UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Gordon Institute of Business Science
University of Pretoria

Impediments implementing renewable energy projects in South Africa

by

Don Forsyth

Student number: 15388192

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

7 November 2016

Abstract

The implementation of independent utility-scale renewable energy projects in South Africa has only recently been adopted en masse and with new initiatives, numerous barriers and challenges have arisen making for a complex and ambiguous environment. The requirement for cheap and clean energy generation has been emphasised by the need for climate change mitigation initiatives, the increasing need for energy to grow the economy and the problems encountered by South Africa's monopolistic energy parastatal to maintain their coal-fired power plant and produce sufficient quantities of electricity. In any fledgeling industry, the skills are generally lacking, meaning that there is a need for academic institutions to fill the need for skills transfer as well as companies to ensure that there are skills transfer initiatives in place. The study explored these challenges and barriers from the viewpoint of developers and Engineering, Procurement and Construction Management companies in particular in the context of South Africa's Renewable Energy Independent Power Producers Programme.

In order to ensure that a complete set of factors were considered during the study, the Enterprise framework for renewable energy was utilised as a structure that draws attention to a wide range of both internal and external barriers in the renewable energy sector. This framework and literature pertaining to the barriers experienced thus far gave rise to four research questions which were utilised as the basis for the interview questions. To draw from the experience of those who have been involved in the RE IPPPP, 11 in-depth, exploratory interviews were conducted from those with differing positions from a diverse selection of organisations.

The study determined that there are seven main barriers and challenges in the sector and that the vast majority of factors emanate from the external environment. It was also found that skills and skills development have been successful especially in the technical areas, but lacking at management and government level. The study culminated in a framework to assist developers and EPCM companies in the renewable energy sector to take cognisance of the challenges and barriers and the factors that create the said challenges and barriers. Recommendations to EPCM companies, management and government and policy makers were formulated. These include policy changes, the reassessment of the Eskom's corporate structure and opportunities in embedded energy production. Recommendations were also made with regards to future research.

Keywords

renewable energy, independent power producers, barriers, challenges, resource-based theory.

Declaration

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

Date: ____________________

Name: Don Forsyth

Signature ____________________

Contents

Page

Abbreviations

AfD	Agence Française de Développement
ANC	African National Congress (South African ruling political party)
BLIPPPP	Baseload Independent Power Producer Procurement Programme
BW	Bid Windows
CAPEX	Capital Expenditure
CDM	Clean Development Mechanism
CO2	Carbon Dioxide
COGEN	Cogeneration
CoGTA	Cooperative Governance and Traditional Affairs
CSIR	Council for Scientific and Industrial Research
CSP	Concentrating Solar Power
DEA	Department of Environmental Affairs
DoE	Department of Energy
DPE	Department of Public Enterprises
DSM	Demand Side Management
EDD	Economic Development Department
EEDSM	Energy Efficiency Demand Side Management
EIA	Environmental Impact Assessment
EPCM	Engineering Procurement Construction Management
ESKOM	Electricity Supply Commission
FDI	Foreign Direct Investment
FiT	Feed-in-Tariff
GDP	Gross Domestic Product
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GW	Gigawatt (One thousand Mega Watts)
GWh	Gigawatt hour
IDC	Industrial Development Corporation
IPP	Independent Power Producer
IRP	Integrated Resource Plan
IRR	Internal Rate of Return
ISES	International Solar Energy Society

KfW	KfW Bank
kW	Kilowatt (One thousandth of a Mega Watt)
LNG	Liquefied Natural Gas
LTMS	Long Term Mitigation Strategy
MRG	Methane Rich Gas
MW	Mega Watt
NERSA	National Energy Regulator of South Africa; alternatively the Regulator
OCGT	Open Cycle Gas Turbine
OECD	Organisation for Economic Co-operation and Development
PESTEL	Political, Economic, Social, Technological, Environmental, Legal
PPA	Power Purchase Agreement
PV	Photo-Voltaic
RE	Renewable Energy
RE IPPPP	Renewable Energy Independent Power Producers Procurement Programme
REDZ	Renewable Energy Development Zones
REEEP	Renewable Energy and Energy Efficiency Partnership
REFIT	Renewable Energy Feed-in-Tariff
REFSO	Renewable Energy Finance and Subsidy Office
RFP	Request for Proposal
SAIBA	Southern African Institute for Business Accountants
SAIPPA	South African Independent Power Producers Association
SAPVIA	South African Photovoltaic Industry Association
SAREC	South African Renewable Energy Council
SASOL	South Africa Synthetic Oil Liquid
SASTELA	The Southern Africa Solar Thermal and Electricity Association
SAWEA	South African Wind Energy Association
SBO	Single Buyers Office (Eskom)
SEA	Strategic Environmental Assessment (Wind and Solar PV)
SECO	State Secretariat for Economic Affairs Economic Cooperation and Development
SESSA	Sustainable Energy Society of Southern Africa
SOE	State Owned Entity

List of Figures

List of Tables

1. CHAPTER 1: INTRODUCTION TO RESEARCH PROBLEM

1.1. Introduction

This research aims to explore the barriers experienced by organisations who have participated in the process of implementing renewable energy projects in South Africa and in so doing aims to improve the bidding process of those who will in future submit bids for the upcoming phases of renewable energy projects in South Africa. In addition, the research aims to introduce a framework to guide organisations that choose to take part in future renewable energy projects.

This chapter introduces the need for this research, the research problem and describes how the research was carried out. It also outlines the theoretical basis that was applied as a guide for this study and the contribution that this study aims to make to the industry. Furthermore, the chapter describes the scope of the study, gives an outline of the method of data collection and summarises the findings that were made and introduces the new framework.

1.2. Description of the problem

The world's human population is growing at a phenomenal rate and with such population growth, there is a need for additional energy sources to meet the ever increasing energy needs. It is predicted that Africa alone will have a population of between 1.53 and 1.60 billion by 2030 (Mountford & Rapoport, 2014) stressing the need for additional energy to pull Africa out of poverty and aiding to advance the economies (Brew-Hammond, 2010). South Africa too requires additional energy to stimulate the economy as stressed by the Minister of Energy, Ms Tina Joemat-Pettersson, during the Department of Energy's (DoE) 2015/16 Policy and Budget speech where she emphasised that; "Energy Security is a pre-requisite for achieving the 5.5 percent economic growth target as envisaged by the National Development Plan" (Joemat-Pettersson, 2015).

Conversely, the world has become increasingly aware that humankind has had a significant negative impact on the natural environment and that it is vital that measures be put in place to prevent further degradation. Governments, business and public bodies from around the world have come together to form partnerships to facilitate the building of the 'green economy'. The aim is to slow the impact that industrialisation is having on the environment and attempt to stop the deterioration altogether ("Sustainable Innovation Forum 2015," 2015). South Africa's role in the deterioration of the environment has been shown to be significant with South Africa being the highest emitter of greenhouse gases (GHG's) on the continent and the twelfth largest emitter of Carbon Dioxide (CO_2) globally with a per capita intensity of almost 10 tonnes per person (Thopil & Pouris, 2015). As asserted by Baker, Newell, & Phillips (2014, p. 792) "in contrast to other developing countries with relatively low Gross Domestic Product (GDP) and high rates of poverty, the country's per capita emissions are high, comparable even to many EU countries including the UK and Germany and four to five times higher than those of Brazil or India".

Taking cognisance of these two forces and the fact that the world holds finite reserves of fossil fuels (Abdmouleh, Alammari, & Gastli, 2015), it becomes evident that alternative methods of generating electricity must be found from energy sources that are continually replenished by nature. Broadly, these alternative methods of electricity generation are referred to as renewable energy. Implementing the process of putting such technologies in place comes with its own and unique challenges and potential barriers. It has been shown that these barriers may be unique depending on the environment in which the renewable energy initiatives are being introduced (Luthra, Kumar, Garg, & Haleem, 2015).

This study aims to explore barriers experienced by the implementers of South Africa's Renewable Energy Independent Power Producers Procurement Programme (RE IPPPP) projects during the planning, engineering, procurement and construction management (EPCM) and the developers of the projects. The need for this study arises from the fact that the traditional fossil fuels used to generate electricity in South Africa are detrimental to the environment (Henneman, Rafaj, Annegarn, & Klausbruckner, 2016) and renewable energy projects are capital intensive (Seetharaman, Sandanaraj, Moorthy, & Saravanan, 2016). Increasing the efficiency of engineering, planning and constructing renewable energy plants, connotes that the costs for implementation would decrease, causing renewable energy projects to become more viable for the project companies and developers, thus reducing the cost to the consumer, lowering carbon emissions and generating energy for future economic growth.

As a result of South Africa's unique apartheid history of segregation and the majority being deprived of a good education, and consequent sanctions imposed on the apartheid government to put pressure on them to abolish the apartheid system, implementing infrastructure projects comes with its own unique challenges. Technology and technical skills, and the political, socio-cultural and economic environments have been shaped by this unique history and the policy makers have included transformation policies into the conditions of the Request for Proposal (RFP) for prospective renewable energy suppliers. These conditions in themselves have been specified in the RFP and therefore the prospective suppliers are fully aware of the conditions before submitting the bid tariff to supply the electrical power to the national grid (Baker, 2015a). However, there are several additional challenges that organisations face during the implementation phase of the project. These challenges may be unique to each individual project, such as the geographical area, the technology being installed and the cultural attributes of the community residing in the area surrounding the project. Although unique, there will always be shared experiences with other EPCM companies who execute the planning, engineering and construction management of such projects as well as the operation of the plants. Such challenges, if recognised in advance by future bidders, are able to provide said bidders an opportunity to take these challenges into account during the bidding and planning phase of the project, enhancing project execution efficiency to ensuring achievement of the budget and the programme.

1.3. Research background

The renewable energy sector has been given numerous opportunities to thrive given the current environment of sustainability, the thirst for clean cheap energy and the willingness of both the private and public sectors to invest. However, there have been numerous reports on the diverse challenges that individual projects have faced in the implementation of such projects. Barriers have been widely reported in the media and previous studies have been carried out that relate to these barriers experienced. Media reports and articles have indicated that these challenges include the need for skills and training, regulatory conflicts (Njikelana, 2016), renewable energy’s baseload capabilities (Winand, 2016), challenges in changing from the more traditional fossil fuel based power generation (Huisman, 2016), discrimination towards renewable energy technology (Allix, 2016), environmental concerns (Makoni, 2015) and land access (Sosibo, 2016) to name a few. Several studies (Cherni & Kentish, 2007; Eleftheriadis & Anagnostopoulou, 2015; Luthra et al., 2015) suggest that such barriers and challenges are not unique to South Africa, but have been experienced in many parts of the world. It is imperative that the industry cognises whether these challenges and barriers have continued with the evolution of the renewable energy sector as experience has been gained and whether future stakeholders will continue to find it lucrative to be involved in the South African renewable energy industry.

The aim of South Africa's Integrated Resource plan of 2010 (IRP2010) was to lay out the proposed generation new build fleet for South Africa from 2010 to 2030 in which it was envisaged that by 2030, in the balanced scenario, the total generating capacity would be 89 532 MW with 19 500 MW being renewable energies in the form of CSP (Concentrating Solar Power), wind, local hydro and Photovoltaic (PV) (Department of Energy, 2011). The updated IRP 2010 published in 2013 decreases the goal of total generation capacity to 81 230 MW bringing the renewable energy generation down to 18 120 MW (Department of Energy, 2013). Although it was the DoE's intention to update the IRP every two years, this has not materialised since the first revision in 2013 and therefore there is much uncertainty from developers both locally and internationally of whether the environment is conducive to continue to support renewable energy initiatives (Pfenninger & Keirstead, 2015).

A further development arose when in a letter addressed to the Energy Minister, Ms Joemat-Pettersson, from the Eskom's chairperson Dr Ngubane it was stated that Eskom was unwilling to sign any additional power purchase agreements with Independent Power Producers (IPP's) beyond the preferred bidders of bid round four extended (Creamer, 2016). This places further pressure onto the renewable energy sector, indicating that further rounds may be affected by the drop in demand as a result of the current economic situation in South Africa and the political landscape. However, the updated IRP which is still to be released estimates that the surplus will be eradicated by 2022 (Creamer, 2016). This being said, the attitude towards renewable energy by the parastatal may slow down the bidding process and put pressure onto the feed-in-tariffs (FiT's) that the IPP's are currently enjoying, squeezing the margins even more and rendering the projects unviable. This development poses further questions relating to the future of renewable energies in South Africa and in so doing renders the findings of this study even more critical if further rounds were to be released by the DoE for bidding.

1.4. Renewable energy technologies

Several renewable energy technologies have been developed to produce electrical power from energy sources that are continually replenished by nature. These include wind turbines, concentrated solar power, solar photovoltaic technology and hydro-electric power. Wind turbines produce electricity by converting rotational energy produced by the wind turning either horizontal or vertical shafts into electrical energy. Most wind turbines comprise horizontal shafts that are turned by large aerofoil type blades and in turn produce the electricity through a generator. Photovoltaic solar panels produce electricity using light which is converted into electrical energy using semiconducting materials. Hydroelectric power uses the force of water flow to turn turbines which in turn generators electricity in a generator. This technology has the advantage of the storage of energy by being able to pump the water up to a higher lying dam during off-peak times and then utilising the potential energy from the water to produce electricity during peak periods of electricity demand. Concentrated solar power uses mirrors to concentrate the heat of the sun heat a tower that contains molten salt. This molten salt is then pumped to a steam generator which in turn rotates a turbine and a generator to produce electrical power. CSP too has the capability of storing the energy in the salt and therefore can produce electrical power for a few hours after the sun has set.

1.5. Scope of research

The scope of the study focused on impediments experienced by South African experts in the field of renewable energy who have had experience implementing South African renewable energy projects and who have been involved in said projects from the funding to the engineering and implementation. The study looked specifically at those who have been involved in the RE IPPPP from bid round one to bid round four extended using specifically solar PV (Photovoltaic), CSP (Concentrated Solar Power), wind turbines or hydro-electric power as the technology to generate the electrical power.

1.6. Business Motivation

The outcome of this study is aimed to provide those who are considering embarking on developing renewable energy projects in South Africa with a framework to identify those factors that are potential challenges during the implementation of such projects and in so doing mitigate risks and potential of delivering a loss-making project . The outcomes will not only be beneficial to the projects under future rounds of the RE IPPPP, but can also be applied to embedded power projects, coal baseload Independent Power Producer (IPP) procurement programme projects, gas to power projects and cogeneration (COGEN) Independent power procurement programme projects as many of the phases in the process are similar or equivalent.

Additionally, there are a number of countries that are looking to replicate the RE IPPPP and therefore if the barriers and challenges are known to the policy makers in said countries, these factors can be taken into account when drafting the policies for the new programme.

1.7. Academic Motivation

The study adds to the academic knowledge base by applying resource-based theory to companies within the renewable energy sector and understanding what knowledge provided them with the competitive edge during the implementation of said projects. Resource-based theory as it applies to the renewable energy sector in South Africa is described in detail in section 2.3.1.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter aims to clarify what the literature has discovered regarding the barriers existing in the renewable energy sector. The literature review has been broken up into three sections. The first explains the South African energy landscape in general and then goes on to discuss the South African renewable energy sector to date in order to create the context of the environment. The second section explains the theoretical basis of the study and the academic theories that have been utilised as a basis and as a framework for the review. The last section explains the findings of previous research and literature regarding the barriers in the renewable energy sector as well as the skills situation in the sector both in South Africa and internationally.

2.2. Background

South Africa is blessed with an abundance of natural resources (Thopil & Pouris, 2015) such as wind, the highest number of sunny days per year in the world (Pollet, Staffell, & Adamson, 2015) and other commodity based resources. South Africa also is in dire need of economic growth (Baker, 2015a). The manufacturing industry plays a significant role in driving the growth of an economy (Zalk, 2014). Beneficiation of natural resources is consequently an area that will benefit the growth of the economy as a whole. To take advantage of this fact, energy is required to facilitate growth in the manufacturing and beneficiation sectors and therefore alternative forms of energy production other than the traditional burning of fossil fuels has been shown to be the answer for both economic growth and the mitigation of GHG emissions. Barriers to the implementation of said projects could render the industry unviable (Luthra et al., 2015) causing the loss of jobs (Walwyn & Brent, 2014), the continued degradation of the environment (Thopil & Pouris, 2015) and a negative effect on the South African economy (Lombard & Ferreira, 2015). Identifying potential barriers is, therefore, vital in ensuring that these projects continue to be developed to increase their market penetration and gain acceptance (Luthra et al., 2015).

2.2.1. Energy in South Africa

South Africa has historically depended on fossil fuels, in the form of coal, as its primary source of energy to produce electricity. Eskom, which is South Africa's primary producer of electricity, is a state-owned entity (SOE) that supplies South Africa with approximately 95 percent of its electricity and about 45 percent of the electricity in Africa. Eskom is an acronym for Electricity Supply Commission (de Kadt & Simkins, 2013) which was founded by the South African government in 1923 following the amalgamation of several privately owned entities (Lloyd, 2012).

As coal is plentiful and is consequently cost-effective and as a result of the low cost of coal and oversupply of electricity, South Africa's electricity prices have been among the lowest in the world (Henneman et al., 2016). But as the demand increased and as a consequence of the lack of maintenance of Eskom's coal-fired power plants, South Africa experienced its first series of load shedding in 2008 (Baker et al., 2014) with an estimated loss to the country of R 50 billion (approximately USD5 billion) during the crisis (Blignaut, Inglesi-Lotz, & Weideman, 2015). The ever-increasing construction costs of Eskom's new coal-fired power stations, namely Medupi and Kusile, (Walwyn & Brent, 2014) and the maintenance needs of the existing power stations (Baker et al., 2014), has led to significant increases in the electricity prices, putting South Africa as the eleventh cheapest electricity producer globally from being the cheapest as recently as 2009 (Baker, 2015a). Although South Africa has also depended on other sources of energy for the generation of electricity such as hydroelectric power and nuclear energy, coal has made up over 90 percent of the electricity generation in South Africa (Henneman et al., 2016). Appendix III gives an overview of all the available energy sources in South Africa.

To transform the energy sector in South Africa, the South African government promulgated the Integrated Resource Plan (IRP) in 2011 (Pfenninger & Keirstead, 2015). The IRP is a 20-year plan setting out targets for the implementation of projects to produce electricity utilising mostly renewable energy technologies (Nakumuryango & Inglesi-Lotz, 2016). The DOE's vision, as stated in the IRP, includes the increase of the clean energy mix to 30 percent by 2025 (Department of Energy, 2015c). The DoE continue to explore the potential to substitute coal with gas, developing the West Coast gas resources offshore gas resources and power production, investing in liquefied natural gas (LNG) import and landing infrastructure, securing feedstock for the gas-to-liquid Mossgas plant, conducting exploratory drilling to establish economically recoverable shale gas reserves, and investigating environmental impacts and mitigation by developing and implementing a Gas Utilisation Master Plan (GUMP).

The exploration of shale gas in the Karoo basin is also one of the DoE's initiatives that are seen to have great potential to alleviate the shortage of energy availability. It is estimated that South Africa has the eighth largest deposit of shale gas in the world. Although there is great potential, there have been many environmental concerns regarding the extraction of shale gas in the Karoo basin and has been passionately protested against by residents of the area and environmental groups (Department of Energy, 2015c). There are also possibilities of hydroelectric power being imported into South Africa from other Southern African countries, such as the Democratic Republic of Congo (DRC) and Mozambique, should they be developed and available for South African consumption. One such initiative is a purchase agreement between South Africa and the DRC that prompted the start of construction of the Inga three project that was expected to deliver 4.8 GW (Renewable Energy Policy Network for the 21st Century (REN21), 2014) with the first phase expected to deliver 2 500 MW. The project was deferred on the 25th of July 2016 with the World Bank announcing that it had suspended the disbursements of its funds (Fabricius, 2016).

SASOL, a South African company primary involved in the supply and production of carbon-based fuels, mining and in the production of chemicals, has been at the forefront of the energy sector in South Africa (Gakusi, Sartori, & Asamoah, 2015) since its inception in 1950. It has to dominate the sector for many years using a technology to convert natural gas to liquid fuels. The technology, commonly known as the Gas-to-Liquid or GTL, both utilise the Fischer-Tropsch process which SASOL also utilises to produce liquid fuels from coal ("SASOL Gas-to-Liquid Overview," n.d.). SASOL also holds the rights to supply natural gas that is extracted from the gas fields in Mozambique and is transported via pipeline to SASOL's plant in Secunda, Mpumalanga where approximately two-thirds are converted into liquid fuels and the remaining third is delivered to approximately 550 customers in the Gauteng Province (Gakusi et al., 2015). SASOL also produces Methane Rich Gas (MRG) which is conveyed to Mpumalanga and Kwa-Zulu Natal provinces.

South Africa operates one Nuclear Energy Plant in the form of Koeberg in the Western Cape which is the only nuclear reactor power plant on the African continent. It is responsible for five to 6.5 percent of South Africa's electricity generation capacity (Pollet et al., 2015).

The focus of the DoE and government to increase the electricity generation in the country comes with opportunities beyond that of the RE IPPPP. The DoE is in the process of putting in place several other IPP programmes to increase the delivery of electricity to the grid of which some are under the Baseload IPP procurement programme (BLIPPPP) announced in 2012 and amended in 2015 (Baker, Burton, Godinho, & Trollip, 2015).

The aim is to procure 400 MW from small renewables, 2 500 MW from coal-fired power station smaller than 600 MW each, 1 800 MW from COGEN, 3 126 MW from gas fired power generation and 1 500 MW from solar technologies (Baker et al., 2015). Other initiatives include the procurement of electricity using technologies such as small hydro, biomass, biogas, landfill gas (Pollet et al., 2015) and the embedded generation programme for rooftop PV (Baker et al., 2015).

2.2.2. South Africa's renewable energy sector

For South Africa's energy mix to change from a fossil fuel dominated to a more sustainable energy sources, the government together with various stakeholders came together to put policies in place to facilitate the transition. In 2009, the DoE implemented the Renewable Energy Feed-in-Tariff (REFIT) policy which was put in place to promote renewable energy technologies in South Africa. The aim was to set up a guaranteed FiT for a certain period per kWh and to guarantee an attractive profit margin to entice investment from renewable energy suppliers (Nakumuryango & Inglesi-Lotz, 2016). The REFIT programme was short lived due to criticism by banks and developers who realised that the Power Purchase Agreement (PPA) was too risky for them as it was skewed in Eskom's favour (Baker & Wlokas, 2014). As there was a need for an alternative programme to drive the renewable energy sector forward and considering the National Development Plan (NDP), the Integrated Resource Plan, other policies (discussed later in his paper) and targets pertaining to GHG emission mitigation, and energy forecasts, the DoE together with National Energy Regulator of South Africa (NERSA) formulated the RE IPPPP in 2011. The RE IPPPP is a bidding process for privately installed and operated, utility-scale renewable energy installations (Baker, 2015b) and is based on competitive tenders but with a regulated price cap, meaning that the prices needed to be equal or below the price cap set by the DoE (Baker, 2015b). The RE IPPPP has been lauded as being highly successful in the roll-out of renewable energy in South Africa by amongst other, the World Wide Fund for Nature (World Wide Fund for Nature (WWF), 2014) and as a flagship procurement programme internationally (Baker, 2015b).

