adoption of long-term PPAs, renewable energy incentives and financial support in the form of financing, tax relief and subsidies. All these benefits will reap profits and encourage private bankers and international funders to lend their support to these operations.

The study highlighted the opportunities and benefits derived from clean energy implementation. Growing awareness and interest from private investors will increase the momentum in renewable energy implementation projects. This will promote local manufacture and create employment opportunities. Usage of renewable energy options will increase when long-term cost saving, social and environmental benefits become apparent. The South African economy stands to boom when all these factors fall into place.

This study found that instead of PPPs, IPPs were the immediate solution to translating the implementation plan into action. The PPP model required state involvement either through resources or guarantees. Legislative barriers proved to be too tedious to pursue this option. The IPP programme on the other hand, was a means to overcome the legislative hurdles and speed up renewable energy transformation.

The study concludes that amidst all the obstacles renewable energy is moving ahead at a much faster pace through the IPP programme and includes generation capacity across the viable technology options.

6.3 Recommendations

The researcher's recommendation to the public and private sectors is to combine forces to bring renewable energy into the mainstream of the energy market. It has the business potential to create new industries and grow to a level that can make South Africa a global leader in this field. It is imperative that the public and private sector stakeholders work together to remove regulatory impediments as a matter of urgency.

In addition, the researcher recommends that in the wake of Eskom's exorbitant tariff increases, high energy users should consider affordable alternative strategies. Making provision for own generation energy can serve the purposes of energy security, cost-effective energy for operations over the long term and reducing their carbon footprints.

The recommendation to private funders is that renewable energy is set to soar to great heights and funding budgets should be increased to meet the higher demand. This is an opportunity in a bull market not to be missed.

The researcher's recommendations to the general public to enquire about the available renewable energy technologies and to participate in the programmes to benefit from lifelong cost saving opportunities presented by these alternative energy solutions.

6.4 Suggestions for Further Research

The research has sparked curiosity in other aspects of this topic. It will be interesting to investigate the following:

- The researcher suggests that a study be done on the grid infrastructure capabilities in South Africa. Will it be able to accommodate the increase in renewable energy generation through independent power producers?
- A study can be done to evaluate the success of the IPP programme.
- A study of the limitations of the REFIT programme

REFERENCES

Abdul-Aziz, A. R., & Jahn Kassim, P. S. (2011). Objectives, success and failure factors of housing public–private partnerships in Malaysia. [doi: 10.1016/j.habitatint.2010.06.005]. *Habitat International, 35*(1), 150-157.

Abednego, M. P., & Ogunlana, S. O. (2006). Good project governance for proper risk allocation in public–private partnerships in Indonesia. [doi: 10.1016/j.ijproman.2006.07.010]. *International Journal of Project Management, 24*(7), 622-634.

Amigun, B., Musango, J. K., & Stafford, W. (2011). Biofuels and sustainability in Africa. [doi: 10.1016/j.rser.2010.10.015]. *Renewable and Sustainable Energy Reviews, 15*(2), 1360-1372.

Anderson, P. M. L., Hoffman, M. T., & O'Farrell, P. J. (2010). Above ground perennial plant biomass across an altitudinal and land-use gradient in Namaqualand, South Africa. [doi: 10.1016/j.sajb.2010.03.004]. *South African Journal of Botany, 76*(3), 471-481.

Angelis-Dimakis, A., Biberacher, M., Dominguez, J., Fiorese, G., Gadocha, S., Gnansounou, E., et al. (2011). Methods and tools to evaluate the availability of renewable energy sources. [doi: 10.1016/j.rser.2010.09.049]. *Renewable and Sustainable Energy Reviews, 15*(2), 1182-1200.

Anon. (2008). In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol. 1 & 2, pp. 1014). Alberta: Rolf A. Janke, SAGE Publications Inc.

Arent, D. J., Wise, A., & Gelman, R. (2011). The status and prospects of renewable energy for combating global warming. [doi: 10.1016/j.eneco.2010.11.003]. *Energy Economics, 33*(4), 584-593.