The initiative aims to install 17.8 GW of electrical power from renewable sources by 2030 (Walwyn & Brent, 2014) and has been broken up into various bid rounds where the DoE determines the energy needs for the period (as set out in the IRP) and requests private companies to bid using the allocated technologies (Nakumuryango & Inglesi-Lotz, 2016) as shown in Table 2.1 below. The first bid round of the RE IPPPP took place in 2011 with 1 416 MW of renewable energy being contracted. To date, there have been four bid rounds with the latest bids been submitted in August of 2014 bringing the total contracted renewable energy contribution to 6 327 MW from 92 projects (Department of Energy, n.d.).

Table 2.1: Capacity allocations for bid round or bid window (BW)

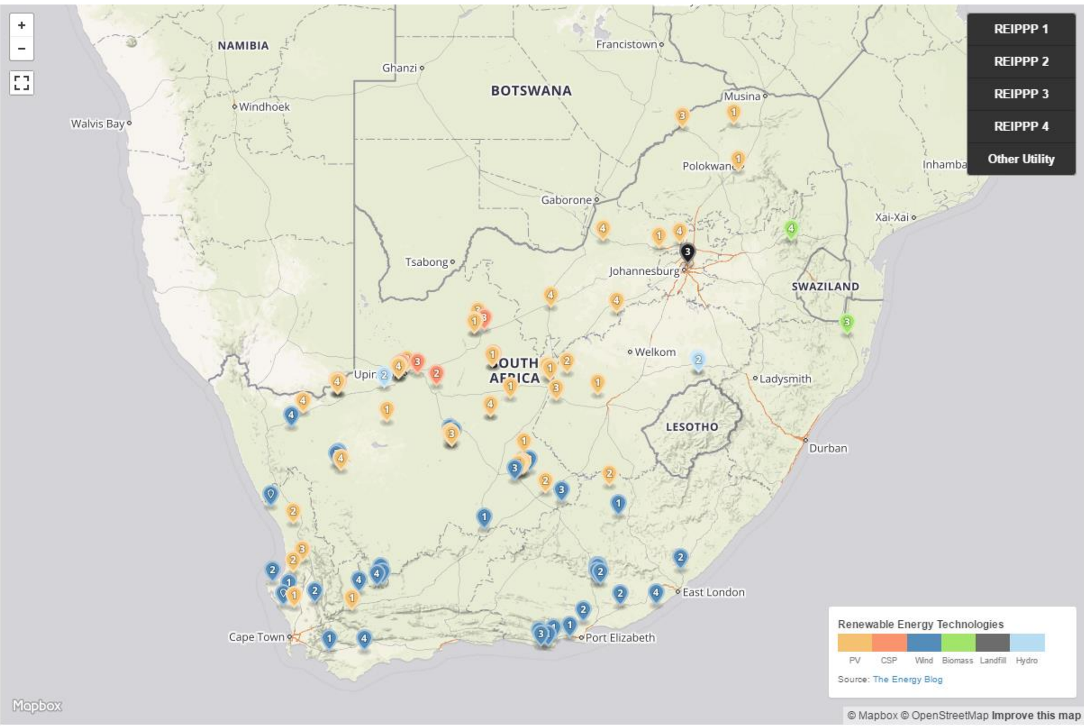
RE Type	BW 1 (MW)	BW 2 (MW)	BW 3 (MW)	BW 3.5 (MW)	BW 4 (MW)	Remaining MW capacity
Onshore wind	*634.0*	*563*	*787*	*0*	*1 362.4*	*660*
Solar PV	*632.0*	*417.1*	*435.0*	*0*	*812.9*	*626*
Concentrated solar power	*150.0*	*50.0*	*200*	*200*	*0*	
Small hydro (≤40MW)	*0*	*14.3*	*0*	*0*	*4.7*	*116*
Landfill gas	*0*	*0*	*18*	*0*	*0*	*7*
Biomass	*0*	*0*	*16*	*0*	*25*	*19*
Biogas	*0*	*0*	*0*	*0*	*0*	*60*
Total	1 415	1 044.4	1 286.3	200	2 175.3	1 488

Source: Adapted from NERSA, 2016 and Greencape, 2015

Table 2.1 indicates the different technologies and the capacities allocated to said technologies in each round or bid window (BW) and the remaining capacity of each of the technologies as per the ministerial determinations. Although both onshore wind and PV have a significant way to go in meeting the total requirements, there is a large scope for small hydroelectric power plants as well.

The total grid-connected RE IPPPP projects in commercial operation as of February 2016 was 2 145 MW, with installed power of 2 626 MW (NERSA, 2016). All projects are distributed across the country with the majority being situated in the Western, Northern and Eastern Cape. Figure 2.1 indicates the distribution and technology of each of the installed projects.

Figure 2.1: Utility-scale Renewable Energy Generation Sites - South Africa



Source: "Utility-scale Renewable Energy Generation Sites - South Africa," n.d.

As shown, the PV projects are located across the country, however, there is a noticeable absence of any projects in Kwa-Zulu Natal. The majority of wind projects are located in the Western, Northern and Eastern Cape with the CSP projects being located in the Northern Cape.

As alluded to in table 2.1 above, there are several other technologies available besides PV, CSP and wind turbines for the production of electricity that have played a role in the RE IPPPP. These energy sources include landfill gas, biomass, biogas and small-scale hydropower (Pollet et al., 2015). Landfill gas is produced by the degradation of organic matter that has been placed in a landfill designed in such a way that the extraction of mostly methane gas is possible through a network of pipelines. In South Africa, this gas has in the past been flared into the atmosphere but recently more and more gas is being used either to drive gas engines or is compressed to a high pressure in tubes and transported to industrial customers who utilise it in their thermal processing plant. Compressed landfill gas can also be utilised as an alternative to petroleum products as a fuel for automobiles. In the production of bio-fuel, organic material is placed in an anaerobic digester and is converted into a usable fuel either for transportation or for the generation of electricity through diesel generators or gas engines.

2.2.3. Industry Stakeholders

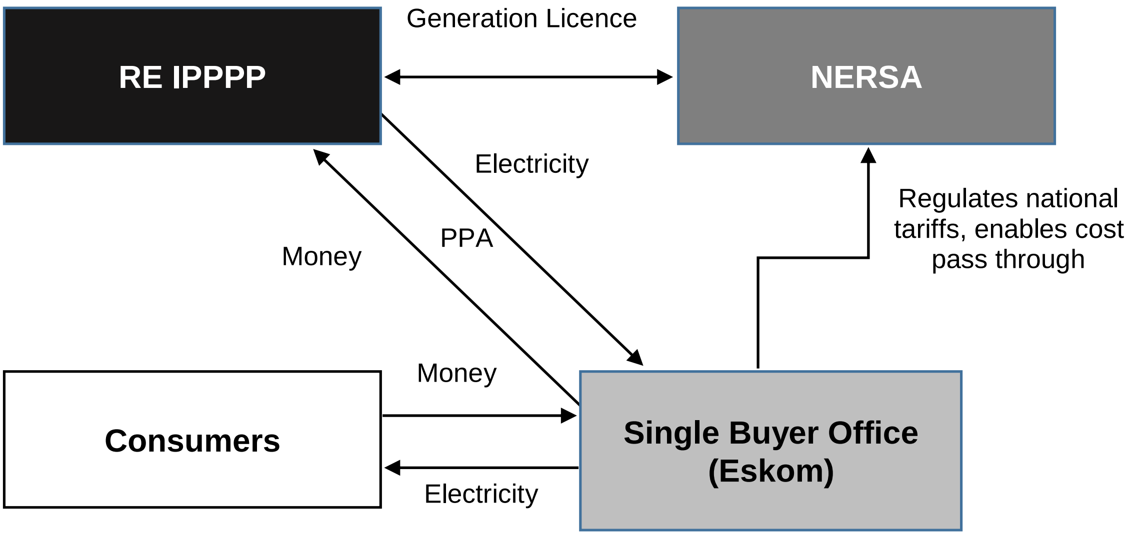
A significant consideration in the implementation of any change in the method of operation is that the stakeholders involved must be committed to implementing the change for themselves as well as the organisation or sector in which they are a part of. (Cummings, T., & Worley, 2015). In changing from generating electricity from the fossil fuel methods to any alternative source in South Africa a number of stakeholders have been identified for consideration in this research paper. The stakeholders vary from government organisations, the private sector, academic institutions, environmental organisations and the environment itself. The Government Communication Information System (2013) identifies the key stakeholders in the South African energy sector as regulatory bodies such as the NERSA, institutes such as the South African National Energy Development Institute (SANEDI) as well as suppliers of energy such as Eskom and SASOL. Additionally, the Department of Energy (2015a) indicate that during the implementation stage of the projects there are several stakeholders who have a wide range of functions to perform within the industry.

With regards, the implementation of renewable energy projects, Baker (2015b) view the stakeholders as those who have influence and are affected by individual projects. The relationships between these stakeholders are complex as it does not only involve local regulatory bodies, the company implementing the project and the client, but now includes foreign technology partners, Joint Ventures (JV's) with foreign companies, as a result of initiatives such as Clean Development Mechanism (CDM), plus local community ownership and black shareholding.

The CDM was put into place to facilitate the transfer of environmentally sound technologies to developing countries (Doukas, Karakosta, & Psarras, 2009). It allows for companies in countries that are in Annex 1 of the Kyoto Protocol (developed countries) to develop renewable energy initiatives in developing countries that are not listed in Annex 1 of the Kyoto Protocol, where it is cheaper to do so, and promotes technology transfer as well as helping the initiative to reduce global Greenhouse Gas (GHG) emissions ("Sustainable Innovation Forum 2015," 2015).

All these stakeholders and the relationships between them make the renewable energy sector complex and as such creates barriers of entry to those who have limited experience in the process in previous bidding rounds. The relationships between stakeholders directly involved in the RE IPPPP are indicated in Figure 2.2 below.

Figure 2.2: RE IPPPP Structure

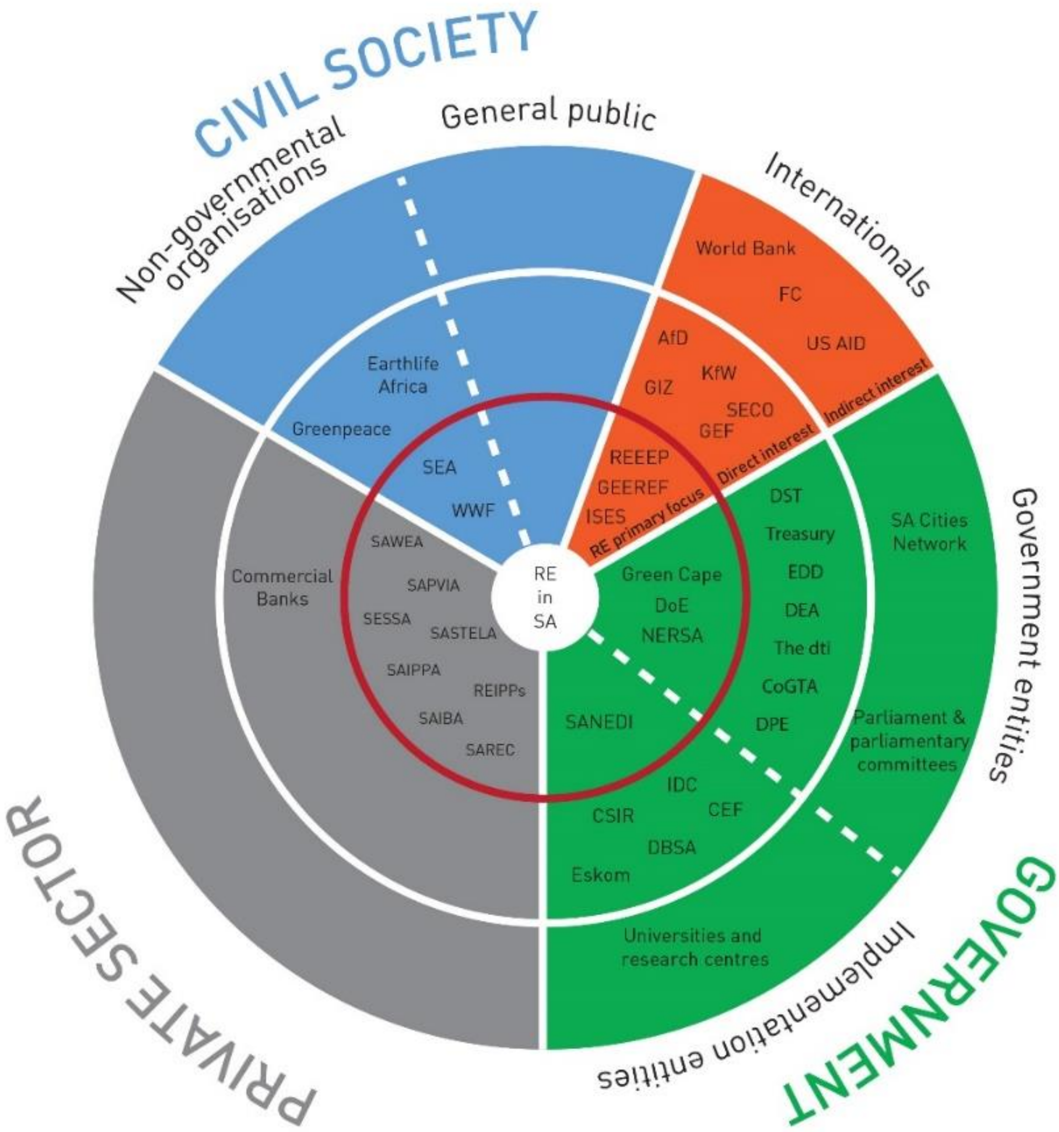


Source: World Wide Fund for Nature (WWF), 2014

Once the bid has been submitted to the DoE, a committee consisting of the DoE and international consultants, evaluate the proposals individually and once a decision has been made, announces the preferred bids publicly. It is then NERSA who approves the final PPA between the IPP and Eskom, through its Single Buyer Office (SBO). National Treasury provides a guarantee over Eskom's PPA payment obligations. Appendix V shows the the process between Eskom and the IPP's in more detail.

The Department of Energy (2015a) further explains the stakeholders involved in the renewable energy sector in South Africa. Stakeholders are first categorised into Civil Society, Government, Internationals and the Private Sector. Civil Society is split into non-government organisations which are primarily environmental organisations, and the general public. The private sector incorporates the commercial banks and the associations that look after the interests of the particular sector within the renewable energy space. The government is segmented again into those who are involved in the implementation and those government entities that have an interest in the renewable energy sector. Implementers include the likes of Eskom, the CSIR and SANEDI.

Figure 2.3: Main RE industry role players in South Africa

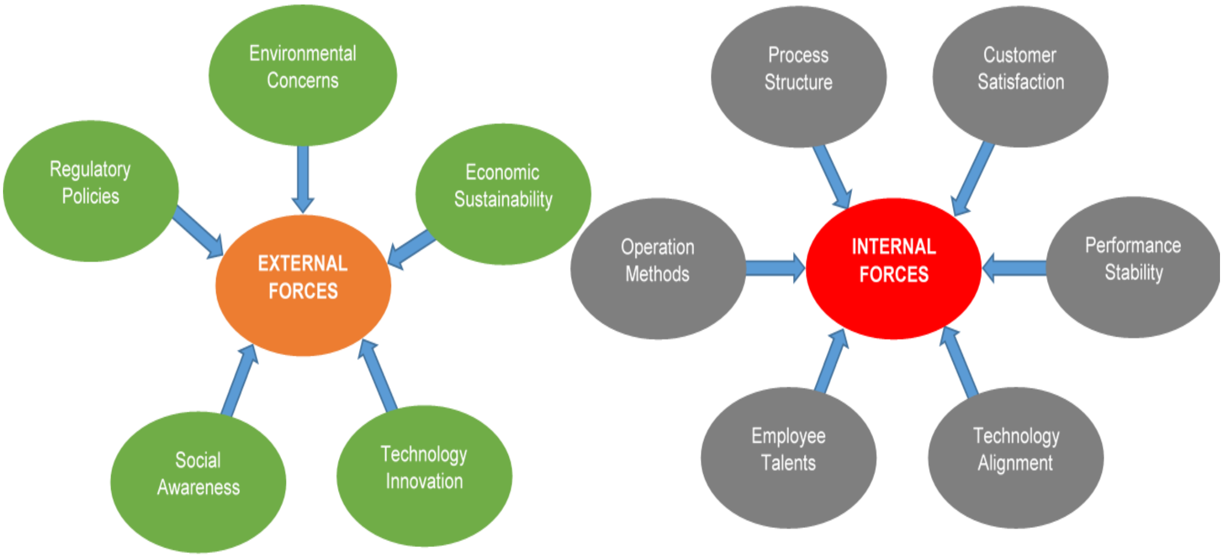


Source: Department of Energy, 2015a

2.3. Academic sources

To ensure that all aspects were covered in the analysis of the impediments experienced by this implementing renewable energy projects, it was initially decided that a framework based on Political, Economic, Social, Technological, Environmental, and Legislative (PESTEL) be utilised. Appreciating that PESTEL was intended as a tool to analyse the external environment of an organisation (Maliki et al., 2012) rather than factors such as skills and technology, an alternative framework was sought. Once the literature review was initiated, several additional potential frameworks were uncovered and it was determined that the factors considered by Seetharaman et al. (2016) not only cover those factors considered in a PESTEL analysis but add to it and are specifically aimed at the renewable energy sector.

Figure 2.4: Factors taken into consideration as impacting renewable energy growth



Source: Seetharaman et al., 2016

Figure 2.4 above shows the factors that will be considered in the literature review that follows. Additionally due to the skills level in this particular sector and with the shortage of skilled technical resources, Resource Based Theory was also considered to be relevant for this study to ascertain the skills that South Africa possesses and the value that a firm can add to the value chain of the renewable energy sector. A short explanation of Resource Based Theory is included in the literature review to describe how this theory is relevant to the industry.

2.3.1. Resource-Based Theory

Resources can be considered as anything that could give a firm a competitive advantage (Wernerfelt, 1984). These include physical capital, human capital and organisational capital resources that are valuable, rare, difficult to imitate and non-substitutable (Barney, 1991). In the case of the majority of EPCM companies and those that are operating and maintaining the equipment utilised to generate electrical power, resources would be intangible assets in the form of the skills and knowledge of the technology or individuals who are permanently or semi-permanently employed, efficient procedures and capital amongst others (Caves, 1980). Wernerfelt, (1984) argues that the holder of a resource is able to maintain its competitive advantage as it impacts the cost and ability of the firm that is holding the resource and it is not required that the firm holding the resource acquire said resource which requires time and potentially capital to be expended. This gives the firm who has the resource a competitive advantage over those who are entering the market for the first time. Firms entering the market will be facing what is described as resource position barriers. Resource position barriers have been demonstrated in the renewable energy industry by the difficulty of local firms entering the market (Eleftheriadis & Anagnostopoulou, 2015). Barney (1991) suggests that "firms obtain sustained competitive advantages by implementing strategies that exploit their internal strengths, through responding to environmental opportunities, while neutralising external threats and avoiding internal weaknesses" (Barney, 1991, p. 99).

Baker, (2015b) argues that the ownership of the renewable energy industry in South Africa is becoming more concentrated and ownership is increasingly becoming dominated by equity investors and foreign utilities due to the capital intensities of such projects. Round three of RE IPPPP saw the winning bidders for the wind projects shared amongst only three developers. All three developers are foreign companies who were able to raise capital on the back of their balance sheets (Walwyn & Brent, 2014) and therefore gave them the upper hand on the local companies. Not only is the advantage owing to financial aspects of the projects, but also larger companies have the ability to take risks as a result of their large asset bases, experience and ability to leverage off economies of scale. Local IPP's are required to finance the project themselves, invest at risk and only derive revenue once the electricity is fed into the grid (Baker et al., 2014).

2.3.2. Enterprise framework for renewable energy

Seetharaman et al., (2016) identify that most studies involving the barriers of renewable energy implementation are focused on external forces to the firm and some base the research on country-specific policies or specific sectors within the renewable energy industry. It has also been shown that the renewable energy sector has not rooted itself in the supply of electricity as initially expected.

Seetharaman et al. (2016) conducted a multi-faceted quantitative study using a framework that categorises a number of factors that are potential barriers to internal and external factors from the point of view of the EPCM firm. This formed the basis of the research with said factors and associated aspects presented in Figure 2.4 above. It was concluded that firms are doing poorly predominantly in managing the internal factors identified and suggest that firms must rather focus on internal forces such as skilled employees, business and technology strategic alignment, and business process. It is not to say however that external factors do not play a role. External factors such as environmental changes, social awareness, technology improvements and economic conditions influence the internal factors.

2.4. Barriers and challenges

The renewable energy sector is in a constantly changing environment in which new developments occur on a daily basis. Understanding the challenges and barriers faced thus far in South Africa from previous studies during the planning, engineering, procurement, construction management and operation phases and the experienced gained in other parts of the world, allows an understanding of what factors need to be considered when undertaking such a renewable energy project.

Several barriers have been identified by various studies conducted around the world with regards to renewable energy implementation. These barriers can be divided into seven main categories; economic and financial, market, awareness and information, technical, ecological and geographical, cultural and behavioural, and political and government issues (Luthra et al., 2015). As expounded above, one can take an even broader view and relate to the implementation stage of the projects, one can group these barriers into internal and external forces with internal forces being shown to be the most significant barriers to renewable energy firms (Seetharaman et al., 2016). These include high degrees of performance improvement, business process, skilled employees, and business and technology strategy alignment. Barriers pertaining to the renewable energy sector in South Africa were identified while the REFIT programme was still under consideration. The barriers that were considered included high capital costs, the lack of financing mechanism, the FiT's, the lack of awareness of the technology, the lack of local infrastructure (Pegels, 2010) and the technology complexity (Baker, 2015b). What can be noted is that of the barriers identified there is only a single factor of implementation that could be considered as internal to the firm, namely technology complexity. However, as there was no wide roll-out of the renewable energy projects at that time, there were a limited number of local companies in a position to make any contribution towards a study focusing on such factors.

Although extensive research has been undertaken in the field of barriers and challenges faced by renewable energy projects in South Africa, the majority of the emphasis has been on the external factors influencing implementation and operation of such projects. This study aims to confirm the previous research by tapping into the experiences of the stakeholders in the EPCM and development environments who have been involved in bid rounds one to four extended of the RE IPPPP taking cognisance of both internal and external factors impacting on renewable energy growth as identified by Seetharaman et al. (2016) and shown above in Figure 2.4. Additionally, the study leans on resource-based theory to recognise the value chain strategy of the organisations with regard to experience and skills, and technology expertise. In order to establish sub-factors for each of those identified by Seetharaman et al., (2016), studies by Eleftheriadis & Anagnostopoulou (2015) and Luthra et al. (2015) when considering barriers experienced internationally, and (Pegels, 2010) and (Baker, 2015b) which studies barriers that have been encountered in the South African context. A summary of the barriers is found in Table 2.2 below.

Table 2.2: Summary of barriers found in previous research

		Journal Articles				
	Factors Type	**Identifying barriers in the diffusion of renewable energy sources**	**Barriers to renewable / sustainable energy technologies adoption: Indian perspective**	**Enterprise framework for renewable energy**	**Renewable energy in South Africa: Potentials, barriers and options for support**	**The evolving role of finance in South Africa's renewable energy sector**
Economical & Financial (EF)	High initial capital cost	X	X	X	X	X
	Lack of financing mechanism	X	X		X	X
	Transmission & distribution losses		X			
	Inefficient technology		X			
	Lack of subsidies		X			
	Feed-in Tariffs (FITs)	X			X	

	Economic sustainability			X		
	Cost of debt / currencies					X
Market (MA)	Lack of consumer awareness to technology	X	X			
	Lack of sufficient market base		X			
	Unable to meet electricity power demand alone		X			
	Lack of paying capacity		X	X		
	Customer relationship barriers			X		
Awareness & Information (AI)	Need for backup or storage device		X			
	Unavailability of solar radiation data		X			
	Lack of IT enablement		X	X		
Technical (TE)	Lack of awareness of technology	X	X	X	X	
	Less efficiency		X			
	Technology complexity		X			X
	Lack of research & development work		X	X		
	Lack of trained people & training institutes		X	X		
	Lack of local infrastructure	X	X	X	X	
	Lack of national infrastructure	X	X			
Ecological &	Scarcity of natural & renewable resources		X			

	Geographic conditions		X			
	Ecological issues		X			
Cultural & Behavioural (CB)	Lack of experience		X	X		
	Rehabilitation controversies		X			
	Faith & Beliefs		X			
	Industry operational barriers			X		
	Performance barriers			X		
	Socio-economic					X
Political & Government Issues (PG)	Lack of political commitment		X			
	Lack of adequate government policies		X	X		
	Lack of public interest litigations		X			

Source: Adapted from Baker, 2015b; Eleftheriadis & Anagnostopoulou, 2015; Luthra et al., 2015; Pegels, 2010 and Seetharaman et al., 2016

During the literature review, it became evident that certain barriers, both internal and external, were considered more frequently than others and some were more relevant to the South African context than others. In the paragraphs that follow, a critical overview of significant literature is given (Saunders & Lewis, 2012) by extracting the major themes derived from journal articles that have been peer-reviewed as well as policies, articles, presentations and websites which are relevant to the research that was undertaken.

2.4.1. Economic and financial

The decreasing of the FiT's with subsequent bidding rounds is a potential barrier to the diffusion of the technology by discouraging new entrants and existing RE IPPPP suppliers as a result of falling profitability of each round (Eleftheriadis & Anagnostopoulou, 2015). In this respect, the existing suppliers potentially enjoy an advantage as a result of experience gained during previous projects and of economies of scale (Winkler, Hughes, & Haw, 2009), leveraging off the ability to import large quantities of spares, having a procurement process able to negotiate preferential prices and being in a position where relationships have been built in the past. Table 2.3 below indicates the average FiT's for round one to four of the RE IPPPP.

The average bid prices for each round of the RE IPPPP has decreased substantially. This indicates that the developers are becoming more competitive by innovation, technology learning and that technology is becoming more cost effective with economies of scale being applied (Winkler et al., 2009). However, Wee, Yang, Chou, & Padilan (2012) argue that the lack of economies of scale may, in fact, be a barrier to renewable energy development as a consequence of said types of projects being of a smaller scale than conventional power plants (Abdmouleh et al., 2015). As the bid rounds have progressed, the price caps decreased significantly with PV experiencing a reduction of over 71 percent from round one and FiT of wind plants decreasing by 45.8 percent from round one to round four.

Table 2.3: RE tariff decreases over the course of the RE IPPPP

	Average bid prices (RSA c/kWh)			
	Round 1	**Round 2**	**Round 3**	**Round 4**
Wind	*114.3*	*89.7*	*65.6*	*62*
Reduction from previous round		*-21.52%*	*-26.87%*	*-5.49%*
Total Reduction from round 1			*-42.61%*	*-45.76%*
Solar PV	*275.8*	*164.5*	*88.1*	*78.6*
Reduction from previous round		*-40.36%*	*-46.44%*	*-10.78%*
Total Reduction from round 1			*-68.06%*	*-71.50%*
Concentrated solar power	*268.6*	*251.2*	*146.0*	
Reduction from previous round		*-6.48%*	*-41.88%*	
Total Reduction from round 1			*-45.64%*	

Source: Greencape, 2015

The fundamental goal of the bidding process is for bidders to present a price at which the bidder will supply a unit of electricity into the grid. The price must be presented using the local currency (South African Rand) (Baker & Wlokas, 2014). The South African Rand has been extremely volatile in recent times and it is, therefore, difficult for the bidding firm to predict the revenue that will be obtained from the venture over the long term, especially for the firms that are foreign currency based. Potential financers are also more reluctant to finance projects where speculation on a currency forms part of the risk. As one financer put it, “if you want to speculate on currencies you don't do it by lending to a wind farm’’ (Baker, 2015b, p. 151). This suggests that the feed-in bidding price is higher than it would be if the bidding currency was either US Dollar or Euro based as the price would have to include the risk associated with the Rand volatility.

The cost of debt in South Africa is also a consideration. Baker (2015b) argues that “the average cost of debt for renewable energy projects financed under RE IPPPP is understood to be based on an average interest rate of 12 percent per year for a 20 year period. In comparison, the average interest rate in Europe and the United States is understood to be about seven percent per year for ten to fifteen years, causing the overall cost for the project to be higher and therefore the FiT’s to be elevated in comparison to the same projects in Europe or the United States” (Baker, 2015b, p. 151).

Additionally, bidders must raise a bond of R 100 000 per MW bid on top of the R 15 000 required by the DoE for each bid submitted (Baker et al., 2014) bringing the cost to the developer of each bid to about US$ 2 million (Walwyn & Brent, 2014). This cost includes the legal costs required to submit a bid and naturally depends on the size of the project (Walwyn & Brent, 2014). Considering all the barriers and challenges mentioned above, it would seem that the economic barriers would make such renewable energy projects unfeasible, however, Giglmayr, Brent, Gauché, & Fechner, (2015) argue that with the experience that has been gained both technologically and the predictions of plant performance to date denotes that there is less risk for the investor and this puts South Africa in an excellent position to capitalise on the further investments.

To assist the developers to implement the projects and to ensure that the projects proceed, the South African government, in the form of the DoE, has established a subsidy programme for renewable projects and has established the Renewable Energy Finance and Subsidy Office (REFSO). The REFSO has a number of criteria that need to be met in order to release the finance. Some of the criteria include Black Economic Empowerment (BEE) targets (Baker & Wlokas, 2014), the project must be a minimum of one MW in size and a feasibility study must have been completed to establish that the project value is less than R 100 million. The subsidies themselves are laid out as R 500 per kW for projects feeding the grid and therefore the minimum subsidy that is available for such projects would be R 500 000. However, the maximum subsidy available is 20 percent of the project value and therefore R 20 000 000 (Renewable Energy Finance and Subsidy Office, n.d.).

The renewable energy sector has been seen as one of the sectors where there is a potential for job creation (Walwyn & Brent, 2014). Employment has been identified, together with the improvement in the quality of education, as the highest priority of the nine central challenges facing South Africa (National Planning Commission, 2011).

Economic sustainability is linked to renewable energy consumption, employment in the renewable energy sector and capital expenditure on renewable energy projects (Shahbaz, Loganathan, & Zeshan, 2015). It can be said that any form of energy generation will create employment and that the increase in capital expenditure has the potential to create economic growth, but in a study conducted by Inglesi-lotz, (2016, pp 61) revealed that an estimated "one percent increase of renewable energy consumption will increase GDP by 0.105 percent and GDP per capita by 0.100 percent while a one percent increase in the share of renewable energy to the energy mix of the countries will increase GDP by 0.089 percent and GDP per capita by 0.090 percent". While one could conclude that this is a case in which it may not be relevant to all countries and that circumstances may be different, it can be deduced that putting renewable energy policies in place would be beneficial to the environment and there is a high possibility that it would be advantageous to the economy of the country into which it is being introduced.

As with any investment in major infrastructure, energy projects have the potential to uplift communities close to where they are located. Direct jobs are created in the construction phase of the project, the operational phase and indirectly through manufacturing, R&D, financing (Walwyn & Brent, 2014) and in supplying those working at the plant. Increased socio-economic welfare, poverty alleviation, health improvement, better education and empowerment through training are seen as benefits to renewable energy. Communities also benefit from specific policies which have been put in place by policy makers to directly uplift these communities. The RE IPPPP is a prime example of such policies as it is a requirement that each developer first meets the socio-economic development requirements before the bidding price is considered (Baker et al., 2014). The socio-economic requirements include a "minimum of 2.5 percent ownership by communities living within a 50-kilometre radius from the site" (Baker, 2015b, p. 150). This, however, creates expectations of an immediate revenue stream into these communities but dividends only become available long after the project is complete. Such unmet expectations can create frustration and hostility if not managed correctly (Baker, 2015b).

Baker & Wlokas (2014) go as far to say that these unmanaged expectations could, in fact, threaten the viability of the project.

2.4.2. Market

Renewable energy initiatives are largely targeted at rural areas due to their remoteness and the ease at which renewable energy sources are available. Customers in rural areas are generally at the lower income level or are mostly unemployed making it difficult for them to pay for the electricity that they consume especially if said electricity is generated using and more costly renewable energy (Luthra et al., 2015). In 2010, 70 percent of people living within the borders of South Africa had access to electricity. Subsequently, the government has committed to provide access to electricity to 95 percent of people living in South Africa, by 2030 (National Planning Commission, 2010). This poses the question of whether those who do not currently have access would have the means to afford the additional cost of alternative energy considering that the electricity prices are rising above inflation without the effects of renewable energy being implemented. This could cause those members of the population to switch back to more polluting solid fuels for cooking and heating (Henneman et al., 2016). However, with the ever rising costs of the construction of the two new power stations, namely Mudupi and Kusile, and the falling costs of renewable energy due to the competition of renewable energy FiT’s, Walwyn & Brent (2014) argue that wind and solar power generation could become cost neutral by 2017. The industry will have to wait and see whether the costs of all forms of renewable energy will decrease sufficiently to compete directly with the coal-fired power stations in the long term.

Wheeling agreements are also a potential market where power is transmitted back into the national grid by renewable energy sources and a third party off-taker is then able to utilise the electricity. The government has put legislation in place for wheeling to be possible, however, there have been limited cases where it has been implemented (Baker et al., 2015). Municipalities are seen as the major hurdle in wheeling to customers within the municipal district. There have been successes, particularly in the Nelson Mandela Bay district where the municipality aims to provide 10 percent (318 GWh) of the total municipal consumption through privately traded renewable energy (Euston-Brown, Ferry, & Giljova, 2015).

The market in Sub-Saharan Africa has been largely untapped with only approximately

25 percent of the population having access to electricity (Brew-Hammond, 2010) indicating that renewable energy technology would be suitable due to the technology to service a small community or geographical area. Utility scale renewable energy plants could possibly be problematic in countries north of South Africa because of the lack or poor condition of transmission infrastructure (Sebitosi & Okou, 2010).

2.4.3. Awareness and information

One of the factors that renewable energy has been criticised for and has not been able to mitigate is that of baseload capability. Baseload providers are those power plants that provide a constant and predictable supply of electricity (Pfenninger & Keirstead, 2015). Renewable energies such as wind and solar PV are seen as variable power providers due to variable geographical and environmental resources (Luthra et al., 2015). Coal and nuclear are seen as baseload power plants with a capability of providing electricity regardless of the environmental circumstances. Concentrated solar power (CSP) has been seen as the most likely candidate for a renewable energy source that can be utilised as a baseload supplier of electricity. CSP concentrates the sun's rays onto a central column using mirrors arranged around the column. CSP has a limited ability to store energy and still produce electricity in the evening and when clouds shade the mirrors. To overcome this barrier, technology for the storage of thermal energy is under continual development but still not real technology exists to make CSP a baseload power plant (Pfenninger & Keirstead, 2015).

Other forms of storing energy are the use of battery energy storage systems, flywheels, superconducting magnetic energy storage, compressed air energy storage, and pumped storage. However, energy storage remains uneconomical at this stage and with continuous development, may become viable in the near future (Department of Energy, 2015b).

The non-availability of data pertaining to solar radiation and average wind directions and speeds have been cited as one of the barriers to the implementation of renewable energy projects (Luthra et al., 2015), but this has been alleviated over the years by studies undertaken that have made this type of information freely available for South African conditions such as those carried out by the Council for Scientific and Industrial Research (CSIR) (Bofinger, Zimmermann, Gerlach, Bischof-Niemz, & Mushwana, 2016).

2.4.4. Technical

Apartheid and the resulting sanctions forced South Africa to make itself independent of external energy sources. This history brought about technologies such as SASOL's utilisation of coal as a feedstock to produce liquid fuels (Baker et al., 2014) and the establishment of the monopolistic, state-owned Eskom who utilises coal as the primary energy source for the generation of electricity. Coal being abundant and cost effectiveness also stimulated its use and spending of Research and Development (R&D) was encouraged. As can be expected, these organisations have developed significant influence over the years and it is this power that they use to protect their core competencies. Unfortunately, their core competencies are not renewable energy based and thus the bulk of investment into energy R&D has been in the development of innovation in fossil fuels (Pegels, 2010). Most renewable energy technologies are complex and the lack of R&D in this sector makes adoption of renewable energies difficult as large investments are required to catch up to the innovations that have been developed in energy derived from fossil fuels. Similarly, experience and education have also been seen to lag behind in energy generation other than that of fossil fuel power generation (Luthra et al., 2015).

Lack of experience with regards to the implementation of large projects in developing countries is not only associated with the complex technology linked to renewable energy projects but also in the realm of project and contract management (Toor & Ogunlana, 2008) during the construction phase and the maintenance and operations phases (Seetharaman et al., 2016). Additionally, Luthra et al., (2015) argue that such projects are hindered as a result of a lack of experience of the customer and little guidance is provided for them in the decision-making process. A shortage of experienced human capital has been cited as an "obstacle to the future growth of the growing renewable energy industry" (Seetharaman et al., 2016, p. 1371) and will need to be addressed to facilitate the successful growth of the industry in South Africa.

For electricity to be transmitted from the source to the end user, a complex transmission network is required (Wee et al., 2012) demanding high capital commitments that do not produce adequate returns for private sector investment (Eleftheriadis & Anagnostopoulou, 2015). This fossil fuel infrastructure is well established in South Africa, however, renewable energy must be placed where the maximum quantity of the natural resource is located. In the case of Concentrated Solar Power (CSP) and PV, this is in the Northern Cape which is one of the best solar resources in the world but will require investment in infrastructure to transmit the electricity to where the demand is found (Pegels, 2010). Other infrastructure that must be considered in renewable energy projects includes roads and communications (Luthra et al., 2015). Without this vital infrastructure being in place, the projects have the potential for cost overruns and the timelines will be put under heavy strain. Additionally, infrastructure such as the necessary equipment and services for the power company may be lacking in the immediate proximity (Seetharaman et al., 2016) and may create a barrier in the operational and maintenance aspects of the generation of power. As stated in the introduction, the call for the study arises from the need to increase efficiencies of renewable energy projects. To achieve this, the timelines of construction must be reduced, increasing innovation in construction methods, giving the firm a competitive advantage and reducing resources spent on heavy litigation processes (Toor & Ogunlana, 2008).

Having regard to cost overruns, Baloyi & Bekker (2011) argue that material cost, price fluctuations, poor bills of quantity estimates and material take-off, delays in payment, and a shortage of skilled labour are the most significant challenges. Delays in payment are also responsible for time delays together with other hold-ups caused by clients such as design changes, lack of decision-making (Baloyi & Bekker, 2011) and inexperience (Toor & Ogunlana, 2008). Other factors which cause delays include incompetent and inexperienced contractors and suppliers, lack of resources, complex and confusing government regulations and complicated designs. Toor & Ogunlana (2008) argue that an underdeveloped business environment, complexities in the regulatory and legislative environment, and socio-cultural factors also play a role. Procurement practices play a significant role due to bureaucracy, corruption, cultural differences and many levels of administration in developing countries.

It is a requirement that Eskom issue a ‘budget note’ to the IPP for the project to reach financial close. The ‘budget note’ outlines the costs associated with the connection to the national grid. In the recent past, Eskom has been holding back on issuing the ‘budget notes’ citing that the budget has not been approved for any projects beyond bid round three (Baker et al., 2015).

The connection to the national grid has seen delays and challenges specifically once the bidding process has been finalised and the preferred bidders have been announced. It is here that Eskom is required to carry out strategic planning around the required infrastructure and is obligated to issue a budget quotation to the preferred bidder. To carry out the required studies, there are potential delays before a final figure can be issued (World Wide Fund for Nature (WWF), 2014). The full process is shown in detail in Annexure V. The IPP has an option either to self-build or to get Eskom to carry out the grid connection as they are constrained by Eskom's ability to fund the connections and infrastructure (Baker et al., 2015).

2.4.5. Cultural and behavioural

The lack of awareness of the technology associated with renewable energies by both the public and the private sector and in particular by the rural population is regarded as one of the barriers facing the industry (Luthra et al., 2015). Additionally the lack of knowledge of the technology available, the knowledge and experience to manage said technology and the lack of spares and maintenance expertise regarding the technology are regarded as potential challenges (Doukas et al., 2009).

Environmental controversies have also been experienced during the implementation of renewable energy projects. Controversies such as ecological and rehabilitation concerns and the consequential public interest litigations (Luthra et al., 2015) as well as the delays caused by the lack of "capacity to understand , adapt and adopt the technologies for greater benefit" (Luthra et al., 2015, p. 769).

The management of renewable energy plants are complex and if there is a lack of keeping information up to date, making the correct decisions about procurement and maintenance decisions as well as operation decisions, there is a potential of loss of supply, causing contracts to be breached and the plant to lose revenue (Seetharaman et al., 2016).

South Africa finds itself in a unique situation where policies have been put in place to encourage companies implementing renewable energy initiatives to involve the community that is within 50 kilometres of the location in the form of part ownership, employment and profit share (Baker & Wlokas, 2014). This in itself presents many challenges. These challenges are discussed in more detail in section 2.4.1 above.

2.4.6. Environmental

It seems ironic to list the environment as one of the challenges or barriers to the implementation of renewable energy projects as the aim of renewable energy is to protect the environment. There are however a number of negative impacts on the environment that need to be considered such as materials that are used in the industry that when discarded, can harm the environment and cause health risks (Seetharaman et al., 2016). Other challenges include the altering of the local eco-system weather conditions and impact on the local communities (Wee et al., 2012) with regard to hydroelectric plants. However (Luthra et al., 2015) argues that "associated ecological and environmental problems with a dam can be solved easily with proper afforestation, and the social problems can be addressed by sensitive, democratic and participatory rehabilitation policies." Regarding wind energy infrastructure, challenges in the form of changes to the landscape, soil erosion, reduced air circulation (Wee et al., 2012) and the effect on birds and bats that inhabit the area need to be considered (Huso, Dalthorp, Miller, & Bruns, 2016). Wind turbines need to be situated in appropriate locations in order to minimise the effect on the local wildlife particularly large raptors and vulture species. Most of the casualties occur when the bat and birds collide with the spinning blades of the turbines. This puts pressure on those companies intending to implement a wind farm project to ensure that the planned location of the wind farm has been thoroughly investigated and that all necessary studies have been carried out to mitigate the impact on the environment (Reid, Kruger, Whitfield, & Amar, 2015).

Wind turbines can also be detrimental to the health of the human population living in the vicinity of wind farms. Noise emissions from wind turbines caused sleep deprivation and impaired mental as well as physical health of those living nearby (Nissenbaum, Aramini, & Hanning, 2012).

Landscape change, soil erosion, reduced solar irradiation for plants and vegetation, habitat loss (Wee et al., 2012), excessive water consumption and the use of hazardous materials in manufacturing (Luthra et al., 2015) have been cited as barriers to the implementation of solar energy projects.

2.4.7. Political and regulatory landscape

The proper design of policies is vital for the promotion of the renewable energy sector.

Ben Jebli & Ben Youssef (2015) suggest that such policies will also increase international trade, encourage economic growth and exchanges, and encourage technology transfer but South Africa is lagging behind the Organisation for Economic Co-operation and Development (OECD) developing countries in renewable energy supply development (measured from 2001 to 2010) which suggests that South Africa requires “appropriate policies” to promote the industry (Nakumuryango & Inglesi-Lotz, 2016, p. 1003).

Policies that are directly applicable to the renewable energy sector are the White Paper on Renewable Energy, The National Environmental Air Quality Act, the Long-Term Mitigation Strategy (LTMS) report, the Integrated Resource Plan (IRP2010), the National Climate Response White Paper and the revised Integrated Resource Plan (IRP2013) published in 2013. Within the LTMS, carbon tax was proposed to reduce carbon dioxide emissions. This was meant to come into effective in 2015, but according to the draft bill, it will only become effective in January 2017 (“The proposed South African carbon tax,” n.d.). To make matters worse, there have been delays in finalising the policies mentioned above including the target set by the White Paper on Renewable Energy of 10 000 GWh to be generated by renewable energy sources by 2013 (Giglmayr et al., 2015).

The IRP was meant to be a subset of the Integrated Energy Plan that was intended to be released in 2012 but never materialised (Baker et al., 2015). As mention in the introduction, it was the DoE’s intention that the IRP would be updated every three years, but after the first update released in 2013, no further updates have been issued (Pfenninger & Keirstead, 2015).

Although lack of political commitment has been revealed as a highly ranked barrier in other countries (Luthra et al., 2015), the South African government and the DoE have shown that they are committed to climate change mitigations and the promoting the generation of electricity from all forms of energy, (South African Energy Department, 2013) in order to grow the economy. Contrary to this, there has been some suspicion regarding the secrecy behind the RE IPPPP. This has raised some concern over parties gaining from such initiatives who do not contribute to the value of the initiative (Baker et al., 2014), suggesting that there may be another wave of corruption and individuals who gain profit by winning government tenders. These individuals are known as “tenderpreneurs” in South Africa (de Kadt & Simkins, 2013).

The DoE's IRP2010 is a master plan for the national electricity generation mix. It aims to double the national electricity capacity from 2011 to 2030. This includes over 16 000 MW of new coal generation that will be introduced and in so doing increase the amount of GHG emissions and the electricity prices. The IRP2010 was negotiated by a technical 'advisory group' that provided inputs into the modelling process. This 'advisory group' comprised of representatives from the Energy Intensive User Group of Southern Africa (EIUG), Eskom and government. The EIUG consist of 36 members including coal producers and South Africa's largest consumers of electricity (Baker et al., 2014). These members, who hold a great deal of power in South Africa, have been admitted to form the basis of the committee to put such a plan in place. It is ironic that those who are most likely to be against the renewable energy industry are making decisions regarding the future of energy in South Africa.