Aron, J., Eherhard, A. A., & Gandar, M. V. (1991). Fuelwood deficits in rural South Africa. [doi: 10.1016/0961-9534(91)90031-7]. *Biomass and Bioenergy, 1*(2), 89-98.

Barry, M.-L., Steyn, H., & Brent, A. (2011). Selection of renewable energy technologies for Africa: Eight case studies in Rwanda, Tanzania and Malawi. [doi: 10.1016/j.renene.2011.04.016]. *Renewable Energy, 36*(11), 2845-2852.

Bartle, A. (2002). Hydropower potential and development activities. [doi: 10.1016/S0301-4215(02)00084-8]. *Energy Policy, 30*(14), 1231-1239.

Beck, B., Surridge, T., Liebenberg, J., & Gilder, A. (2011). The current status of CCS development in South Africa. [doi: 10.1016/j.egypro.2011.02.625]. *Energy Procedia, 4*, 6157-6162.

Bikam, P., & Mulaudzi, D. J. (2006). Solar energy trial in Folovhodwe South Africa: Lessons for policy and decision-makers. [doi: 10.1016/j.renene.2005.07.015]. *Renewable Energy, 31*(10), 1561-1571.

Borchers, M., Euston-Brown, M., & Mahomed, L. (2008). Chapter 25 - Energy Planning in South African cities. In D. Peter (Ed.), *Urban Energy Transition* (pp. 563-584). Amsterdam: Elsevier.

Bram, B. (2009). Connecting political economies of energy in South Africa. [doi: 10.1016/j.enpol.2009.04.041]. *Energy Policy, 37*(10), 3951-3958.

Brent, A. C., & Kruger, W. J. L. (2009). Systems analyses and the sustainable transfer of renewable energy technologies: A focus on remote areas of Africa. [doi: 10.1016/j.renene.2008.10.012]. *Renewable Energy, 34*(7), 1774-1781.

Bugaje, I. M. (2006). Renewable energy for sustainable development in Africa: a review. [doi: 10.1016/j.rser.2004.11.002]. *Renewable and Sustainable Energy Reviews, 10*(6), 603-612.

Carr, A. S., Bateman, M. D., Roberts, D. L., Murray-Wallace, C. V., Jacobs, Z., & Holmes, P. J. (2010). The last interglacial sea-level high stand on the southern Cape coastline of South Africa. [doi: 10.1016/j.yqres.2009.08.006]. *Quaternary Research, 73*(2), 351-363.

Chineke, T. C., & Ezike, F. M. (2010). Political will and collaboration for electric power reform through renewable energy in Africa. [doi: 10.1016/j.enpol.2009.10.004]. *Energy Policy, 38*(1), 678-684.

Cooper, D. R., & Schindler, P. S. (2001). *Business Research Methods* (Seventh ed.). Singapore: Irwin/McGraw-Hill.

Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (Second ed.). Thousand Oaks: SAGE Publications.

CSIR, C. f. S. a. I. R., Dr Jeremy Gibberd. (2009). Energy-Efficient Buildings on the Horizon. *Sciencescope*.

Dasappa, S. (2011). Potential of biomass energy for electricity generation in sub-Saharan Africa. [doi: 10.1016/j.esd.2011.07.006]. *Energy for Sustainable Development, 15*(3), 203-213.

DEAT, D. o. E. A. a. T. (2004). *A national climate change response strategy for South Africa* Pretoria: Retrieved from http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup3_south_africa.pdf. White Paper on the Renewable Energy Policy of the Republic of South Africa, Government Gazette no. 26169 C.F.R. § 16 (2003).

Dieter, H. (2004). Renewable Energy in Southern Africa. In J. C. Editor-in-Chief: Cutler (Ed.), *Encyclopedia of Energy* (pp. 333-346). New York: Elsevier.

DoE, D. o. E. Renewables Retrieved 31/01/2012, 2012, from http://www.energy.gov.za/files/esources/renewables/r_hydro.html

DOE, D. o. E. (2010). *Policy to Support the Energy Efficiency and Demand Side Management and Program for the Electricity Sector through the Standard Offer Incentive Scheme*.

DoE, D. o. E. (2011). *Annual Report 2010/2011*. Pretoria: Retrieved from http://www.energy.gov.za/files/Annual%20Reports/Dept%20Energy%20Annual%20Report%202011.pdf.