2.5. Skills and skills transfer

Seetharaman et al., (2016) imply that skills transfer in the renewable energy sector are lacking globally and that there is a requirement for more knowledge and information sharing with regards to renewable energy technologies particularly in Africa where there is a high potential to tap into the natural resources available (Oirere, 2016). Training has also been cited as being inadequate, particularly pertaining to management skills and those who have the leadership skills to implement such projects (Luthra et al., 2015). There is a great need for skilled employees but there is a lack of availability of human capital as indicated in Table 2.4 below. The table shows the global requirements for human capital and skilled workers in the renewable energy technologies that have dominated the renewable energy landscape in South Africa.

Table 2.4: Requirements for skilled workers

Technology	Global (no. of employees)	Key regions (no. of employees)
Wind Power	± 630 000	China 150 000 / Germany 100 000 / USA 85 000 / Spain 40 000 / Italy 28 000 / Denmark 24 000 / Brazil 14 000 / India 10 000
Solar PV	± 350 000	China 120 000 / Germany 120 000 / Japan 26 000 / USA 17 000 / Spain 14 000
Hydropower		Europe 20 000 / USA 8 000 / Spain 7 000
Solar Thermal Power	± 15 000	USA 1 000 / Spain 1 000

Source: Seetharaman et al., 2016

South Africa has come a long way in the transfer of skills at the EPCM level with most of the international companies subcontracting to local companies in rounds one to three. However, in the latter rounds of the RE IPPPP, it is expected that the said sub-contractors will act as the sole contractor on the renewable energy contracts. This too could mean that the cost of the projects will come down and again become more competitive (Baker & Wlokas, 2014).

There are a number of institutions that provide short courses in renewable energy, but there are very few that provide degrees or postgraduate diplomas specifically in the field of renewable energies. The University of Stellenbosch has established the Centre for Renewable and Sustainable Energy Studies (CRSES) which is the central point of entry for the field of renewable energy into the university. CRSES offers postgraduate programmes in renewable and sustainable energy studies consisting of masters and doctoral programmes as well as a postgraduate diploma in engineering in renewable and sustainable energy (Department of Energy, 2015b).

2.6. Conclusion

The renewable energy sector is fraught with barriers and challenges, not only in South Africa but also throughout the world. South Africa has its own unique challenges due to the complex past which needs to be considered when dealing with various stakeholders. The review of the literature emphasises these barriers and challenges faced by companies aspiring to be a part of this exciting and highly technologically advanced industry. Skills throughout the world have been seen to be lacking in the industry and therefore policies and legislation must be put into place to encourage the skills development.

The South African government and the industry stakeholders including the EIUG have a positive outlook on the industry but there are some stakeholders that have something to lose, namely SASOL and Eskom. It is evident that Eskom has the most to lose, being a supplier and a purchaser of electricity. This places Eskom in both a powerful and a vulnerable position as they have the power to refuse to submit grid connection letters to the IPP's and are also vulnerable because of the fact that the business is being eroded by the smaller IPP's. SASOL finds itself in a situation where the energy being produced requires none of its products including natural gas, methane-rich gas and liquid fuels that they produce. Having said that, SASOL has the advantage of being able to supply the gas required for the BLIPPPP, with the first announcements of preferred bidders expected in 2016.

The literature review, other than Seetharaman et al. (2016), contains very few references to internal forces in the firm as being barriers to implementation of renewable energy projects. The two exceptions are that of skills and skills transfer, and the ability for a company to finance projects off their balance sheets. Both of which provides a company with a sustainable competitive advantage over firms that are not in possession of either human capital or large and healthy balance sheets.

The uncertainty that is associated with government policies and the uncertainty of what Eskom will do next is probably the biggest barrier to entering the industry. Develops may find it difficult to find investors willing to enter into such an environment where Eskom seems to be unpredictable and there is no clear plan pertaining to the next rounds of the RE IPPPP including the amount of electricity per technology and the timeframes that can be expected.

3. CHAPTER 3: RESEARCH QUESTIONS

3.1. Introduction

With the DoE intending to roll-out the fifth wave of REIPPPP RFP's in 2016/17 and potential additional waves thereafter, are potential bidders cognitive of the various challenges faced in the renewable energy environment in South Africa? It is imperative that efficiency of the process be enhanced and therefore aid industry with lower electricity prices and in so doing aiding the economy which is facing a rating downgrade during the course of 2016 or in early 2017 (Cohen & Yoo, 2016)

3.2. Purpose of the study

The purpose of the study is to acquire an understanding of the future prospects of renewable energy projects in South Africa and recognising that there are a number of potential barriers that are unique to the South African renewable energy environment. It is the study's intention to investigate the barriers from EPCM companies' perspective and to create a framework to assist these companies during future RE IPPPP RFP's.

3.3. Research questions

For a conclusion to be reached in answering the broader question of this research, exploration of the following questions will be conducted.

3.3.1. Research Question 1

What barriers or challenges are faced during the planning, engineering, procurement, and construction of renewable energy projects?

3.3.2. Research Question 2

Are internal or external factors more of a challenge when implementing renewable energy projects?

3.3.3. Research Question 3:

Are there sufficient skills available in South Africa to design, construct and operate renewable energy projects?

3.3.4. Research Question 4:

What future opportunities have been identified for EPCM companies in the renewable energy sector in South Africa?

3.4. Research objectives

3.4.1. Primary objective

The primary objective of this study is to determine the potential barriers to the implementation of renewable energy projects within the South African context from the point of view of the organisations implementing the projects and to develop a framework to assist the bidders during future bidding rounds.

3.4.2. Secondary objectives

To achieve the desired primary objective, secondary objectives were established. The secondary objectives are:

- to critically review the literature relating to barriers experienced in the renewable energy sector and to determine whether said barriers are relevant in the current South African environment;
- to determine whether internal or external forces are responsible for impediments experienced in the renewable energy sector in South Africa;
- to obtain a better understanding of the skills available in the renewable energy sector in South Africa.

3.4.3. Empirical objectives

To achieve the desired primary objective, empirical objectives needed to be established. The empirical objectives are:

- to explore the barriers and challenges existing in the renewable energy sector in South Africa;
- to evaluate which factors that were most significant to the respondents;
- to develop a framework that would assist EPCM companies who intend to bid on future RE IPPPP projects.

4. CHAPTER 4 - RESEARCH METHODOLOGY AND DESIGN

4.1. Introduction

This chapter aims to explain the research design employed by the researcher to gather the data necessary to derive a conclusive result and to answer the research questions posed. It also outlines the sampling process, the gathering of the information and the analysis of the data employed.

4.2. Research design

A large gap in time exists between South Africa's first installations of renewable energy in the 1970's and 1980's and the new wave of Independent Power Producer (IPP) installations that have been commissioned during the first decade of the 21st century. During this time, there has been a growing need for additional power and South Africa has gone through a major political transformation. With a change in the political regime comes new cultures and ideas regarding the way in which projects are funded, awarded and implemented. Being cognitive of this it was deemed necessary to do exploratory research as "it is about discovering general information about a topic that is not understood clearly by the researcher" (Saunders & Lewis 2012).

A pragmatic philosophy was utilised in this research as an understanding of the renewable energy environment from the perspective of individuals and their response towards one another as well as how the individual perceives the environment that they find themselves in and interprets the environment from their point of view. A pragmatic philosophy is a research philosophy that suggests that the researcher is to be guided by what is possible and therefore a combination of philosophies can be adopted. In this case, it is interpretivism and critical realism (Saunders & Lewis, 2012) which has been identified as being possible and by using a pluralistic approach, knowledge was derived extracting the experiences and viewpoints of multiple participants operating in similar environments (Cresswell, 2014).

Smith & Bowers-Brown, (2010) describe qualitative research as looking in depth at the information involved in a situation. Therefore qualitative research was chosen to enable in-depth analysis of the responses from semi-structured interviews containing open-ended questions.

As the author has limited knowledge of the renewable energy sector in South Africa, the development of the theory will take place as a result of analysing the data after it is collected. Saunders & Lewis, (2012) define this research approach as induction. An inductive research approach suggests that a variety of experiences across the full range of renewable energy types as well as differing positions of the interviewee with respect to the project is required.

4.3. Research methodology

4.3.1. Sampling

Saunders & Lewis, (2012) suggest that non-probability sampling are sampling techniques that are used for selecting a sample when one does not have a complete list of the population. The author's judgement was used to obtain the correct types of samples to get the best results. This is defined by Saunders & Lewis, (2012) as a purposive sampling technique. Although the names of the firms involved in the RE IPPPP bidding process one to 4.5 are publically available, the names of those individuals who were involved in the projects may not necessarily be available and therefore the samples were obtained by using a combination of convenience and referrals from those who have been contacted or snowball sampling (Saunders & Lewis, 2012).

4.3.2. Population

This research was aimed to obtain a deeper understanding of the factors that influence the implementation of renewable energy projects from the perspective of those who were involved in the implementation of such projects within the South African environment. The universe for this study, therefore, consist of individuals who have experience in the renewable energy sector within the South African context and those who are currently involved in the implementation of said projects.

The interviewees consisted of CEO's, technical directors, engineers, consultants and associates of EPCM companies who have been involved in bid rounds one to four extended of the RE IPPPP using the conceptual frameworks for sustainable energy landscapes (Stremke, 2015) and the Energy architecture (World Economic Forum, 2012) as a basis to draw out common trends in the industry as to how they perceive or have experienced the challenges related to such projects in a South African context.

Table 4.1 below lists the respondents indicating each respondent's experience and positions that they hold in the firms that they currently work for or in which they worked in which they were involved in renewable energy projects. The final column indicates their current involvement in the RE IPPPP programme.

Table 4.1: Overview of the respondents

Respondent	**Roles and Responsibilities in RE IPPPP**	**Current involvement in RE IPPPP**
Respondent 1:	Electrical Engineer of a large EPCM company who has had experience in the RE IPPP programme from the first bid round primarily in the Solar PV space.	High
Respondent 2:	Sales Associate responsible for the wheeling of RE IPPPP projects from the source to the end user and municipalities for redistribution to the end users as well as embedded power from the supplier to the end user and on selling to the municipalities.	Involvement with wheeling of RE IPPPP power and embedded power
Respondent 3:	CEO of an organisation who has had experience in the renewable energy implementation from the first round of the RE IPPPP programme primarily in the Solar PV and Wind Turbine space.	High
Respondent 4:	Business and Investment Adviser in the renewable energy environment currently employed by an international EPCM organisation which has advised and carried out the engineering phases of projects for the investor companies primarily in the hydroelectric space.	High
Respondent 5:	Engineering Director with experience in the implementation of renewable projects during bid rounds one and two of the RE IPPPP.	No longer involved
Respondent 6:	Technical Director of a consultancy company focused on the execution of renewable energy projects.	Involvement in the implementation of renewable energy projects for the wheeling of power
Respondent 7:	Divisional General Manager of an EPC contractor of green initiatives and renewable energy.	High
Respondent 8:	CEO of a leading Solar System Integrator and has extensive experience in the RE IPPPP programme in particular phase one and two Solar and Wind Projects.	Involved in the embedded power space

Respondent 9:	Managing Director & Civil Engineer of a consulting firm specialising in the renewable energy sector. Experience in mostly PV projects from round one of the RE IPPPP, specifically in the funding and implementation of projects.	High
Respondent 10:	Manager of commercial EPC operations of a South African based renewable energy implementation organisations. Has experience in wind and PV projects with current organisation and previous organisations.	High
Respondent 11:	Electrical Engineer for an international developer who has been involved in the RE IPPPP programmes from round one and have been successful bidders in all four rounds including the extended round. Additionally, the respondent was previously employed by Eskom in the department which evaluated and approved the grid connections for renewable energy projects.	High

Source: Author's own

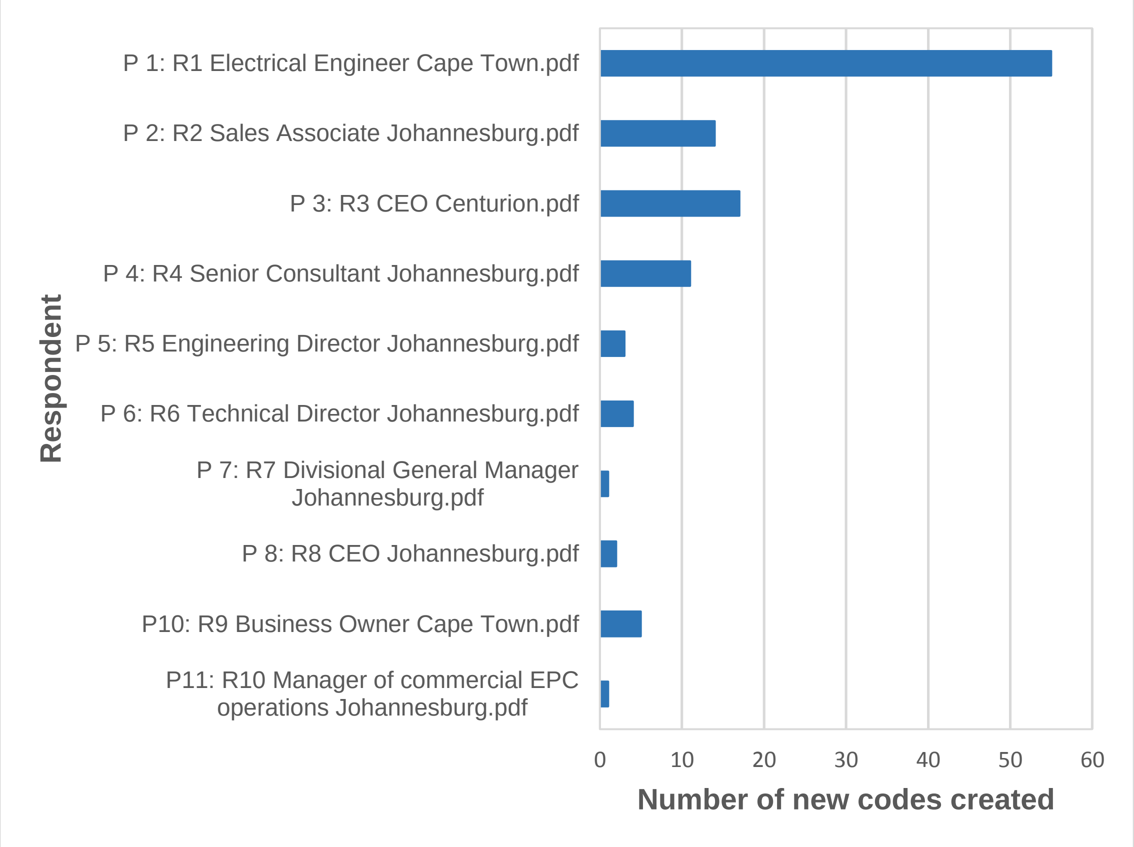
4.3.3. Sampling size

Cresswell (2014) argues that the "idea of saturation comes from grounded theory". (p. 211) and that data is collected until the themes are saturated. Saunders & Lewis, (2012) refer to this stage of semi-structured sampling strategy as data saturation.

In order to achieve data saturation, semi-structured interviews were performed and it was the author's intention to conduct interviews until additional data collection provides little or no additional insights into the research objectives. The exact quantity of interviews could not be predicted before the interview process had run its course, but it became evident after ten interviews that the same themes had been repeated several times and that no new themes were being discussed. However, in order to ensure that no additional themes would emerge, a further interview was conducted. As no further themes had emerged, it was determined that saturation point had been reached. Figure 4.1 illustrates the number of new codes that were added when coding each of the interviewee's transcripts in order of interviews conducted and coding of the transcripts and a distinct downward trend can be observed.

During the initial interview a total of 55 codes emerged and as can be observed, this decreased significantly during the second interview. As the interviews progressed, the specialists in their fields revealed unique codes, however, as the saturation point came closer, the code generation diminished and during the final interview (not shown) the code generation diminished to zero.

Figure 4.1: Code Saturation



Source: Author's own

4.4. Data collection

Interview questions were compiled using a number of sources as frameworks to create themes and ideas so that respondents were guided through a conversation using open-ended questions. This type of data gathering is referred to as semi-structured, in-depth interviews. Saunders & Lewis (2012) argues that semi-structured, in-depth interviews are used to give the interviewer the ability to cover certain themes during the interview and to be able to ask additional questions or delve deeper into certain aspects where appropriate and to seek "deep" information and knowledge (Johnson & Rowlands, 2012). The semi-structured interview plan is shown in Appendix I in section 9.1.

All interviews were face to face conversations where possible but where this was not possible Skype^{TM} interviews were utilised. As Skype^{TM} interviews allow for interviews to be carried out remotely, there was no limitation to the geographic locations of the potential interviewees and as such two interviews were conducted using Skype^{TM} and were recorded using a Skype^{TM} recording application.

It was found that the access to individuals was more challenging than expected and that the use of the author's contacts was paramount in securing initial interviews. Cold calling companies that fitted the target organisations were also used and at first it proved challenging to get past the gatekeepers and in several cases, the gatekeepers were effective enough that access to the required participants was never gained. However, in a number of cases gatekeepers did not prove to be a barrier at all in accessing the required respondent and several interviews were arranged in speaking directly to the desired respondent. Once these avenues had been exhausted, referrals from respondents, or snowballing, was utilised to obtain access to further respondents. Fortunately, the quality of all respondents was exceptional and therefore could be used to gather sufficient quality of data to complete the study.

4.5. Unit of analysis

The unit of analysis utilised in the study was the experience and perceptions of those who have been involved in the implementation of renewable energy projects, specifically in the RE IPPPP programme thus far. Although themes and open-ended questions were employed, occasionally direct questions needed to be asked in order to get the conversation directed to cover a particular theme. Once the conversation was directed onto a particular theme, the respondent was allowed to give his opinions regarding that theme and was not led in any way. Further questioning was then utilised to delve deeper into the respondent's opinion and experiences relating to the particular theme being covered.

4.6. Data analysis

Recordings were then transcribed and the transcripts were analysed by examining the contents and using Atlas.ti7 specialist qualitative data analysis software to identify themes. As the research is inductive by design, codes were created as the themes were identified whilst reading through the transcripts (Thorpe & Holt, 2008). The codes were then reviewed to ensure that there were no duplications of themes and an additional review of the content to further simplify the coding. The transcripts were read through a further two times adding new codes and simplifying the codes so that more clarity could be obtained when carrying out the data analysis and to limit ambiguity. The rationalisation of the codes is shown in Appendix IV. Codes were created to identify whether the themes were positive or negative, in the past or in the future and to understand future opportunities. The codes are listed in table 4.2 below.

Table 4.2: Codes used for theme context

Code	
Positive	Positive theme from the perspective of the implementer
Negative	Negative theme from the perspective of the implementer
Future recommendations	Recommended themes for improvement of the industry
Past	Themes occurring in the past
Present	Themes occurring in the future
New opportunities	Themes identified as future opportunities

Source: Author's own

These codes were then grouped using Atlas.ti's query tool to ascertain the respondent's tendency towards whether this occurred only in the past or is a current barrier and whether there has been an improvement or a decline in the aspect that was mentioned. Themes were extracted from the transcripts and coded according. In addition, all relevant keywords identified as being relevant to a particular theme were also analysed using Atlas.ti7's Word Cruncher, word Count Table and themes were then exposed. Atlas.ti7 allows "researchers to uncover and systematically analyse complex phenomena hidden in unstructured data" (Lewins & Silver, 2007). General themes pertaining to barriers and challenges were extracted and interpreted accordingly and associations made between the codes and families to get a better understanding of the environment.

To answer the third research question regarding whether there are sufficient skills available within South Africa to carry out renewable energy projects, thematic analysis was utilised where themes within and across participants or events were identified and express meanings, patterns and stances were extracted (Brenner, 2008). Using Atlas.ti, codes were created to represent varying skills that emerged during the coding analysis process by reading the transcripts several times. The themes that were identified were then grouped into sub-themes to make the process more manageable. A table (Table

5.2) was then drawn up indicating the themes and the sub-themes emanating from the respondents' narrative.

Using the results of this analysis, a list of dominant challenges were compiled with a weighting for each, allowing further interpretation and the compilation of a framework to assist in further research and to assist the EPCM bid committees to ensure that all aspects of the bid are considered.

4.7. Research Ethics

All respondents were requested to sign a consent letter as shown in Appendix II. The letter explained the reason for the interview, the subject of the research being covered, stated that the interview was voluntary and that the respondent could end the interview at any time without penalty. The letter also guaranteed the anonymity of the respondent. As anonymity was guaranteed, the respondents are referred to as numbers rather than names. All of the above was all explained prior to the interviews being recorded, however, some of the respondents mentioned the organisations that they represent and in some cases mentioned their own names during the interview. Their names and the names of the organisations which they represent were deliberately excluded from the transcripts and are not mentioned in this research report. The fact that the interviews would be recorded was explained to each respondent before commencing. All respondents agreed to have the interviews recorded.

4.8. Research Results

The results from the data analysis contained a vast amount of information that was useful in compiling a framework to assist future bidders of the RE IPPPP programmes when entering the industry and the bid process for the first time. The framework is potentially useful to those who have trading licences to sell electricity back onto the grid as well as those who are involved in the implementation of embedded power projects.

4.9. Research limitations

Due to the title of the research the respondents tendered towards the negative aspects of the industry. Although impediments were being sought from the research, positive aspects were emphasised by all the respondents.

The snowballing and convenience sampling methods may have introduced bias as the respondents were most likely acquaintances who had worked on projects together and had experienced similar barriers and challenges. This was mitigated to a certain extent by having access to various groups from different sources who did not know one another.

Some of the participants are no longer involved in the RE IPPPP programme and have either moved out of the renewable energy industry completely or have decided to continue in the industry but rather to concentrate on embedded power.

Skype™ calls made it difficult to gauge the respondent's body language and expressions which did not allow for subjectivity regarding mood and emotions.

The research design, particularly for the third research question, has limitations as the degree of emergence or interpretation of the themes may vary from one set of respondents to another (Brenner, 2008)

5. CHAPTER 5: RESEARCH RESULTS

5.1. Introduction

This chapter analyses the results obtained from the data collected from the interviews conducted and presents the analysed of the data. The chapter further discusses each of the research questions posed in Chapter 3 above and the roles of each of the respondents to validate their credibility pertaining to the research objectives. Finally, the chapter discusses overall themes that were observed during the interview process and during data analysis.

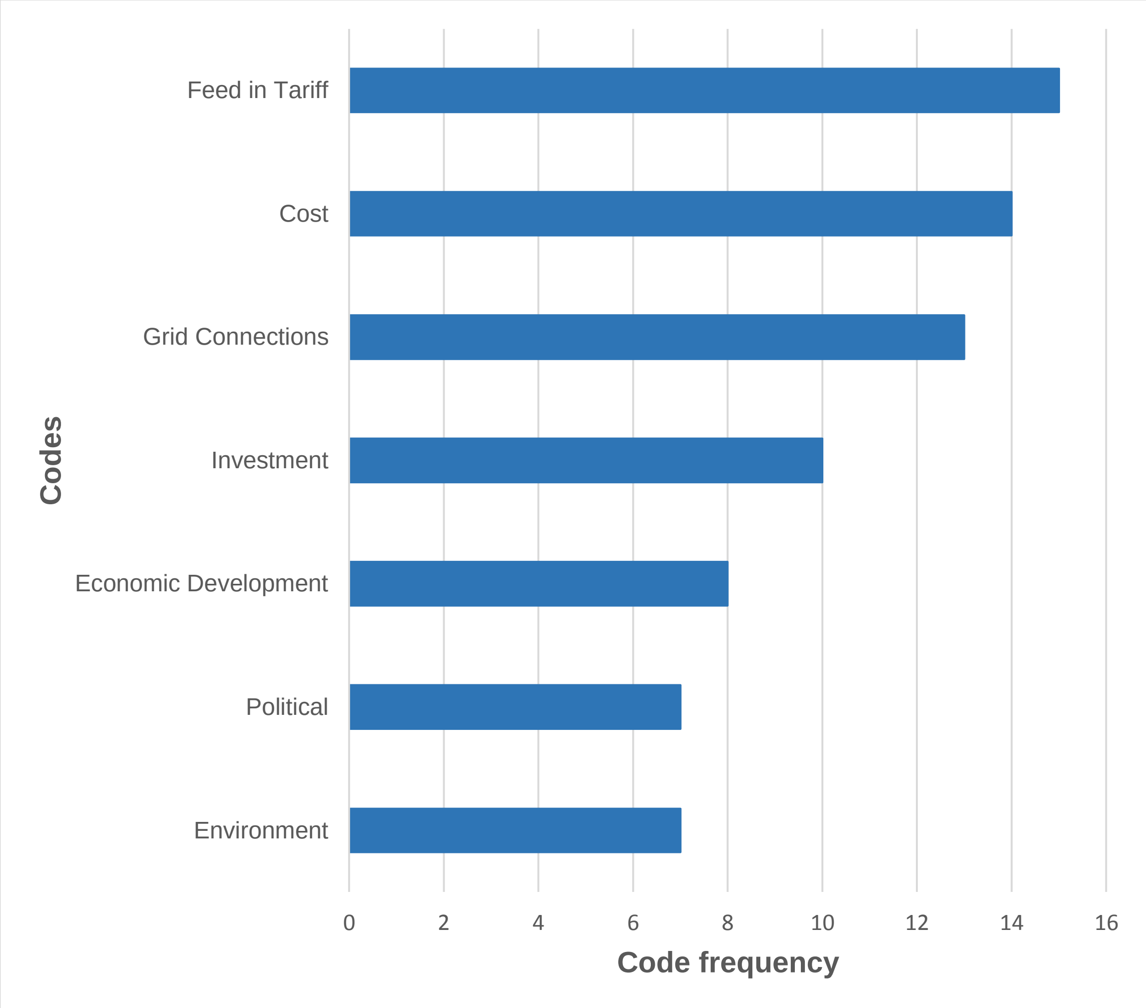
5.2. Research question 1

What barriers or challenges are faced during the planning, engineering, procurement, and construction of renewable energy projects?

Several factors whether positive or negative were observed when respondents were questioned regarding the implementation of renewable energy projects and further when coding the interviews were undertaken. In order to ascertain whether these factors were seen as barriers or negative factors an “and” analysis using Atlas.ti quantitative software was carried out combining the barrier code, the “negative” code and the “present” code identifying it as a barrier that is currently being experienced. A total of 54 potential negative codes were identified. To ascertain the most prevalent barriers, an analysis of the codes using Atlas.ti’s Query tool to identify those barriers mentioned most frequently.

The initial analysis determined the frequency of each of the barriers or challenges identified during the analysis of the interviews. Figure 5.1 below shows that of the 54 barriers, seven were mentioned more than seven times each by the respondents.

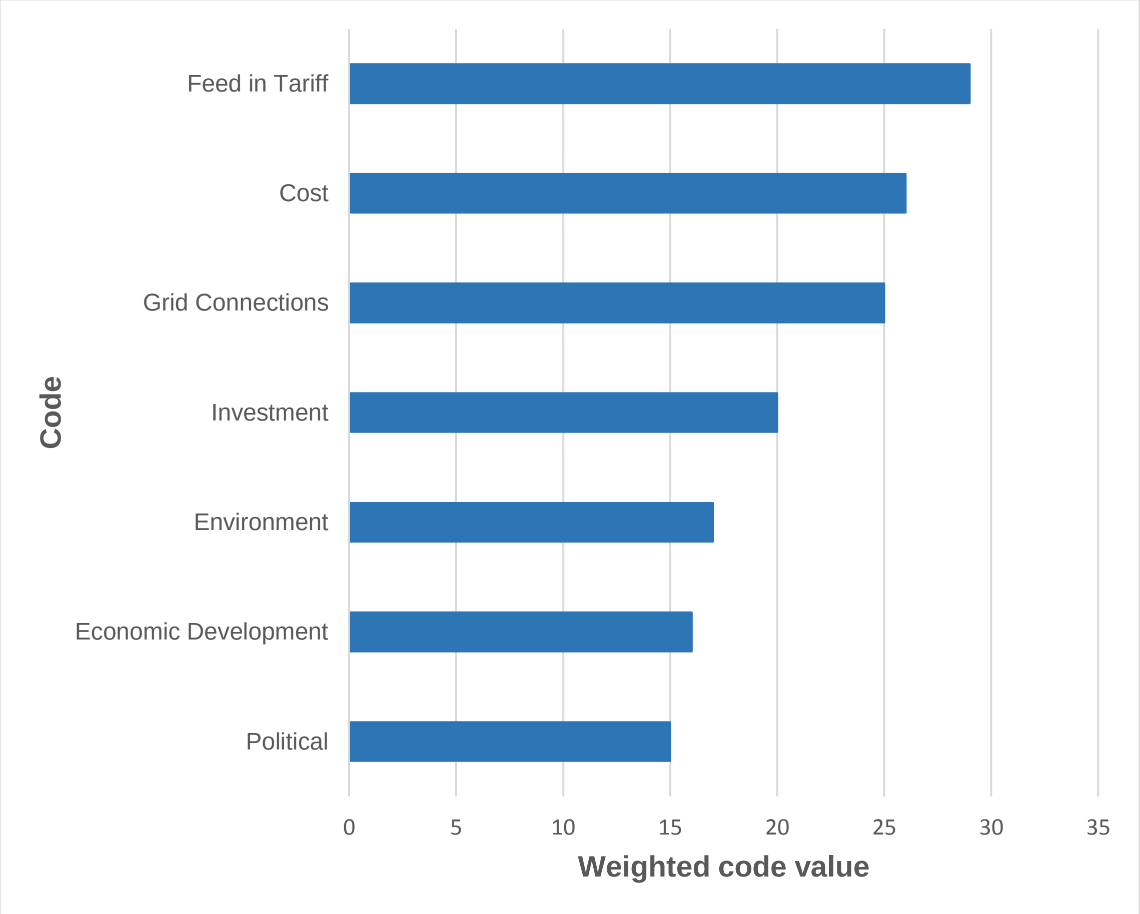
Figure 5.1: Code frequency results



Source: Author's own

To understand whether these barriers and challenges were isolated to the experience of one or more of respondents, it was decided that a weighted method would be utilised. As the number of respondents that mentioned a particular barrier indicates that the barrier is considered to be common in the industry, the number of respondents mentioning the particular barrier was weighted by a factor of two. However, the number of times that this barrier was mentioned needs to also carry a weighting as a particular respondent may have significant experience or be a specialist in a particular area and therefore this barrier must also to be considered. The number of times a particular barrier was mentioned carries a weighting of one. The factors having a weighted result of above 10 are illustrated in Figure 5.2 below.

Figure 5.2: Weighted results of code frequency



Source: Author's own

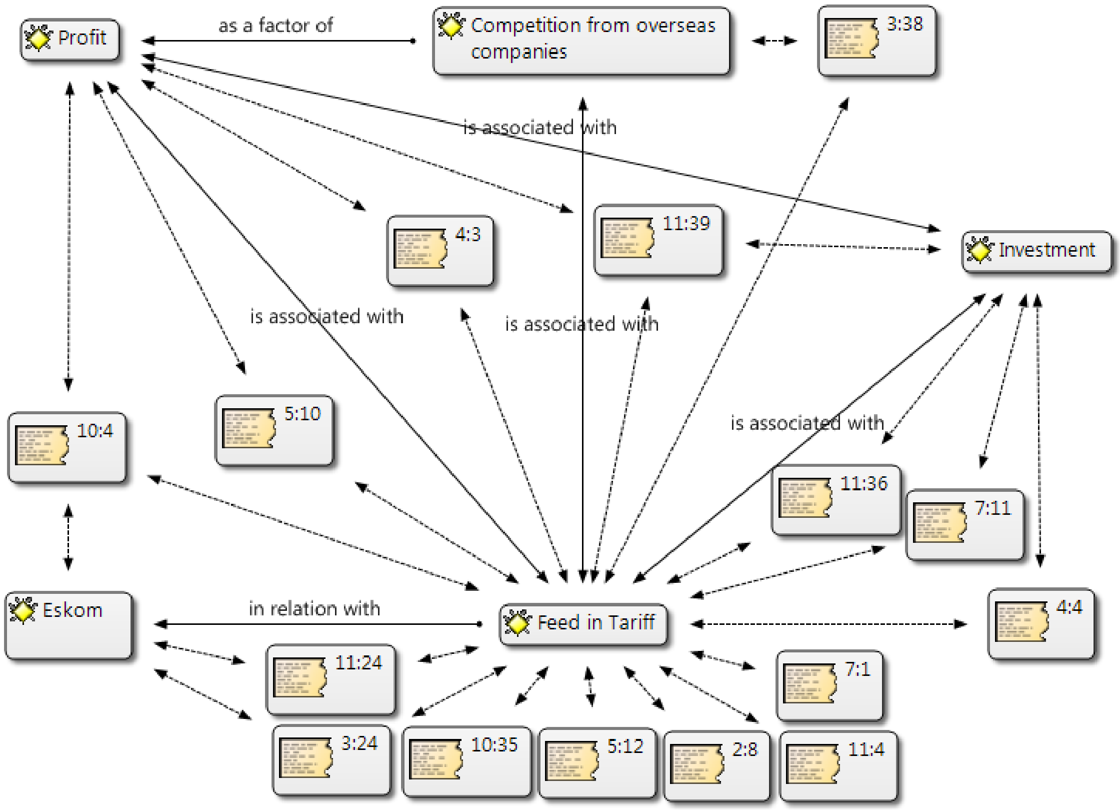
As can be seen, the weighting of the factors did not have much of an impact on the results showing that Political Influences, FiT's, Grid Connections, Costs and Investment remained the top four factors. The other factors remained identical, however, the order in which they appear differed.

To further ascertain the connections between the codes, the said codes shown in Figure 5.1 were analysed using Atlas.ti qualitative software co-occurrence tool with all the codes but excluding those mentioned in Figure 4.2. This resulted in a cross-reference of the codes to give a much richer understanding of associations and therefore the most relevant barriers could be extracted. The strong associations are explained in the sections that follow. In the network diagrams shown in the sections that follow, codes "negative" and "present" have been omitted for clarity, but all quotes have these codes factored into the relationships.

5.2.1. Feed-in-Tariffs

FiT's are the prices that the IPP's are paid by Eskom for the electricity that they produce (Department of Energy, 2015b). The analysis shows that barriers related to FiT's are associated with the company's profit, investment into the renewable energy projects, Eskom and competition from foreign companies. Figure 5.3 shows the network diagram of these associations together with the quotes where Feed-in Tariffs have been mentioned together with the above factors.

Figure 5.3: Feed-in-Tariff network diagram



Respondents express their concern with the potential difficulty being experienced in investment and funding of the renewable energy projects as the competition increases and the tariffs continue to fall. Respondent four explained this very well when he said:

> "one would expect that lending would improve as the lenders get more comfort but that is also not necessarily happening at the moment as the projects are being bid so competitively it actually increases the risk. The margins are so tight and the lenders won't go below the 10 to 11percent they were hoping for. The finance is mainly done locally so the interest rate is pretty high. Everybody's expectation

> is that it would still go down as the comfort levels improve but that is not really happening." (R4)

Respondent ten had a similar opinion regarding the continuous decrease in the FiT's going forward and is also concerned for companies entering the next round.

> "Where we see the tariff in the next round when they announce the expedited round they will be even lower. I don't see how some of the companies if they win the bid at those prices, can make any money." (R10)

Respondent ten puts it a little stronger regarding the risk of investors, explaining that

> "The IRR are getting really tight to the point where we are seeing your equity returns on some of the projects will need to be fairly close to what you are paying on your debt so investors can probably make a better return if they put the money in the bank and not take the risk." (R10)

With respondent five corroborating the above views and indicating that

> "If you look at where the tariffs are now I don't know who is making any money out of it." (R5)

Respondent nine explains that in the first few rounds, companies were making good profits out of the RE IPPPP, but as a result of the decrease in FIT's

> "Some companies say they are not submitting proposals anymore because it is not feasible." (R9)

Regarding the connection between FiT's and the financing of said projects by local companies, respondent three is of the opinion that as the

> "tariffs become so low in subsequent rounds that companies with a higher cost of capital can just not compete. That is typically companies with South African balance sheets. Our cost of capital is due to typical equity returns that we need in the country and the cost of debt is high". (R3)

Eskom is both a competitor and the entity procuring the majority of the power from the IPP's in the RE IPPPP programme implying that there is a heavy conflict of interest and subsequently driving the FiT's lower. Respondent nine confirms that

> "Eskom now has a competitor in the IPP industry". (R9)

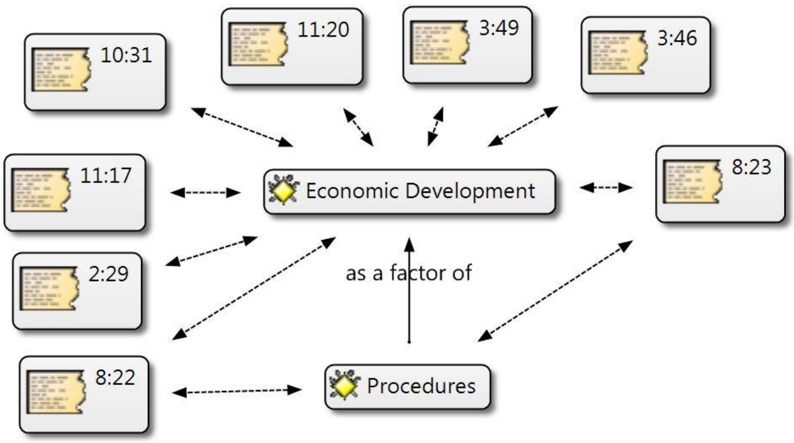
He implies that as a result

> "they [Eskom] can compensate by paying IPPs 65c/kWh for power to inject into the grid. 65c is not feasible. It was not feasible 3 years ago. We still don't do projects now. If a project is below R1 it is still not feasible and not entertained by most investors and ourselves." (R9)

5.2.2. Economic development

Economic development is a factor that is heavily weighted within the bidding process of the RE IPPPP requiring that the communities within a 50 km radius of the project benefit from the establishment of the project (Baker et al., 2014). The data shows that economic development is associated with the procedures that are followed during the bidding, construction and operations of the plants and that barriers exist between these factors. These associations are illustrated in the network diagram in Figure 5.4 below.

Figure 5.4: Economic Development network diagram



The economic development component of the bidding and implementation of the RE IPPPP is generally seen as positive and although it costs time and money, it must be considered during the bidding process, however,

> "this is one part of the processes that is least understood (R8).

Respondent eight goes on to say that

> "community involvement is important but was not properly designed" (R8)

and that

> "there needs to be a better way of doing it". (R8)

Respondent ten suggested that

> "you have to balance the community expectation with the fact that they don't have any money to inject into your project anyway. That has been one area of concern" (R10)

Other expectations also need to be managed as

> "the real cash flows only start in years five, six or seven. It is important to try and strike a balance in creating hope up front without creating too much expectation." (R3)

Respondent ten corroborates suggesting that

> "actual hard cash starts flowing to the communities, say, from year 13 to 14 when your senior debt is paid off. If you don't handle that up front you can land yourself in a situation where you give false impressions and people start wondering why they don't see cash earlier" (R10).

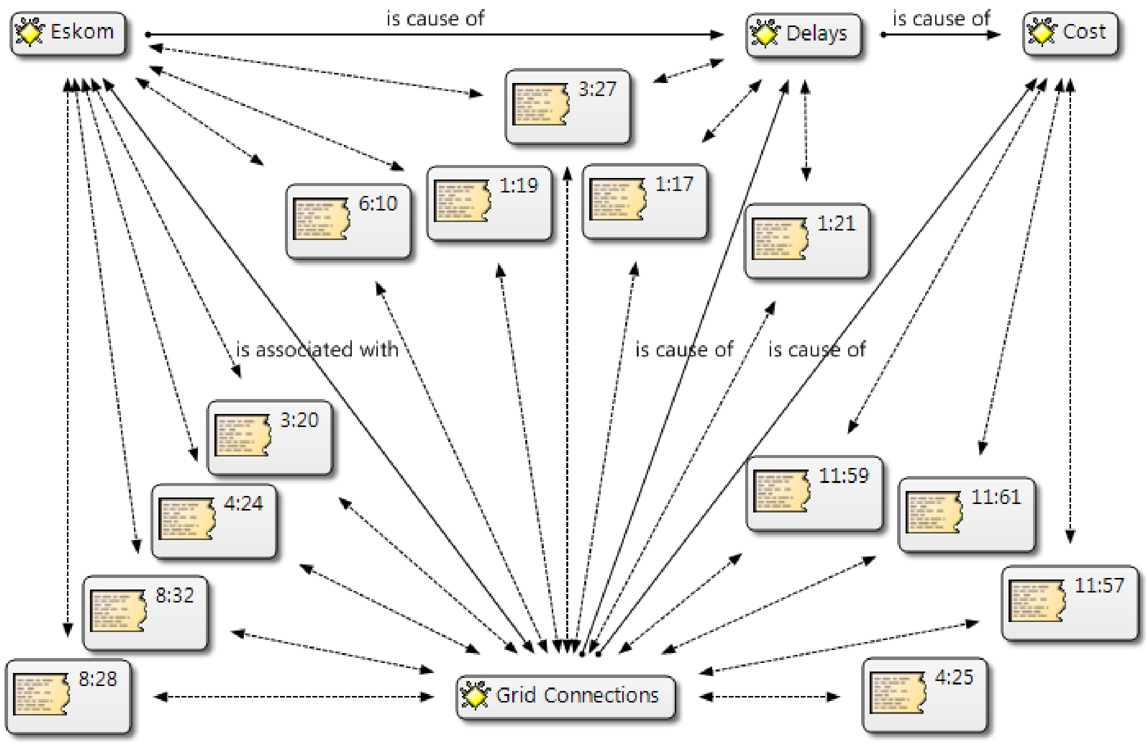
It has also been implied that the process of economic development implementation has been abided by the local developers, but largely ignored by foreign developers. Respondent five suggests that the Europeans were

> "getting truckloads of Filipinos in and getting equipment from everywhere and they came in with low prices and pushed some of the South African companies out. That whole thing was not handled properly". (R5)

5.2.3. Grid connections

It is a requirement that renewable energy projects are connected to the national grid once the construction phase has been completed. Said connections require the input from Eskom whether it be the approval of the designs or Eskom carrying out the connection themselves. The data indicates that delays, cost and Eskom themselves are barriers to the implementation of renewable energy projects. Figure 5.5 below illustrates the network diagram and the connections between the nodes and quotations.

Figure 5.5: Grid connections network diagram



The process of connecting the project to the grid involves Eskom who is firstly required to supply a grid connection letter and a cost estimation before the bid is submitted. Respondent three explains the challenges associated with this process:

> "There are two things that they [Eskom] do. One is not signing the PPA. The other one is more technical, a little more subtle, not giving access to the grid. Not giving you a cost access letter, not giving you a budget quote, and then making it difficult for you to connect on time with the additional risk that puts on investment." (R3)

Additionally,

> "you pick up that there is a bit of resistance to connect at certain locations. It might be an experience thing from the local Eskom representatives working on the transmission system. This is a bit of a worry." (R4)

Eskom's influence is present even when the developer decides to carry out the connection themselves as suggested by Respondent one:

> “your design (is) approved by Eskom and Eskom has to be an integral part of the construction.” (R1)

This sentiment is supported by Respondent one explaining that the

> “budget quote gets finalised pre-financial close. No bank is going to support your project if you don’t have finalisation on your grid connection. Also, the power purchase agreement will not be signed until there is the finalisation of your grid connection. That’s why Eskom cause such a ruckus with delaying the issue of the budget quotes.” (R1)

Access to the grid is also problematic as the number of sites that have simpler connection points is becoming increasingly scarce due to the easier connection points are being taken up as Respondent ten remarks:

> “As the programme has progressed it gets a lot more competitive and a lot more difficult to get good sites. You have to take on sites that score good in one but you have to make a lot more effort to get others to a level that makes it attractive to put in a good bid.” (R10)

Respondent four adds to this by suggesting that

> “All the (favourable) bid spots are obviously taken up first.” (R4)

As the good connection points are becoming scarcer, developers are forced to upgrade the infrastructure at their own cost in order to access the grid. Respondent ten explains that

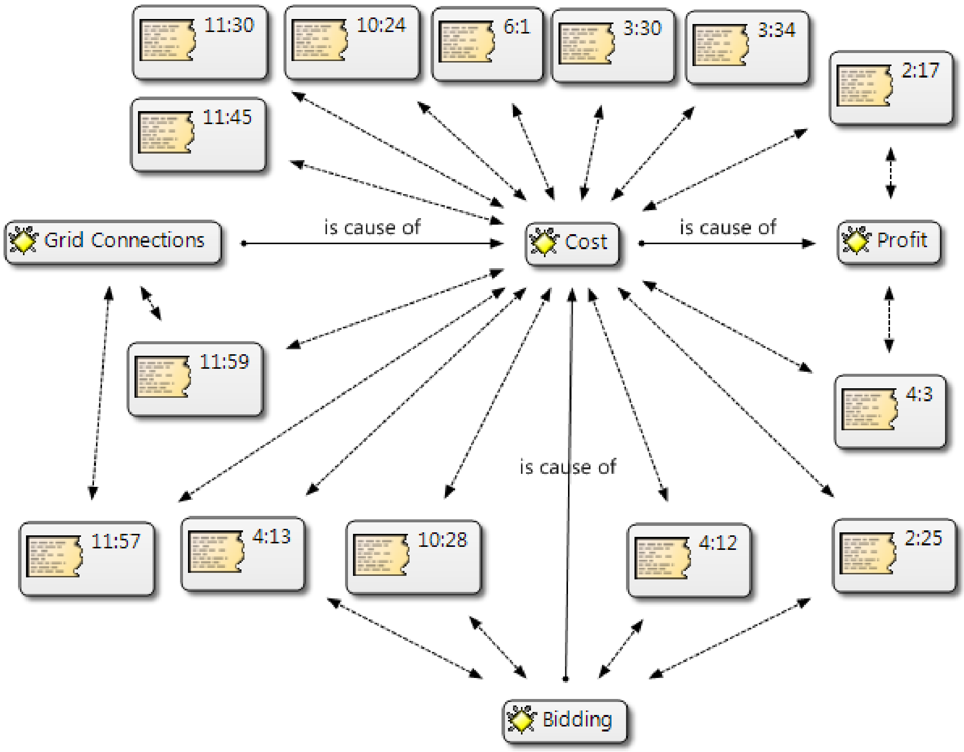
> “in the more recent times you have seen developers having to fork out quite a bit more for grid connections in terms of length of transmission lines or the amount of upstream strengthening needed to the Eskom transmission station, purely because all available bays have been taken up.” (R10)

5.2.4. Capital costs

The costs associated with the development of a renewable energy project includes those costs that are related to any infrastructure project, however, there are additional costs that need to be considered that may be unique to the renewable energy project and to projects that fall under the RE IPPPP programme. During the data analysis, three codes were associated with costs of renewable energy projects under the RE IPPPP programme namely Grid Connections, Profit and Bidding.