Integrated Resource Plan for Electricity 2010-2030, Government Gazette no. 9531 C.F.R. (2011).

Edkins, M., Marquard, A., & Winkler, H. (2010). South Africa's renewable energy policy roadmaps (E. R. Centre, Trans.). Cape Town: University of Cape Town.

ESKOM. (2011). Eskom factsheet – Coal in South Africa. Retrieved from http://www.eskom.co.za/content/CO_0007CoalSARev9.pdf

Farlam, P. (2011). Working together: Assessing public-private partnerships in Africa *NEPAD Policy Focus Report no. 2* Retrieved from http://hdl.handle.net/123456789/31512

Flick, U. (2007). *Designing Qualitative Research*. London: SAGE Publications Ltd.

Foster-Pedley, J., & Hertzog, H. (2006). Financing strategies for growth in the renewable energy industry in South Africa. *Journal of Energy in Southern Africa, 17* (4), 57-64.

Gómez-Barroso, J. L., & Feijóo, C. (2010). A conceptual framework for public-private interplay in the telecommunications sector. [doi: 10.1016/j.telpol.2010.01.001]. *Telecommunications Policy, 34*(9), 487-495.

Graeber, B., Spalding-Fecher, R., & Gonah, B. (2005). Optimising trans-national power generation and transmission investments: a Southern African example. [doi: 10.1016/j.enpol.2004.04.025]. *Energy Policy, 33*(18), 2337-2349.

Grimsey, D., & Lewis, M. K. (2005). Are Public Private Partnerships value for money?: Evaluating alternative approaches and comparing academic and practitioner views. [doi: 10.1016/j.accfor.2005.01.001]. *Accounting Forum, 29*(4), 345-378.

Harald, W. (2007). Energy policies for sustainable development in South Africa. [doi: 10.1016/S0973-0826(08)60561-X]. *Energy for Sustainable Development, 11*(1), 26-34.

Holmes-Watts, T., & Watts, S. (2008). Legal frameworks for and the practice of participatory natural resources management in South Africa. [doi: 10.1016/j.forpol.2008.02.005]. *Forest Policy and Economics, 10*(7–8), 435-443.

IPCC, C. W. T., Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp. (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

James T, M. (2001). Making the energy transition in rural east Africa: Is leapfrogging an alternative? [doi: 10.1016/S0040-1625(99)00091-8]. *Technological Forecasting and Social Change, 68*(2), 173-193.

John, C. (1982). The critical period concept: Research, methodology, and theoretical issues. [doi: 10.1037/0033-2909.91.2.260]. *Psychological Bulletin, 91*(2), 260-275.

Joubert, J. R., & van Niekerk, J. L. (2011). *Designing the ShoreSWEC as a breakwater and wave energy converter*. Paper presented at the Annual Student Symposium. http://www.crses.sun.ac.za/files/services/conferences/annual-student-symposium-2011/3-17nov_joubert.pdf

Jyoti K, P. (1979). Renewable energy options: What could developing countries expect from them? [doi: 10.1016/0360-5442(79)90027-6]. *Energy, 4*(5), 989-994.

Karekezi, S., & Kithyoma, W. (2002). Renewable energy strategies for rural Africa: is a PV-led renewable energy strategy the right approach for providing modern energy to the rural poor of sub-Saharan Africa? [doi: 10.1016/S0301-4215(02)00059-9]. *Energy Policy, 30*(11-12), 1071-1086.

Kimemia, D., & Annegarn, H. (2011). An urban biomass energy economy in Johannesburg, South Africa. [doi: 10.1016/j.esd.2011.10.002]. *Energy for Sustainable Development, 15*(4), 382-387.

Kothari, C. (2009). *Research Methodology: methods and techniques* (Second Edition ed.): New Age International.

Krupa, J., & Burch, S. (2011). A new energy future for South Africa: The political ecology of South African renewable energy. [doi: 10.1016/j.enpol.2011.07.024]. *Energy Policy, 39*(10), 6254-6261.

Kumar, R. (2010). *Research Methodology: A Step-by-Step Guide for Beginners*: SAGE Publications.