Figure 5.6 below indicates that there are two common quotes associated with Grid Connections, four associated with the Bidding process and two that could have an influence on the Profitability of the project. All are also co-occurrences with the “Negative” and “Present” codes as discussed in the introduction.

Figure 5.6: Costs network diagram



The additional cost associated with Grid Connections was stated by respondent ten who expressed his concerns twice during the interview and explained these costs it in great detail. Regarding access to the grid and therefore the costs associated with the access respondent ten stated that

> “It is getting more difficult to have access to good resource sites, areas close to substations without severe or expensive grid connections.” (R10)

He also expressed his concern regarding the costs of Grid Connections in the fact that

> “in the more recent times you have seen developers having to fork out quite a bit more for grid connections in terms of length of transmission lines or the amount

> of upstream strengthening needed to the Eskom transmission station, purely because all available bays have been taken up.” (R10)

The association with the bidding process with the cost of the project involves the risk that the developer and investor are exposed to and the costs associated with the bidding process as eluded to by respondent two when he explained that

> “You have to pay your money, throw your hat in the ring. It takes a lot of money before you can get to the point where you can do that. It is hugely expensive, there is no guarantee.” (R2)

Respondent four as the same opinion regarding the risk and costs associated with the bidding process as expressed below.

> “You obviously have to get your ducks in a row and that takes a lot of money. To get a bid in…. My understanding is that it is quite a big gamble.” (R4)

He continues to explain that

> “It is the ability to pay, let’s say, R15 million to get a shot at getting a RE IPPPP project. In terms of bidders in the last allocations, the number of small players has been small. If you have 20 percent (chance) of getting a project is a high risk. A really large institution can take that on”. (R4)

Respondent nine concurs with the above and explains that

> “Now the average cost of bidding is about R600 000. Eskom is not that much involved. Draft PPA with Eskom, get the estimation letter and that is it to connect the project into the grid”. (R9)

With regards to the profit being made on the projects and costs that need to be considered, the exchange rate has played a significant part. Respondent four explains it from the viewpoint of a PV project, however, there is a foreign component for all renewable energy projects.

> “This is to do with the PV projects, 65 percent of it is imported and the Rand exchange rate since December there is a 20 percent loss right there of which 65 percent should carry right through into a PPA rate”. (R4)

The market for renewable energy has also been explained and this leads directly to the profitability of such projects. Respondent two who is involved in the wheeling of power from renewable energy projects to municipalities explains that

> "The municipalities can buy the power but the reality is and in accordance with the regulation their rate that they pay from Eskom is a benchmark. If they get (an) alternative source of supply they cannot pay more for the power than what they are paying from Eskom. It is a nonstarter, particularly from a renewable energy standpoint because of the fact that it is so expensive. They are not prohibited from buying power as long as it is below or equal to". (R2)

Indirect costs such as legal costs also have an influence on the profitability of projects. As an example, deemed power payment has also come under the spotlight and the legal costs associated with getting the money owed from Eskom when they are unwilling to pay has large costs associated with it. Respondent three explains.

> "We've got an issue now with Eskom where they don't want to pay us deemed energy because their reputation looks bad but they have to pay us deemed energy because the distribution was so useless because the work wasn't done. Now they have to pay us deemed energy but they are contesting that. We are going to have to pay lawyers and go to court". (R3)

Costs associated with environmental factors and Environmental Impact Assessments (EIA's) are also a factor to consider as experienced by respondent nine while implementing a recent project.

> "You find that in some instance you do an EIA study and you have to move some of the plants [flora] and the cost of moving, it cost about R3.2 million". (R9)

The concern regarding baseload can be mitigated by including storage as a pre-requisite for renewable energy projects in future rounds of the RE IPPPP. Respondent ten states that

> "we are too far away from cheap and affordable energy storage" (R10)

and that

"we are looking at a five to ten year horizon that the cost of grid storage is at parity you can really have that conversation that displacing baseload or load following in a spinning reserve type of plant." (R10)

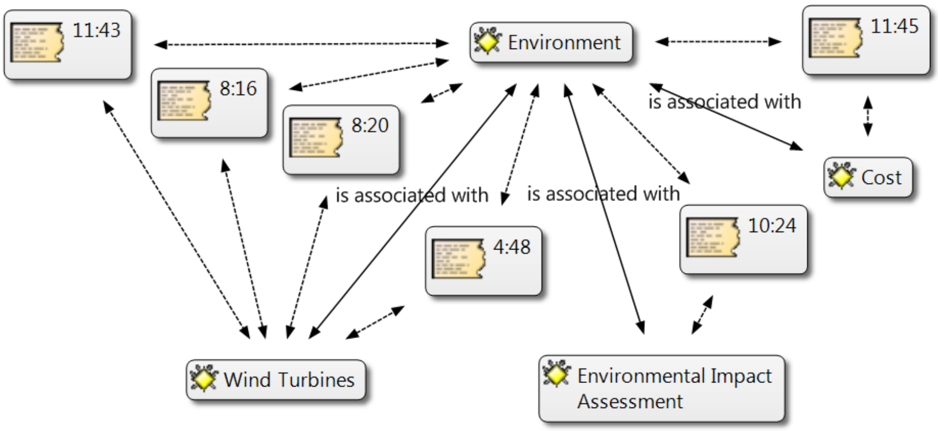
Finally, respondent six sums it up by stating that

"REIPPPP is expensive to get involved in." (R6)

5.2.5. Environmental

Environmental challenges play a significant role in the implementation of renewable energy projects. Figure 5.7 illustrates the respondents who made reference to environmental challenges and their co-occurrence to other codes.

Figure 5.7: Environment network diagram



The technology where most challenges are encountered is on wind turbines. The challenges include

"visual pollution" (R10)

Respondent eight emphasises this a little more by saying that

"poorly located wind farm is an environmental disaster" (R8).

Other challenges include the

"bird and bat monitoring" (R10)

As the

> "bird life becomes a big issue. A developer does not want to hear that he cannot generate because there is a flock of birds approaching". (R4)

The EIA's and the costs of removal of protected plant life [flora] have also been seen as a challenge as indicated by respondent nine where he had experienced this first hand.

> "The environmental scientist took co-ordinates of more than 200 different species of plants [flora] that had to be moved and replanted. We couldn't move and replant 10 000 kilometres away and there is no free land that is local." (R9).

The process also includes a

> "sophisticated noise study." (R8)

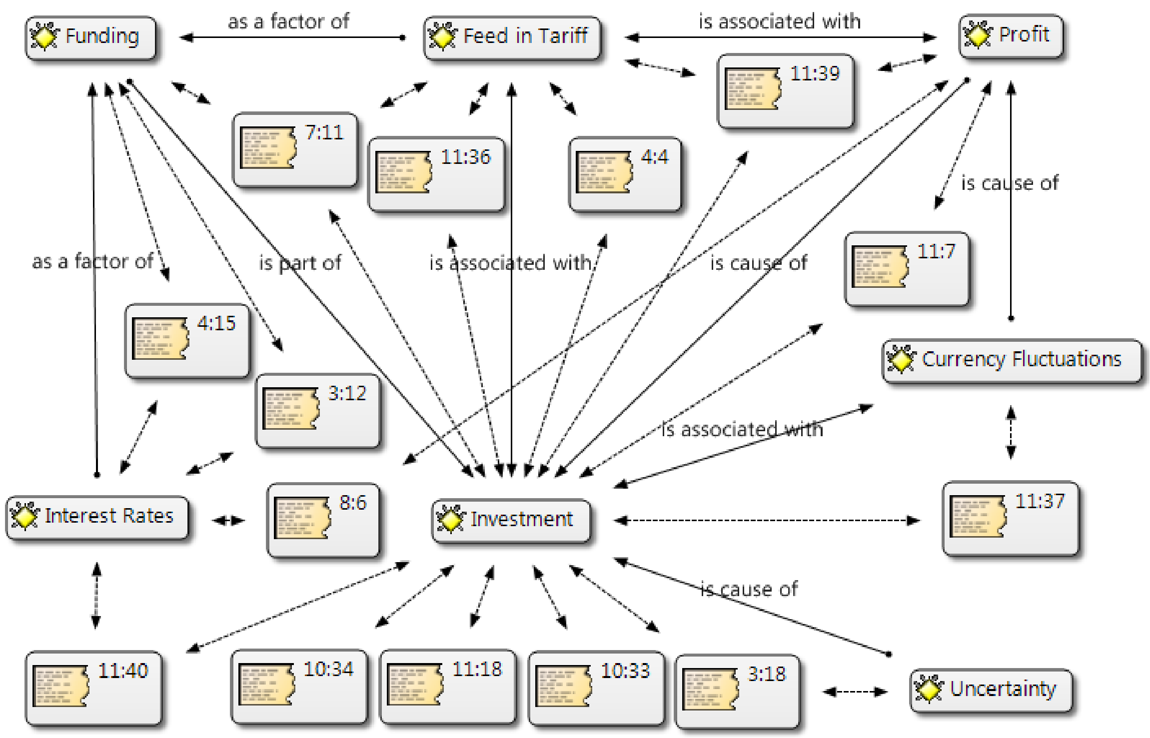
Respondent eight explains this further:

> "When the wind is pumping the farm doesn't make a noise as it is drowned out by the wind. The time it did make a noise, even if it was below the threshold, but a noise that could be disturbing was often when the wind died down after pumping. All the fans and cooling equipment was running in the turbines, and the wind blew from one specific direction. The perimeter houses could hear the turbines for approximately one hour" (R8).

5.2.6. Investment and funding

Investment into renewable energy projects is similar to any other investment in which the investor looks at the perceived risk of the investment and the likelihood of receiving a return that is expected. In the case of renewable energy projects, there are a number of potential risks that can be considered from the point of view of the developer and the implementer. It was found that the association between FiT's and investment was the most prevalent. Figure 5.8 below shows the association between investment and FiT's and the number of quotes that associated with investment barriers. Additionally, factors such as uncertainty, profitability and currency fluctuations have influence over the decisions to invest in projects.

Figure 5.8: Investment network diagram



The respondents showed concerns about the continual drop in the FiT's due to the competitive nature of the bidding process and the return on investments as respondent seven put it,

> "Because of the present drops in tariffs, you will find reluctance in terms of funding." (R7)

Respondent four concurs adding that,

> "The margins are so tight and the lenders won't go below the 10 to 11 percent they were hoping for." (R4)

Once again, respondent ten affirms that those who have already reached financial close on previous bids seem to have an advantage as well as

> "those who have (a) strong appetite for being involved (that) are able to accept those returns." (R10)

and

> "I don't see how some of the companies if they win the bid at those prices, can make any money. Scary, that is definitely coming into play." (R10)

Respondent ten continues to emphasise that the returns for the risks are not as lucrative as they were in the previous bidding rounds and that

> "The IRR are getting really tight to the point where we are seeing your equity returns on some of the project will need to be fairly close to what you are paying on your debt so investors can probably make a better return if they put the money in the bank and not take the risk." (R10)

Investors are also being influenced by the volatility of the Rand as a consultant confirmed,

> "when you convert those returns, all PPA are Rand dominated, that erodes a lot of the value. I don't know how their boards are making these decisions." (R9)

Respondent eight concurs that there is a risk, specifically for foreign developers who are

> "taking risk on Rand volatility. Everything is Rand based but a large portion of the CAPEX is either USD or Euro based. If OPEX costs are USD or Euro linked there is a big risk. When the Rand really tanked hard it had a very bit impact on project returns." (R8)

With regards to the interest rates that have been used for the funding of said projects, the one CEO explains that

> "we have hedged our forex and our interest rates fully during construction. But, due to the IFRIS rules most of your volatility you take into your balance sheet but then your hedging effectiveness or ineffectiveness goes to your income statement. This can swing by 50 to 70 million Rand in a quarter. Shareholders that listed this report on typical headline earnings per share is massively impacted by that swing which is just a volatility swing. This is completely out of your control." (R3)

Reluctance by local companies has been seen as a result of the awareness of the financial and investment side of the renewable energy industry. Respondent explains that

> "local companies don't understand the business case for renewable energy and that is one of the challenges…. They are not sure if they should put their money in because they are not understanding. (R9)

Conversely, respondent nine stated,

> "International companies know what they are investing in, they know that returns are very good, they are better than property." (R9)

The cost of debt or interest rate also has an effect on the investments and profitability of the projects in particular when competing with foreign companies. Respondent three explains that

> "A European player like Denel can come in funded from their balance sheet at six to seven percent interest rates. South African companies' whack is probably 15 percent. He just can't compete from a funding perspective." (R3)

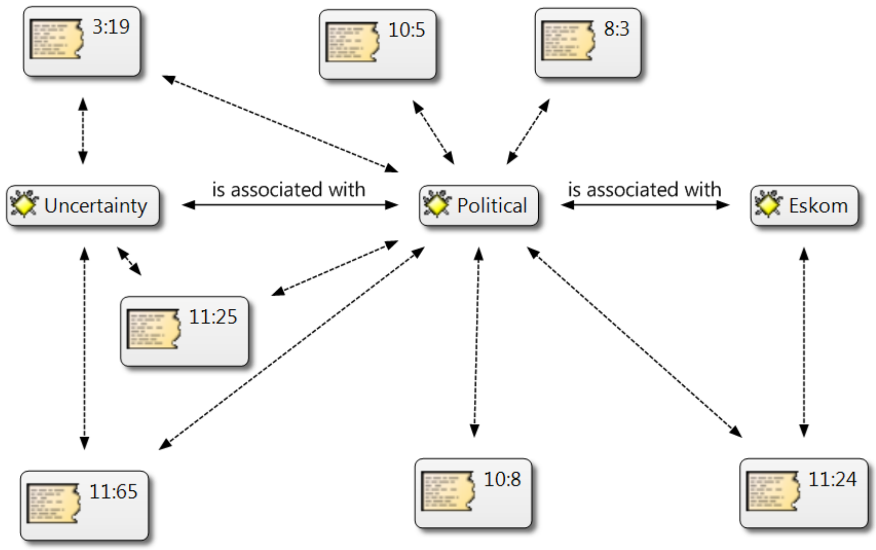
Respondent four corroborates indicating that

> "some of these international players bring low cost debt into the market and that they only have to commit certain returns on pension funds or whatever in Europe. If you can get it down from a 12 percent debt to a 10 percent and it is 80 percent debt financed they are in the running. This is compared to the smaller player that doesn't bring the same experience and approaches a local lender. This is a reflection of the risk on the project." (R4)

5.2.7. Political and regulatory landscape

As discussed earlier, the political landscape and domestic policies have a strong influence on the investment into a country by locals and international investors particularly in the certainty of the political landscape and policies put forward by the government. The South African political landscape has become more volatile over the past few years (Hlatshwayo & Saxegaard, 2016) and thus investment into large infrastructure projects is dependent on the political landscape of the country being invested in. Political factors have been negatively associated with uncertainty and Eskom in implementing renewable projects. Figure 5.9 below illustrates the connections between the codes and the quotations where these factors have been mentioned.

Figure 5.9: Political network diagram



Political uncertainty is not only a consequence of the policies of the national government but also from the municipal government. With regards to changes in the municipal power in the municipal district, respondent nine explains the uncertainties associated with changes in the municipal structure and change in political power within the municipality.

> "Municipalities can procure for more than five years from other companies. You need more than five years to recoup the investment, you need 20 years. If you develop such a project for a municipality (five MW), every five years there is a new contract, a new municipal manager, a new political party. What if the new political party doesn't want to go ahead with the contract and you have committed to 20 years of investment on the project?" (R9)

Respondent eight concurs that there are risks associated with the political landscape of local government as he explains that there is uncertainty as municipalities are

> "mal-administered to begin with and their books are not in order. The treasurer will not be a guarantor for the municipalities." (R8)

An additional concern is the government's stance on nuclear power plants stating that government have

> "a vested interest in nuclear which is not the right solution for the country." (R8)

Eskom too has come under the spotlight regarding the fact that in the recent past they have refused to sign new PPA's with projects are on the verge of reaching financial close. Respondent ten believes that

> "Eskom was making noise, trying to leverage that at NERSA not granting them their new tariff increases from last year which created a big hole. It is just politics." (R10)

And that this has

> "detracted in a way because I know that the foreign investors have asked us what is going on, will the programme run ahead, and we are giving them the same sense of comfort that the Minister has sent out officially." (R10)

Further uncertainty has been created by the delay in the updating of the IRP. This creates doubt as well and that

> "they [the DoE] should make it clear that the strategy and plan going forward in terms of allocation of technology, MW per round and what their planning is for 2030. Also, more certainty on that country wide MW is going to be allocated to renewables as opposed to nuclear as opposed to coal." (R10)

Respondent three sums up the feelings of most of the respondents by emphasising that,

> "Subsequent to the initial successes we are sitting in an environment where politics are playing out at a massive risk." (R3)

5.3. Research question 2

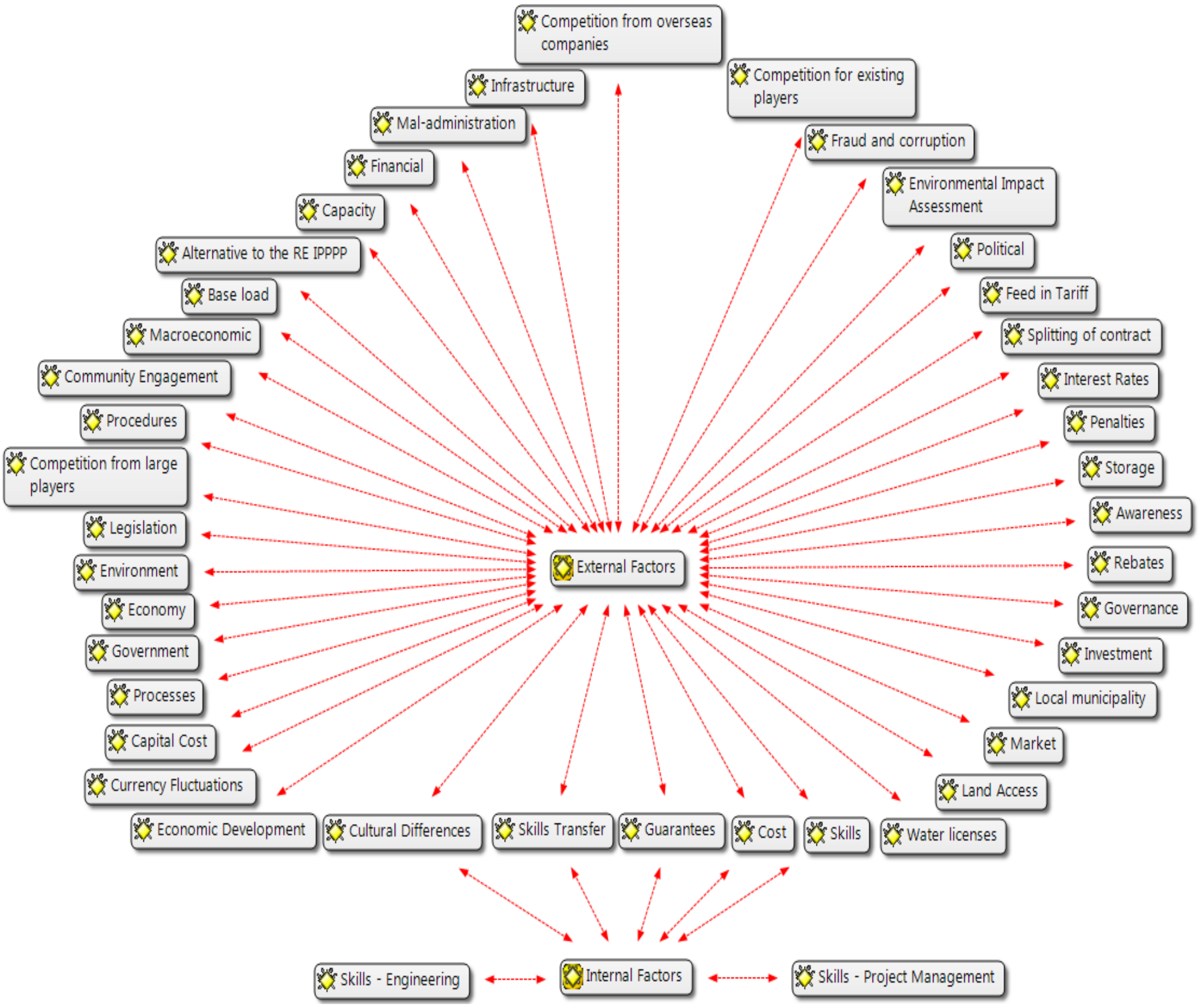
Are internal or external factors more of a challenge when implementing renewable energy projects?

During the process of collecting data, it became evident from the first interview that external factors have a higher influence on the renewable energy sector than that of internal factors within the firm. However, to validate this statement, codes were identified as potential factors, then listed and categorised into internal and external factors. Some factors could be either internal or external and therefore these factors have been categorised as both internal and external factors. In order to ascertain whether these factors were seen as barriers or negative factors an "and" analysis using Atlas.ti quantitative software was carried out combining the barrier code, the "negative" code and the "present" code identifying it as a barrier that is currently being experienced.

Of the 43 factors identified, 36 have been classified as external, two as internal and five being both external and internal. Figure 5.10 illustrates these factors and the relationships between them.

The number of times an internal factor was mentioned was six as opposed to external factors that were mentioned 116 times.

Figure 5.10: Internal and external factor network diagram



5.4. Research question 3

Are there sufficient skills available in South Africa to design, construct and operate renewable energy projects?

5.4.1. Respondent remarks

The respondents were asked about skills and skills development during the RE IPPPP programme and also mentioned skills during the general conversation. These were then coded according to the skills requirements and general themes were then extracted. The most relevant of these are discussed in the sections that follow.

Respondent one

> "In the beginning, because this was a new programme there is really no current capability in the country."
>
> "Your EPC had to have a certain amount of experience and a number of projects that they have done before. That was the clear message that they want experienced guys to come in but then, of course, there are the local economic development requirements so they are basically telling them fine, you can come in but you have to develop the skills locally."
>
> "In some instances that worked but in other instances that we saw it was an absolute disaster."
>
> "We used a lot of our London and Spanish colleagues when we started up to help us to develop the skills locally. We started with a team of three and are probably about 20 now. That is in five years."
>
> "We basically became a centre of excellence where people from elsewhere in [company name] contact us to help them with their renewable projects where we get enquiries from the Middle East, Africa, South America, Russia and India."
>
> "We do get people in long term assignment. Currently, we have an American gentleman who spent two years in Spain."

"During operations projects are low on staff requirements. Training programmes may be undertaken during construction but then the project comes to an end. There is probably not another project in the area. I am not entirely sure how successful it has been."

"About five years ago when RE IPPPP started we got some of our due diligence from the UK and Spain and so on to give guidance on how to do due diligence advisory work."

"It wasn't rocket science but there were a couple of things we had to pick up on in terms of what the banks were nervous about, what our own technical people were nervous about. Since then we have gained a lot of experience. Our price offering to our clients has become better."

Respondent two

"There are companies that have looked at giving back, taking a portion and allocating it to a particular trust. It is difficult to give back to the local community so rather just improve their lives by offering employment, skills transfer, etc. It is sustainable because the life span in a solar farm is between 18 to 25 years. The PPA is typically for 20 years"

Respondent three

"Ja, a lot of foreign input still. A lot of the projects are now in their second or third year of operation so there is capability and capacity building in operations. I think from a feasibility perspective, bidding perspective, those capacities have been built. It is now about creating experience and that will take another five to six years."

"A lot of capacity building, skills building. It is not yet that evident but I think in ten years' time it will be amazing what impact it has had."

Respondent four

"There is an ownership component, and it is good if you can get people trained up especially if the project continues in a stable way."

"I think that universities are responding to market needs. There is a renewable energy centre at Stellenbosch. UCT has a renewable energy drive and there are similar drives at University of Pretoria and Wits. Any of the engineering disciplines will equip you to a certain extent."

"On the PV side in ZA we are the leading skills centre for the group globally."

Respondent five

"Solar and wind projects are simple to do. You get your loads for the wind turbines, geotechnical information for the soil, design the civil base, do the electrical studies, overhead calculations, substation, control instrumentation and you implement."

"In fact, I never felt that some of our people were lesser in experience than the Spanish guys in the fact that we hadn't done all of these things. We were more thorough. I generally felt that our engineering and construction was far superior than anything I have seen."

Respondent six

"On the wind farm in Cape Town we have three technicians that run on different levels of experience and then when Germans come over for certain maintenance we pay them to shadow and we get the knowledge transfer."

Respondent seven

"Certain specialised skills were not available in the country. We had a foreign partner for live line technology who trained local resources. We now use 100 percent in-house specialised services and trained people. We have done this with most other technologies."

Respondent eight

"Our lenders leant quite heavily on foreign expertise. Lender's technical support was provided by a US company and legal firms learnt on foreign offices for capacity from abroad. I believe skills were passed on successfully."

"Definitely engineering and project manager skills. All the skills are readily available in SA. We have done the full ambit of project development, engineering, procurement, construction and to a large extent maintenance, all using SA resources. I think financial and legal skills are definitely available here."

"I think the first rounds we lacked legal capacity, particularly on financial structuring. That cost us a lot in the first rounds."

Respondent nine

"They are struggling because in South Africa not many companies have the experience. Three of the projects they were awarded they missed the financial closure process."

"Skills shortage is quite high on the government side."

"There is so much work for engineers but there aren't any renewable energy engineers. If you find one he is employed and is very comfortable there. He gets paid what he wants. Remember, this is a new industry in South Africa. It is about five years old. Where will you find an engineer in South Africa with seven years' experience?"

"All companies bring their managers from Europe."

"In my opinion, I don't think there is skills transfer at a high level. In a PV plant project, you will have a PV system designer, a project civil engineer and an environmental engineer. These three will run the project and give high-level presentations to the board. These are the skills shortage that I am referring to. You can't find PV system designers in SA."

"South African universities do not offer those degrees. Prof ……. tried to launch a course at Stellenbosch. It hasn't been approved yet. They are seeing if students will be interested in enrolling. Not official yet. Small courses are presented at UCT, renewable energy to understand the markets, but there are no degrees for PV design. Design is the most important step in solar projects. We need to get students interested, they are so clueless at high school level that when they get to University they don't know what a PV system designer is. This won't be fixed overnight."

Respondent ten

"There has been a lot of local knowledge and expertise gained."

"In initial rounds, a lot of that knowledge and high value engineering and project management was lying with international firms. Knowledge transfer is happening in projects going forward. It will be local companies and local developers that will be more successful. A new local industry has gained from this."

"Depending how good your economic development programme has been, a lot of companies have introduced training programmes where they skill up semi-skilled labour, then those people have been, besides being successful during construction, are now certified welders or have other technical type skills. That knowledge they did not have prior to training and they can then enter the job market."

5.4.2. Themes and sub-themes emanating from the primary data

During the primary data gathering, themes pertaining to different functions and sectors within the renewable energy industry became evident. These skills levels are listed in Table 5.1 below, demonstrating the sub-themes of respondents.

Table 5.1: Themes and sub-themes emanating from the interviews

Themes (Functions and sectors)	Sub-themes
Management	There is a general feeling that at the management level, skills are lacking due to foreign developers bringing the higher level skills into the country when implementing renewable energy projects.
Engineering general	The general engineering skills in the country are at a high level and can compete with any other country's level of engineering
Engineering specific	Engineering skills specific to the renewable energy sector is generally good, however, more experience is needed.
Construction	Skills transfer during the construction phase is generally seen as excellent. Skills transfer to local communities are seen as favourable, but this is at the artisan level and not specific at a level where skills pertaining to renewable energy are transferred.
Education/Training	Although there are many programmes to educate those who are interested in the renewable energy sector, these courses are short courses and not at a graduate level. The universities are looking at introducing undergraduate programmes but still need to be implemented.
General skills	The skills transfer and skills development is seen as very favourable and the general opinion is that the skills levels in the renewable energy sector in South Africa have developed to a point where the sector has sufficient skills and experience to develop projects with minimal input from foreign companies.
Experience	There continues to be a lack of experience within the renewable energy sector in South Africa which will be rectified over time.
Government	There is a shortage of skills within the government pertaining to the renewable energy sector in South Africa.

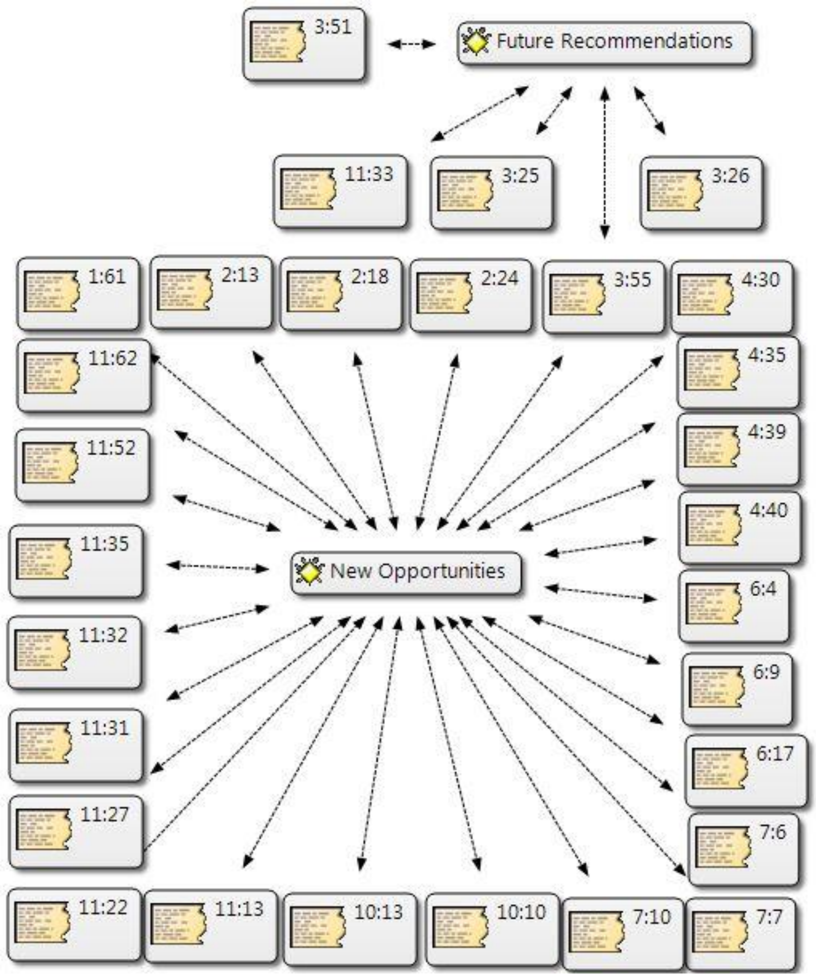
Source: Author's own

5.5. Research question 4

What future opportunities have been identified for EPCM companies in the renewable energy sector in South Africa?

Although there are many barriers associated with the future of renewable energy projects, opportunities are also available to the EPCM companies. During the interview process, the negative aspects were focused on, but positive aspects arose from the conversations and the future of these types of companies was discussed. The results below, although not extensive due to the nature of the interviews, indicate a certain number of opportunities for such companies going forward. Figure 5.11 below indicates the new opportunities and future recommendations that were made during the interviews.

Figure 5.11: New opportunities and future recommendations network diagram



When referring to alternative sources of power and particularly the new gas-fired power stations, respondent one expresses that this alternative

> “also looks great, it seems as if there is a lot going on”. (R1)

Respondent ten shares the same sentiments by stating that

> “For now we really have to get the gas programme off the ground.” (R10)

The gas programme has been seen as a great opportunity as a result of Eskom

> "not (being) really happy with using the coal as spinning reserve for the renewables because ideally the way that coal (the boilers and turbines that they use for the large plant) you don't want to ramp that up because they are most efficient when running at baseload 80 percent load factors. So now if you start using that to fill out the gaps for renewables it is not ideal for your efficiencies and stuff. Ideally, you want to get your quick ramp up and down gas, OCGTs or combined cycle GTs. Gas has the flexibilities and is more suited to that. That's another drive why the DOE and industry is pushing for gas to come online." (R10)

There are very few companies currently involved in the wheeling of power from renewable energy or alternative sources of power to municipalities to individual companies or to municipalities. However, the government is seen to be in favour of this initiative as stated by respondent two, who refers to a function he attended where the Minister of Energy delivered a speech. He indicates that

> "she loves the model and wants to see it replicated throughout SA. She will assist where she can to make it happen and will support projects that fall outside the IRP." (R2)

An additional advantage to wheeling of electricity from rooftop PV is that anything

> "that is below 100kW per grid connection point does not necessitate an EIA or an IPP license. There is talk of the threshold being moved to one or even five MW." (R2)

Making the projects less red-tape intensive and lowering the price to implement the projects. The downsizing from large utility-scale renewable energy projects has already taken place in other parts of the world as highlighted by respondent nine.

> "In America, Peru and Europe it all begins with big commercial firms and then it shrinks down to commercial properties for a couple of years then it goes down to consumer domestic (roof top) and now we are moving to the rooftop in SA." (R9)

Despite Eskom making threats not to sign any further PPA's, the government has come out strongly, reassuring developers and investors as alluded to by respondent ten.

> In the last few weeks the Energy Minister has come out quite strongly and even issued letters to developers and everyone involved in the industry that it is

> business as usual, round five is going to continue, the government is committed to the renewables programme, just to give comfort and confidence to foreign investors and the local market as well." (R10)

The government has also indicated that have the intention to develop zones where renewable energy technology would be incentivised called REDZ or Renewable Energy Development Zones. This was explained by respondent four.

> "The plan was to identify regions with good resources and decent grid connections and get IPPs into a process where they can get expedited approvals of their environmental authorisations in these earmarked zones." (R4)

The advantages to the development are alluded to by respondent four.

> "The REDZ initiative was a good one. Some of the high-level work would have already been completed for the identified area. This would mean less of a burden on the developer. They obviously need to get their project specific layouts approved, consumption rates, etc. This will definitely help." (R4)

With regards to the market of electricity, there is support from the private sector as well for the inclusion of rooftop embedded power for private households and property developers as stated by respondent nine that

> "basically now in the next one and a half years when you get a bond for a house FNB will tell you that the approval of the bond is subject to you using Bright Black and getting solar power on your roof. It has already been approved and is just a piece of paperwork inside RMB." (R9)

Respondents also alluded to the fact that the market for power is growing and that there is growing potential north of South Africa. Respondent three believes that the opportunity is there and that electrification in,

> "Sub-Saharan Africa is very low. Of the billion people living in Africa, 600 million don't have access to electricity. There is a massive market and a massive opportunity. We can carry on investing and we don't just have to invest in South Africa, we can take it north. If we do that Africa will be the next growth engine of the world." (R3)

Respondent seven concurs declaring that

> “we are looking at this outside of the country.” (R7)

and that as a result of this in

> “years to come the amount of electricity generated will be ridiculous.” (R7)

To reduce importation costs and the risks associated with currency fluctuations, local manufacture and supply would be welcomed by developers. However, there is a general belief that as experience increases and skills develop it

> “will be local companies and local developers that will be more successful. A new local industry has (been) gained from this.” (R10)

He goes on to say that there

> “was a lot of talk about guys setting up shop to manufacture towers locally, this is on-going, hasn’t been as successful as DOE would have liked it to be. There are talks of getting this off the ground again down in the Cape.” (R10)

6. CHAPTER 6: DISCUSSION OF RESULTS

6.1. Introduction

This chapter discusses the findings in chapter five, attempts to answer the research questions posed in chapter three and to either confirm, contradict or add to the findings in the literature review. The chapter is structured according to the research questions and the research objectives. As the study's primary objective is to develop a framework to assist future bidders in the renewable energy sector in South Africa, the findings will be utilised to develop such a framework.

6.2. Barriers and challenges of renewable energy projects

The barriers and challenges experienced by organisations that implement renewable energy projects throughout the world are diverse, however, there are high degrees of commonality between their experiences. As illustrated in Table 2.1 (section 2.4), previous research has shown that factors such as high initial capital cost, lack of financing mechanisms, lack of awareness of technology and lack of local infrastructure have been the most dominant barriers and challenges experienced (Baker, 2015a; Eleftheriadis & Anagnostopoulou, 2015; Luthra et al., 2015; Pegels, 2010; Seetharaman et al., 2016).

In the South African context, it was found that although the high initial capital costs were one of the top seven challenges faced by organisations implementing renewable energy projects, other challenges mentioned above were not as prominent as initially anticipated from the information contained in the literature review. The paragraphs below set out the details of the findings in section 5.1 above taking each of the top seven barriers and discussing the associations between them as well as those factors that influence them.

The said factors identified during the data collection in this study are discussed independently below and include the academic implications and the repercussions on the industry in each case. Taking these factors into account when bidding on renewable energy projects as well as working on mitigating these factors as far as possible, may affect the industry to become more efficient in this ever increasing competitive environment.

6.2.1. Feed-In-Tariffs

Eleftheriadis & Anagnostopoulou, (2015) argue that with the continuing fall of the FiT's have a significant effect on the profitability of the developer and has had the effect of discouraging new entrants. The respondents indicated that the fall in tariffs is having a significant effect on the companies' ability to make money at all. Both respondents five and ten are left wondering how the companies in the next round are in fact going to attain profitability with the projects that they have recently been awarded and whether the reward is worth the risks being taken. Respondents also indicated that the main competition comes from those who are able to finance the projects either off their balance sheets or by way of debt with a lower interest rate than that been available locally. This is confirmed by Walwyn & Brent (2014) who state that off balance sheet finance was observed in round three of the RE IPPPP by all three winning bidders who were all foreign entities (Baker, 2015b).

Investors and funders have been discouraged by the increased competition as return on investment has been diminished, as alluded to by respondent 7, in contrast to the first few of rounds of the RE IPPPP where competition was open and the prices were of such a level that the developers made a good return on investment (Walwyn & Brent, 2014). These first movers took the risk associated with the new initiative and as a result reaped the rewards. These developers made significant profit and continue to do so with the projects being signed for period of twenty years, however this does not denote that first mover advantage is sustainable as other companies enter the market, they will be required to differentiate themselves from the new entrants (Barney, 1991) to enjoy the sustained competitive advantage.

With the ongoing decrease in profitability, there has been some scepticism of how developers are able to make any money out of the most recent rounds of the RE IPPPP. Most of the respondents. This is particularly true when considering projects that are being funded locally especially those that are geared mostly toward debt. With the higher interest rates (Baker, 2015b) to contend with and the fact that lenders are not comfortable with the returns that are being forecast, respondent four is of the opinion that the FiT's may increase.

Furthermore, Eskom is selling electricity to the municipalities at a rate which has been stipulated by NERSA. As Eskom are the producers as well as the procurers of electricity, Respondent nine explains that Eskom finds itself in a position of direct competition to the suppliers from whom they are purchasing the electricity (Baker, 2015a). Not only does this mean that there is a conflict of interest which means that it is in Eskom's interest not to sign any more IPP's, but also that Eskom will drive the tariffs so low in order to keep the IPP's out of the industry altogether.

6.2.2. Economic development

Economic development of the communities situated within a 50-kilometre radius of the renewable energy project is one of the prerequisites in the RE IPPPP bidding process (Baker & Wlokas, 2014). The general attitude from all the respondents was that this was a positive initiative, however, there were a few challenges for the EPCM companies. This included the fact that although it was a positive initiative, is one part of the processes that is "least understood" (R4) and that there are is room for improvement in the design of the initiative. Giving the bidders a clear understanding of what is expected is of critical importance not only to uplift the community but to also level the playing fields for the developers. It was indicated by respondent five that there

> "are still grey areas. The whole economic development audit process fell down." (R5)

and

> "They (Europeans) were getting truckloads of Filipinos in and getting equipment from everywhere and they came in with low prices and pushed some of the South African companies out. That whole thing was not handled properly". (R5)

These guidelines need to be set by the policy makers and those who are responsible for the ongoing success of the programme.

Managing expectations of the communities has been recognised and is one of the areas that need specific attention as many communities are anticipating revenue streams as soon as the IPP starts sending electricity into the grid (Baker, 2015b). As the community will only start seeing real returns once the "senior debt has been paid off," (R10) it is of the utmost importance that the community leaders are well informed and that one needs to "strike a balance in creating hope up front without creating too much expectation." (R3)

Developers have the responsibility to ensure that the communication with the local communities has been of such a nature that there is no room for misinterpretation and for the expectations to misunderstand. This can be an onerous task considering cultural differences and differing levels of cognising the financial aspects associated with project finance.

6.2.3. Grid connections

The connection to the national grid by the renewable energy projects has in recent times been seen as an increasing challenge. As explained by respondent one, Eskom approves the initial connection and location of the connection and gives an indicative cost. This cost becomes an input into the bidder's financial model who then submits a feed in rate at which the bidder is prepared to sell the electricity at. The bid is submitted to the DoE and if the bid is successful, it becomes a preferred bidder. Baker (2015a) continues the explanation that Eskom's role is limited to connection of the projects and the purchaser of the electricity that is produced by the IPP's. Before financial closure the PPA needs to be signed and finalised with Eskom and Eskom gives a final budget quotation for the connection.

The developer has the choice of either a 'self-build' or to get Eskom to carry out the connection. Respondent one clarifies that even though the developer may carry out the connections themselves, "your design [is] approved by Eskom and Eskom has to be an integral part in the construction". Eskom, therefore, retains control over the process in addition to controlling the upstream process.

The process of financial closure is then put into place and all documentation and designs must be completed within the time stipulated. The bidder requests from Eskom a fixed and firm price for the connection. It is here where the bidder is at risk as there is no guarantee that the initial cost for the grid connection will stand. The financial closure of the project, therefore, comes into jeopardy, either lowering the IRR of the project or causing the project to become unviable altogether.

Additionally, as stipulated by respondent four, “All the (favourable) bid spots are obviously taken up first” and as the programme progresses, the connections become less and less favourable. It portends that there may be insufficient transmission infrastructure in the area to support the new power plant or there may be a need to upgrade or install downstream infrastructure such as transmission stations. This is supported by Pegels (2010) who argues that significant investment is needed to get the infrastructure to where the renewable energy plants are located. There is also a reluctance on the part of the grid company to invest in the additional infrastructure needed. These costs are then passed onto the developer of the renewable energy project and if it is in the interest of the developer, the developer then pays (Cherni & Kentish, 2007). Respondent ten confirms this as stated,

> “in the more recent times you have seen developers having to fork out quite a bit more for grid connections in terms of length of transmission lines or the amount of upstream strengthening needed to the Eskom transmission station, purely because all available bays have been taken up.” (R10)

Baker et al (2015) explain that Eskom in recent times has been delaying the submission of said indication of grid connection costs as well as the submission of budget costs to the developers. Additionally, Eskom’s chairman recently sent a letter to the Energy Minister stating that Eskom was unwilling to sign any additional PPA’s (Creamer, 2016). This was confirmed by respondent three who stated that there

> “are two things that they [Eskom] do. One is not signing the PPA. The other one is more technical, a little more subtle, not giving access to the grid. Not giving you a cost access letter, not giving you a budget quote, and then making it difficult for you to connect” (R3).

Naturally, any delays in such projects come with financial costs and these are costs that may or may not have been taken into account in the bidding stage. Once again these delays and additional costs may jeopardise the implementation of the project.

In order to prevent the conflict of interest associated with the Eskom holding the position of purchaser and supplier of electricity, it may in the interest of the industry and South Africa to split Eskom into two separate entities namely transmission and power producer.

6.2.4. Capital costs

This research shows that costs associated with the RE IPPPP are still a factor when implementing renewable energy projects as alluded to by the majority of respondents. There are a number of reasons for the high initial costs, most of which emanate from the requirements stipulated in the bidding documents, the onerous legal procedures, the technology itself and the grid connection costs (Baker et al., 2014). When asked why smaller firms are not entering the market, respondent four suggested that it "takes a lot of money" and it has to do with having the "ability to pay" to get a bid in. This on top of the realisation that there is a small chance that one would land a project and that a large sum needs to be paid, results in a large risk. A cost of R 15 million before the project financial close was implied by respondent four. Respondent two expressing that

> "It is hugely expensive, there is no guarantee." (R2)

Other costs that are associated with the RE IPPPP include environmental considerations, the cost of grid storage, legal costs, connecting to the grid, financing and funding, and exchange rate uncertainties (Walwyn & Brent, 2014). All these factors are discussed in previous and subsequent sections within this chapter. It is imperative that the above costs be recognised when compiling a financial model as failing to do so could affect the profitability of the project.

6.2.5. Environmental

Of the renewable energy industry technologies that are associated with environmental challenges, wind turbine technology is mentioned most often. Challenges include the changes in the landscape, soil erosion, (Wee et al., 2012), the effect on local wildlife such as birds and bats as well as the effect on the human population that resides in proximity to the wind farms (Huso et al., 2016). These challenges need to be taken into account specifically regarding the location of said wind farms. Getting such an aspect wrong would cause irreparable damage to the project. Respondent eight emphasises that "poorly located wind farm is an environmental disaster" (R8).

On the one hand, the develop needs to protect the environment in which the project has entered, however, the developer has implemented the project to make a profit. As respondent four expresses;

> "a developer does not want to hear that he cannot generate because there is a flock of birds approaching." (R4)

This is where the EIA is crucial. Most developers make use of consultants to carry out said studies, however, cognisance of the aspects associated with the EIA must be taken by the EPCM company to ensure that all risks have been mitigated. With respect to wind farms, these include "visual pollution" (R10), bird and bat migratory routes and patterns, a "sophisticated noise study" (R8), study of the local fauna and a study of any historical or cultural significance of the area.