Lemaire, X. (2011). Off-grid electrification with solar home systems: The experience of a fee-for-service concession in South Africa. [doi: 10.1016/j.esd.2011.07.005]. *Energy for Sustainable Development, 15*(3), 277-283.

Madubansi, M., & Shackleton, C. M. (2006). Changing energy profiles and consumption patterns following electrification in five rural villages, South Africa. [doi: 10.1016/j.enpol.2005.10.011]. *Energy Policy, 34*(18), 4081-4092.

Marczyk, G. R., DeMatteo, D., & Festinger, D. (2010). Essentials of Research Design and Methodology Vol. 2. *Essentials of Behavioral Science* (pp. 304). Retrieved from http://books.google.co.za/books?id=IhLlSGyJwcwC

Mathiesen, B. V., Lund, H., & Karlsson, K. (2011). 100% Renewable energy systems, climate mitigation and economic growth. [doi: 10.1016/j.apenergy.2010.03.001]. *Applied Energy, 88*(2), 488-501.

McBurney, D., & White, T. (2007). *Research Methods* (Seventh ed.). California: Thomson Wadsworth.

Munzhedzi, R., & Sebitosi, A. B. (2009). Redrawing the solar map of South Africa for photovoltaic applications. [doi: 10.1016/j.renene.2008.03.023]. *Renewable Energy, 34*(1), 165-169.

Musango, J. K., & Brent, A. C. Assessing the sustainability of energy technological systems in Southern Africa: A review and way forward. [doi: 10.1016/j.techsoc.2011.03.011]. *Technology in Society, 33*(1-2), 145-155.

National Treasury. Public Private Partnership Retrieved 24/01/2012, 2012, from http://www.ppp.gov.za/Pages/whatis.aspx

Treasury Regulations for departments, trading entities, constitutional instructions and public entities, Regulaion Gazette No. 27388 C.F.R. (2005).

NERSA, N. E. R. o. S. A. (2009a). *Renewable Energy Feed-In Tariffs Phase II*. Pretoria: Retrieved from http://www.nersa.org.za/#.

NERSA, N. E. R. o. S. A. (2009b). *Renewable Energy Feed - In Tariff Phase 2* Pretoria.

Oladiran, M. T., & Meyer, J. P. (2007). Energy and exergy analyses of energy consumptions in the industrial sector in South Africa. [doi: 10.1016/j.apenergy.2007.02.004]. *Applied Energy, 84*(10), 1056-1067.

Paish, O. (2002). Small hydro power: technology and current status. [doi: 10.1016/S1364-0321(02)00006-0]. *Renewable and Sustainable Energy Reviews, 6*(6), 537-556.

Pegels, A. (2010). Renewable energy in South Africa: Potentials, barriers and options for support. [doi: 10.1016/j.enpol.2010.03.077]. *Energy Policy, 38*(9), 4945-4954.

Pereira, M. G., Sena, J. A., Freitas, M. A. V., & Silva, N. F. d. (2011). Evaluation of the impact of access to electricity: A comparative analysis of South

Africa, China, India and Brazil. [doi: 10.1016/j.rser.2010.11.005]. *Renewable and Sustainable Energy Reviews, 15*(3), 1427-1441.

Public Private Partnership Manual, Regulation 16 of the Public Finance Management Act, 1999 (PFMA) C.F.R. (2004a).

Public Private Partnership Manual, Regulation 16 of the Public Finance Management Act, 1999 (PFMA) C.F.R. (2004b).

Municipal Service Delivery and PPP Guidelines, Regulation 16 of the Public Finance Management Act, 1999 (PFMA) C.F.R. (2007).

Rafey, W., & Sovacool, B. K. (2011). Competing discourses of energy development: The implications of the Medupi coal-fired power plant in South Africa. [doi: 10.1016/j.gloenvcha.2011.05.005]. *Global Environmental Change, 21*(3), 1141-1151.

Ramiah, I., & Reich, M. R. (2006). Building effective public–private partnerships: Experiences and lessons from the African Comprehensive HIV/AIDS Partnerships (ACHAP). [doi: 10.1016/j.socscimed.2006.01.007]. *Social Science & Medicine, 63*(2), 397-408.

Randall, S.-F. (2003). Indicators of sustainability for the energy sector: a South African case study. [doi: 10.1016/S0973-0826(08)60347-6]. *Energy for Sustainable Development, 7*(1), 35-49.

Rogerson, C. (2010). In Search of Public Sector–Private Sector Partnerships for Local Economic Development in South Africa. *Urban Forum, 21*(4), 441-456. doi: 10.1007/s12132-009-9074-9

Sebitosi, A. B., & Pillay, P. (2008a). Grappling with a half-hearted policy: The case of renewable energy and the environment in South Africa. [doi: 10.1016/j.enpol.2008.03.011]. *Energy Policy, 36*(7), 2513-2516.

Sebitosi, A. B., & Pillay, P. (2008b). Renewable energy and the environment in South Africa: A way forward. [doi: 10.1016/j.enpol.2008.05.013]. *Energy Policy, 36*(9), 3312-3316.

Shackleton, C. M., & Scholes, R. J. (2011). Above ground woody community attributes, biomass and carbon stocks along a rainfall gradient in the savannas of the central lowveld, South Africa. [doi:10.1016/j.sajb.2010.07.014]. *South African Journal of Botany, 77*(1), 184-192.

Spalding-Fecher, R., Williams, A., & van Horen, C. (2000). Energy and environment in South Africa: charting a course to sustainability. [doi: 10.1016/S0973-0826(08)60259-8]. *Energy for Sustainable Development, 4*(4), 8-17.

Stephen, K. (2002). Renewables in Africa—meeting the energy needs of the poor. [doi: 10.1016/S0301-4215(02)00058-7]. *Energy Policy, 30*(11–12), 1059-1069.

Susan J, F.-W. (1997). Towards developing a methodology for doing qualitative research: The dynamic-comparative case study method. [doi: 10.1016/S0956-5221(97)00028-6]. *Scandinavian Journal of Management, 13*(4), 439-455.

Thomas P, F. (2009). The potential of concentrating solar power in South Africa. [doi: 10.1016/j.enpol.2009.07.017]. *Energy Policy, 37*(12), 5075-5080.

Tompkins, E. L., & Eakin, H. (2012). Managing private and public adaptation to climate change. [doi: 10.1016/j.gloenvcha.2011.09.010]. *Global Environmental Change, 22*(1), 3-11.

Tsikata, M., & Sebitosi, A. B. (2010). Struggling to wean a society away from a century-old legacy of coal based power: Challenges and possibilities for South African Electric supply future. [doi: 10.1016/j.energy.2009.11.010]. *Energy, 35*(3), 1281-1288.

UNFCCC. (1992). *United Nations Framework Convention on Climate Change*. http://unfccc.int/resource/docs/convkp/conveng.pdf

USEPA, U. S. E. P. A. (2012, 15 March 2012). Combined Heat and Power Partnership Retrieved 19 March 2012, from http://www.epa.gov/chp/basic/index.html

van Niekerk, W. (2008). Renewable Energy in South Africa, Resource and Research.

Visagie, E., & Prasad, G. (2006). Renewable energy technologies for poverty alleviation South Africa: biodiesel and solar water heaters.

Wiginton, L. K., Nguyen, H. T., & Pearce, J. M. (2010). Quantifying rooftop solar photovoltaic potential for regional renewable energy policy. [doi: 10.1016/j.compenvurbsys.2010.01.001]. *Computers, Environment and Urban Systems, 34*(4), 345-357.

Willig, C. (2008). *Introducing Qualitative Research in Psychology : Adventures in Theory and Method* (2nd ed.). Maidenhead: McGraw Hill.

Winkler, H., Hughes, A., & Haw, M. (2009). Technology learning for renewable energy: Implications for South Africa's long-term mitigation scenarios. [doi: 10.1016/j.enpol.2009.06.062]. *Energy Policy, 37*(11), 4987-4996.

Wüstenhagen, R., & Menichetti, E. (2012). Strategic choices for renewable energy investment: Conceptual framework and opportunities for further research. [doi: 10.1016/j.enpol.2011.06.050]. *Energy Policy, 40*(0), 1-10.

Zawilska, E., & Brooks, M. J. (2011). An assessment of the solar resource for Durban, South Africa. [doi: 10.1016/j.renene.2011.05.023]. *Renewable Energy, 36*(12), 3433-3438.

APPENDIX A

Letter to Respondents

Dear Respondent,

I am completing my MBA at the Business School of the University of Witwatersrand (WBS). My MBA research report is on **Renewable Energy through Public Private Partnerships in South Africa**. I would appreciate it you would allow me 1 hour to interview you to understand your organisation's role in this process and the contribution it can make towards this transformation. I understand that you are extremely busy and your agreement to make a valuable contribute to my research is highly appreciated.

The interview will focus on current renewable energy initiatives undertaken by your organisation and your view on the potential for renewable energy resources to become a part of South Africa's energy mix through public private partnering. Confidentiality will be observed throughout the research process and the final report will be for academic purposes only.

I will be available to meet with you at a convenient location and time.

Thank you for your kind assistance.

Yours sincerely

Rekha Lalla

SA Mobile: +27 82 371 8915

E-mail: lalla.rekha@gmail.com

APPENDIX B

Actual Research Instrument

Interview Questions

1) Given that South Africa is richly endowed with natural resources, what are the renewable energy technology options that you would consider to offer the best energy mix solution to the energy dilemma we are currently facing?

2) As one of the major role players/energy users, what plans does your organisation have to implement these renewable energy options?

3) What are the obstacles facing your organisation to implement these options?

4) Government has committed to the global climate change effort, however progress has been slow. What are the factors that are hampering this process?

5) How can we rise above these limitations and move ahead to transform South Africa's energy industry? Will there be any further changes that policy makers need to make to ease the progress and encourage?

6) What role can Public Private Partnerships play towards translating the implementation plan into action?

7) How receptive will your organisation be to Public Private Partnerships to play a role in the implementation of this project?

APPENDIX C

Consistency matrix

Research problem stated here					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research questions**	**Source of data**	**Type of data**	**Analysis**
To determine what are the most viable renewable energy resource options for South Africa and the plans for their implementation.	(Angelis-Dimakis, et al., 2011); (Bartle, 2002); (CSIR, 2009); (Dasappa, 2011); (DME, 2003); (DoE, 2011); (Edkins, et al., 2010); (ESKOM, 2011); (Joubert & van Niekerk, 2011). (Kimemia & Annegarn, 2011); (Munzhedzi & Sebitosi, 2009); (Paish, 2002); (Pegels, 2010); (Sebitosi & Pillay, 2008a); (Sebitosi & Pillay, 2008b); (van Niekerk, 2008); (Zawilska & Brooks, 2011)	What are the most viable renewable energy resource options for South Africa and the plans for their implementation?	Respondents in semi-structured interviews Library resources Organisation documents	Qualitative data	Data reduction Data display Conclusion

Research problem stated here					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research questions**	**Source of data**	**Type of data**	**Analysis**
To identify the obstacles preventing the implementation of renewable energy resource options in South Africa and propose ways to overcome them.	(DME, 2003); (DoE, 2011); (Edkins, et al., 2010); (Krupa & Burch, 2011); (Lemaire, 2011); (Sebitosi & Pillay, 2008a); (Tsikata & Sebitosi, 2010); (Wüstenhagen & Menichetti, 2012)	What are the obstacles preventing the implementation of renewable energy resource options available in South Africa and how can we rise above them?	Respondents in semi-structured interviews Library resources Organisation documents	Qualitative data	Data reduction Data display Conclusion
To analyse and evaluate the role that Public Private Partnerships can play in the transition to renewable energy resource options in South Africa.	(Lemaire, 2011); (National Treasury); (PPP Unit, 2004a); (PPP Unit, 2004b); (PPP Unit, 2007); (Sebitosi & Pillay, 2008a); (Sebitosi & Pillay, 2008b)	What role can Public Private Partnerships play in the transition to renewable energy resource options in South Africa?	Respondents in semi-structured interviews Organisation documents	Qualitative data	Data reduction Data display Conclusion