The costs associated with the EIA and the relocation of flora must also be considered. One respondent shared his experience on one of his projects;

> "You have to move some of the plants [flora] and the cost of moving, it cost about R3.2 million which I did not have in my budget." (R9)

Environmental considerations pertaining to hydroelectric power plants such as "flooding of land" may "induce a change in looking at the scale of hydro systems" (R4), meaning that a larger quantity of smaller hydroelectric plants may be considered in future, effectively mitigating much of the environmental factors associated with the building of dams.

The literature review indicates that the noise associated with wind farms can be detrimental to the health of those residing in the vicinity (Nissenbaum et al., 2012). None of the respondents indicated that this was a factor to be considered, however, the very few of the respondents have been fully involved in the EIA's since, as mentioned earlier, they make use of consultants to carry out the EIA's.

It is of utmost importance for the developer not to be parsimonious in the spending of the EIA and the local community's involvement in the planning of the project. Doing so could lead to legal costs and the need to implement mitigation processes.

6.2.6. Investment and funding

The investment or funding of a renewable energy project from the viewpoint of the EPCM contractor or the developer come with its own unique risks. The most prevalent being that the project will not proceed as a result of the risks perceived by either the investor or the funder which are the same as financing any infrastructure project. These include the risk of low returns due to increased competition, political uncertainty (discussed later in this chapter), the uncertainty that is associated with exchange rate volatility and cost of debt.

6.2.6.a. Risk of low returns on investment

As discussed in section 6.2.1 above, investors are starting to see that they are receiving much lower returns than in the first few rounds of the RE IPPPP and that there is a tendency for investors and funders to be very cautious (Eleftheriadis & Anagnostopoulou, 2015). There is a general consensus amongst the respondents. Statements such as:

> "Because of the present drops in tariffs, you will find reluctance in terms of funding." (R7)

and

> "The margins are so tight and the lenders won't go below the ten to eleven percent they were hoping for". (R4)

It becomes a concern to see that there is a reluctance to invest due to the high prevalence of competition in the sector. However, there must be money to be made or the competition would not be present at all and those who have the appetite for the risk stand a chance to make good returns as the PPA are for a period of 20 years. It appears that if the investor is willing to take the risks, the returns will be forthcoming.

6.2.6.b. Currency fluctuations

As the renewable energy projects under the RE IPPPP are bid in the local currency or South African Rand (Baker & Wlokas, 2014), foreign investors and funders find it difficult to predict the returns with the constant fluctuations of the Rand against all major currencies such as the Euro and the US Dollar (Baker, 2015b). Respondent ten confirms that "all PPA are Rand dominated, that erodes a lot of the value". Additionally respondent eight suggests that there is a risk when considering the importation of equipment, but if any of the OPEX costs are either "USD or Euro linked there is a big risk. When the Rand really tanked hard it had a very big impact on project returns." (R1)

To mitigate the risk associated with the volatility of the Rand, companies, in some cases hedge both the interest rates and the forex during the construction phase. The challenge arises as a result of the fact that

> "volatility (is) take(n) into your balance sheet but then your hedging effectiveness or ineffectiveness goes to your income statement. This can swing by 50 to 70 million Rand in a quarter." (R3)

One must consider these aspects very carefully and mitigate these risks by either hedging or take forward cover on the imported equipment This however also poses and obstacle as taking forward cover increases the import costs and therefore the CAPEX costs causing the bid tariffs to increase and as a result placing more risk on the viability of the project.

6.2.6.c. Cost of debt

The cost of debt has been associated with the funding of the projects, with foreign companies enjoying the upper hand with interest rates. As Baker (2015b) argues that those who have access to funding in Europe or the United States are charged at an interest rate of about seven percent. The cost of debt that South African companies have to pay is in approximately 12 percent

A number of respondents also feel that it is difficult for local companies to compete with these interest rates. Respondent four explains that if a company bidding in the RE IPPPP

> "can get it down from a 12 percent debt to a 10 percent and it is 80 percent debt financed they are in the running." (R4)

Competing in this way effects the ability for South African companies to encourage the manufacturing industry and as a result, cripples job creation in both the manufacturing and construction phases of the industry.

6.2.7. Political and regulatory landscape

The political landscape in South Africa is becoming more uncertain with the African National Congress (ANC) government losing ground in the recent local elections and some of the metros being taken over by the opposition parties (Mashego, 2016). Although this bodes well for a robust democracy, there is always a sense of uncertainty that arises with any change, especially with the shift in the governmental structures. These elections also created uncertainty with regards the national government and the ruling party's ability to maintain the status quo in the next national election.

The change in municipal government has also been a concern for those who are selling power to Eskom directly or wheeling the power to the municipalities. As one respondent stated that

> "every five years there is a new contract, a new municipal manager, a new political party. What if the new political party doesn't want to go ahead with the contract and you have committed to 20 years of investment on the project?" (R9)

Investors need the assurance that revenue will not be cut off five, ten or fifteen years from when the project becomes commercially operational.

As mentioned earlier, investors and funders avoid uncertainty and will not throw money where they feel that there is a political risk. Politics also has a large role to play between the stakeholders involved in the renewable energy sector as was illustrated when the chairman of Eskom sent a letter to the Energy Minister stating that Eskom would not sign any further PPA's even though there were several projects that were very close to financial close (Creamer, 2016). Respondent ten suggested that

> "Eskom was making noise, trying to leverage that at NERSA not granting them their new tariff increases from last year which created a big hole. It is just politics." (R10)

However, this also creates doubts in the minds of investors and potential developers. Respondent one confirms that

> "the foreign investors have asked us what is going on, will the programme run ahead?" (R1)

It was the intention of the DoE to update the IRP every two years, however, it did not materialise, (Pfenninger & Keirstead, 2015) which has left developers wondering what the future high-level plan is for renewable energy power generation in South Africa. Although most respondents expressed the view that there is great uncertainty due to the lack of transparency experienced by not releasing the updated IRP2010, respondent ten encapsulated it, as he put it, the

> "(DoE) should make it clear that the strategy and plan going forward in terms of allocation of technology, MW per round and what their planning is for 2030. Also, more certainty on that country wide MW is going to be allocated to renewables as opposed to nuclear as opposed to coal." (R10)

Having said this, there is also uncertainty created by the political motives of the current regime regarding nuclear energy in South Africa. They appear to have "a vested interest in nuclear which is not the right solution for the country." (R8) The motives of these decisions are unclear, however, it could have a significant negative impact on the renewable energy industry.

6.3. Internal and external factors

Seetharaman et al. (2016) categorise the forces or barriers associated with the implementation of renewable energy projects as either internal or external forces. External forces are shown to be environmental concerns, economic sustainability, technology innovation, social awareness and regulatory policies. This study confirms that these same external forces continue to be barriers and challenges in the renewable energy sector in the South African context. However, a total of 36 external forces were identified, some of which can be considered to be of a low significance, but were nevertheless acknowledged by the one or more of the respondents.

Internal forces have been seen to be of a much lower significance in the context of the renewable energy sector in South Africa with factors such as skills and cultural differences between the project team members from different parts of the world being of concern to the respondents. Culturally, work ethics has been cited as a challenge as respondent three suggest that

> "The mainland Indian population struggles with the South African way. My perception is that they see us as lazy." (R3)

Having said this, internal forces were found to be insignificant in comparison to the external forces. This is contrary to the study carried out by Seetharaman et al. (2016) where internal forces were found to be of higher significance. These forces were identified as customer satisfaction, process structure, operation methods, employee talents, performance stability and technical alignment of which employee talents was the only aligned factor pertaining to this study.

6.4. Skills and skills transfer

South Africa has a well-established and highly regarded engineering sector (Leke & Michael, 2015). This sector is, however, lacking in skills and formal tertiary education aimed specifically at the renewable energy industry. The engineering of the ancillary equipment required for projects that fall under the renewable energy industry has been developed within South Africa specifically as a result of the current electricity infrastructure and South Africa's unique history as discussed in section 2.4.4 above (Pegels, 2010). There are therefore sufficient skills in this sector to carry out the ancillary parts of the projects.

In the past, the engineering was either entirely or partially carried out by foreign partners or in the case of multi-national companies, by employees based overseas. In the case of the multi-nationals, skills have been developed locally by bringing experienced employees into the country to transfer their skills to the local employees. In some cases, it has been so successful that the South African-based employees have been called upon to assist the foreign branches in implementing the projects based abroad as denoted by respondent one

> "We basically became a centre of excellence where people from elsewhere in [company name] contact us to help them with their renewable projects where we get enquiries from the Middle East, Africa, South America, Russia and India." (R1)

The respondents indicated that in the South African context skills are lacking at a management level. This has been alluded to as a consequence of foreign develops importing said levels of human capital into the country to manage the implementation of the projects. The question then is whether there is a lack of commitment by the foreign developers to transfer these skills over to the local companies or whether the aim of these companies is to arrive in the country to make as much profit as possible by using those who already have the experience necessary.

The construction industry has been accused of challenges such as material cost overruns, price fluctuations, poor bills of quantity estimates and material take-off, delays in payment, and a shortage of skilled labour (Baloyi & Bekker, 2011; Toor & Ogunlana, 2008). The analysis of the data suggests however that the skills involved in the construction phase are generally excellent and that the skills transfer to local communities and to the local construction companies is generally good. However, once again, it is respondents' impressions that this transfer of skills is at an artisan level rather than at management or executive level. Skills transfer is, therefore, lacking in this area requiring more emphasis on formal education in the sector and what is needed on a policy and legislative level is to encourage skills transfer and the education of candidates to attain undergraduate qualifications in renewable energy and the management of said projects.

To gain a sustained competitive advantage, companies require the skills and experience without relying on foreign human capital for the management, legal, technical, administrative and project management skills needed to implement a renewable energy power production plants. Due to the shortage of renewable energy engineers in South Africa along with the fact that there are no tertiary institutions offering renewable energy undergraduate degrees, it would seem that those companies who are prepared to invest in the development of such rare and valuable skills will have sustained competitive advantage. These skills are gained through skills transfer and the policies within large multi-national firms to place employees, who have potential in developing into renewable energy specialists, onto global projects where skills can be transferred and brought back into the company's South African renewable energy division.

This kind of investment into human capital is both difficult to imitate and non-substitutable. In addition to a large firm having the competitive advantage as a result of robust and strong balance sheets that only large companies can hold, giving them the sustained competitive advantage over smaller companies and those entering the market for the first time.

Formal education in the renewable energy sector is an area which is lacking in South Africa as there are no undergraduate programmes available, although there is a trend by tertiary education institutions to offer post graduate diplomas and short course as illustrated by The University of Stellenbosch's Centre for Renewable and Sustainable

Energy Studies (CRSES). Respondents in this study were of the same opinion, indicating that formal education of the growing sector is imperative for the sustainability of the local companies in the renewable energy sector.

6.5. Future opportunities

6.5.1. Introduction

There are several initiatives in place to increase the generation of electricity as discussed in section 2.2.1. Said initiatives include the generation of electricity from gas-fired power stations and rooftop embedded PV generation (Baker et al., 2015). The Renewable Energy Development Zone initiative that the Department of Environmental Affairs (DEA) has initiated is discussed below, however, this initiative is clearly absent in chapter two as the reference to this initiative is lacking in academic journals and only came to light while conducting interviews.

6.5.2. Wheeling of electrical power

Wheeling of electricity onto the grid has also seen to be on the increase recently, despite the lack of a regulatory framework to facilitate such initiatives. There has however been some progress in this regard, specifically in the Eastern Cape where the wheeling of several forms of renewable energy has taken place albeit to the municipality and not directly to Eskom (Euston-Brown et al., 2015). The DoE has indicated that they are in favour of these and as respondent two indicates that the minister of Energy “will assist where she can to make it happen” (R2) in other municipalities around the country.

Eskom is reviewing its policies regarding the wheeling of embedded power and this in itself would increase the opportunities for those who have experience in the RE IPPPP as the technology and implementation processes are near to identical. Another advantage to the smaller embedded PV projects, as respondent two explains, is that anything “that is below 100 kW per grid connection point does not necessitate an EIA or an IPP license. There is talk of the threshold being moved to one or even five MW.” (R2)

The barriers of entry have thus been lowered making it simpler to move into developing such projects, specifically the larger projects such as those within the industrial and mining sectors. The progression from utility-scale renewable energy to rooftop embedded has been seen throughout the world, culminating into the installation of domestic rooftop PV.

6.5.3. Renewable energy development zones

The Department of Environmental Affairs has introduced a Wind and Solar PV Strategic Environmental Assessment (SEA). This initiative's objective is to streamline regulatory processes for new renewable energy plants without compromising the environment. In order to achieve this, eight REDZ have been identified throughout the country, located predominantly in the Northern, Western and Eastern Cape with one being in the Northwest province and another straddling the Northern Cape and the Free state (Department of Energy, 2015b). The REDZ programmes have been welcomed by those within the industry and "would mean less of a burden on the developer" (R4). This initiative in itself would denote that the costs of developing renewable energy projects would reduce and would positively affect the price of electricity to the end user as well as lowering the barriers to entry for new entrants and smaller players in the market.

The REDZ programme has the possibility to assist Eskom in developing the transmission infrastructure as the grid connections locations would be known before the initial request for grid connection application from the IPP. Furthermore, potential IPPs will have the advantage of investigating certain areas where new plants would be located rather than having to investigate the entire country.

6.5.4. Gas fired power stations

The DoE aims to procure 3 126 MW of power from gas-fired power stations under the BLIPPPP (Baker et al., 2015) which can be considered as another opportunity for those who already have experience in the RE IPPPP programme as well as those who are entering the market for the first time. The advantage of gas turbines is that they have the capability of remaining efficient when ramped up and down in accordance with the demand. Coal fired power station, however, lose efficiency and do not perform well when not running at baseload capacities. Respondent one indicates that it is an opportunity for everyone within the energy sector and "that there is a lot going on" (R1).

Gas turbine technology is complex, expensive and difficult to replicate, creating a high barrier to entry for both the new entrants and those who the knowledge and experience have based on the previous rounds of the RE IPPPP and in effect levelling the playing fields. However where the experience and knowledge would be effective would be in the legislative environment and the requirements and procedures involved to connect to the grid and the bidding process itself, giving those with experience the upper hand in the bidding process once the technology has been acquired.

6.5.5. Market

The market is growing as a consequence of the fight against climate change, the increased awareness of renewable energy initiatives by the government and the DoE, as well as the memory of load shedding experienced in 2008. The private sector is also encouraging the use of renewable energy in the form of rooftop embedded power for commercial and domestic buildings. Respondent nine indicates that

> "when you get a bond for a house FNB will tell you that the approval of the bond is subject to you using [company name] and getting solar power on your roof." (R9)

These types of initiatives are the start of the private sector getting involved and initiating such programmes can only stimulate the market. As a result of the low number of the population in sub-Saharan Africa having access to electricity (Brew-Hammond, 2010), the market is wide open for those who have the skills and the experience to enter this market. Respondent three is of the opinion that sub-Saharan Africa is "the next growth engine of the world" (R3). If this is, in fact, the case, energy will be in great demand. Others too are looking north for new opportunities including respondent seven who concurs with respondent three that "the amount of electricity generated will be ridiculous (high)." (R7)

The optimism in looking north into sub-Saharan Africa comes with barriers such as poor transmission infrastructure (Sebitosi & Okou, 2010) and the affordability of electricity for those living in poverty (Luthra et al., 2015). As a result, the exploration needs to be investigated thoroughly before investing large amounts of capital.

6.6. Renewable energy implementation framework

As has been ascertained from this study, implementers and developers of renewable energy projects face a number of barriers and challenges. Although the findings of this study are aimed particularly at the renewable energy sector in South Africa and have been aimed at the future RE IPPPP, other IPP projects, such as the coal baseload and COGEN, will have similar and in most cases identical challenges and barriers. It is, therefore, imperative that future bidders take cognisance of the most prevalent barriers and challenges experienced by those who have already been through the process of bidding and implementing such projects. To make the process clear and easy to navigate, the renewable energy implementation framework was developed and is illustrated in Figure 6.1 below.

The framework consists of four columns. Column three lists the seven most prevalent barriers and challenges or codes identified by the respondents in no particular order. Column two lists the factors causing the barriers and challenges listed in column three and column four lists the effects of the barriers and challenges to the implementation of the renewable energy projects. Column one provides the recommended future markets for exploration and exploitation for existing developers and implementers, and those considering entering the renewable energy space.

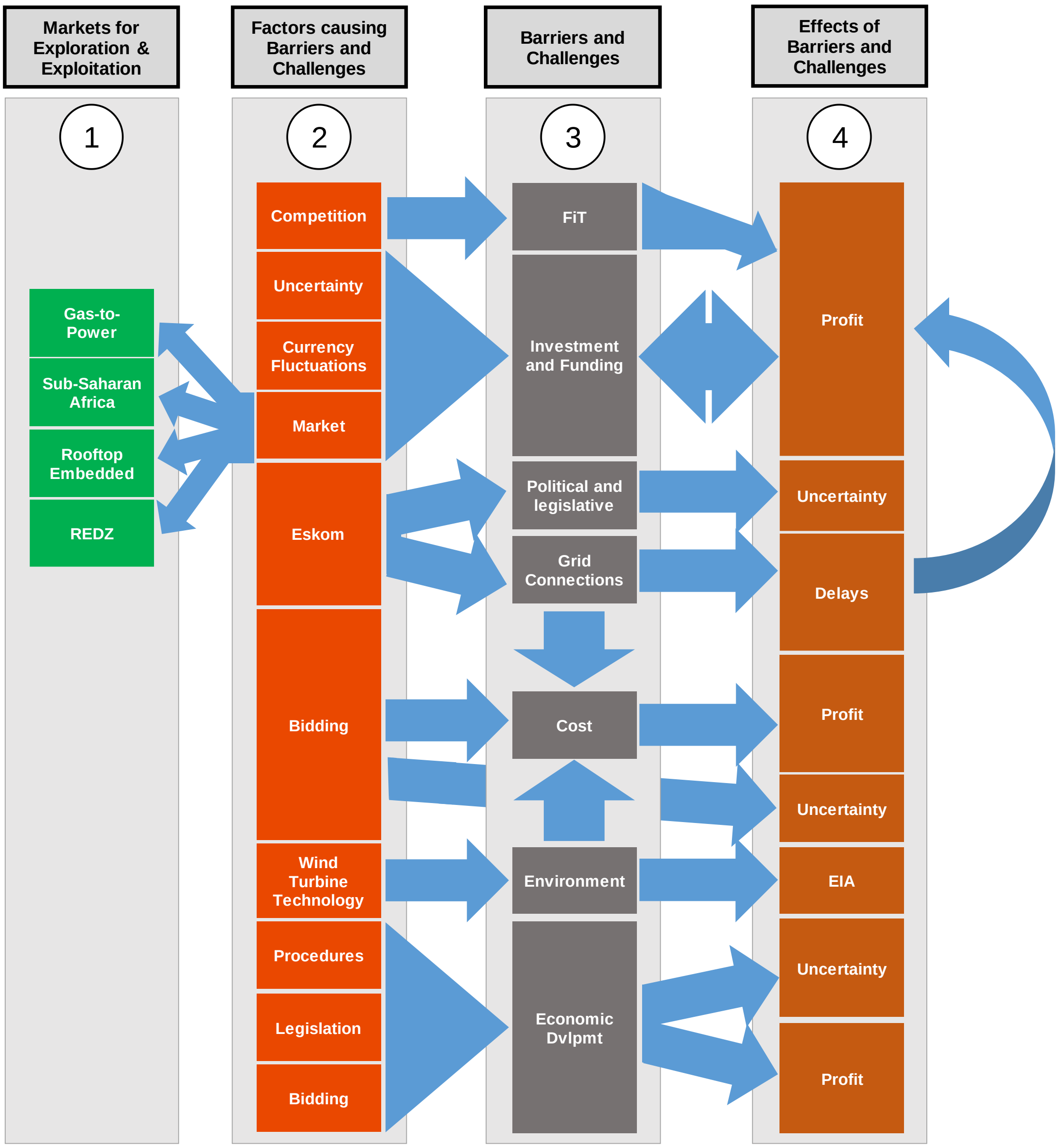
The framework demonstrates that competition in the market forces the FiT's to fall as has been observed as the RE IPPPP has progressed from round one to round four extended. As the FiT's fall, the profitability of the project lowers bring the Internal Rate of Return (IRR)

> "to the point where we are seeing your equity returns on some of the project will need to be fairly close to what you are paying on your debt so investors can probably make a better return if they put the money in the bank and not take the risk." (R10)

This, in turn, affects the investment in the projects and funding of the projects due to the perceived risk by investors compared to the return from other less risky investments. Funders too become sceptical wondering whether the project will be able to pay back the debt that is owed and therefore become reluctant to lend the capital needed to get the project to a point of financial close. If the investors and funders decide not to invest the capital, the process stops and therefore the EPCM contractor loses the project and as a result, the profits of the company are jeopardised.

Uncertainty, currency fluctuations and market demand affect the appetite of investors and funders which in turn influences the viability of the project and dictates whether or not the project will go ahead. This in turn, once again, jeopardises the profitability of the company.

Figure 6.1: Renewable energy implementation framework



Source: Author's own

Eskom influences both the political and legislative landscape and has a significant influence on the grid connections. The political and legislative landscape has the potential to create uncertainty, particularly with the recent developments where Eskom has refused to sign new PPA's (Creamer, 2016) and the fact that there is a conflict of interest resulting from Eskom being both supplier and purchaser of electricity. Eskom has the ability to delay projects by delaying grid connections and the cost estimate letters to carry out said grid connections. Grid connections have the potential to be costly as discussed in section 5.2.3 above.

The bidding process itself has many costs associated with the process, which has an influence on the profitability of the project. Uncertainty is created by the bidding process as was observed by several respondents, one who explained that

> "You have to pay your money, throw your hat in the ring. It takes a lot of money before you can get to the point where you can do that. There are international companies that have spent a lot to throw their hat in the ring and they don't win the contract. It is hugely expensive, there is no guarantee." (R2)

The environmental factors that cause concern during the implementation of projects in the renewable energy sector have been observed primarily in wind turbine technology. However, challenges pertaining to environmental factors are not only associated with wind technology as there are many factors that require consideration when assessing the environmental impact. The framework aims to draw attention to the fact that wind turbine technology has been cited as being the most costly regarding the EIA's, actions that need to be carried out in order to meet the environmental requirements and to satisfy the requirements to the satisfaction of the communities residing in the area.

Procedures, legislation and the bidding process have an influence on the factors pertaining to economic development. The processes that are in place have created a sense of uncertainty and these must be considered when bidding for such projects.

In addition, the model illustrates the recommendations and future markets for those who have developed the experience in the RE IPPPP process. This includes rooftop embedded solar PV projects, exploring sub-Saharan Africa as a potential new market, the new gas IPP programmes that are being considered by the DoE and the REDZ which, if put into action, will make developing and implementing renewable energy projects more efficient.

7. CHAPTER 7: CONCLUSION

7.1. Introduction

The research into the barriers to the implementation of renewable energy projects is extensive, using both qualitative and quantitative methods. It was found that there is a need to add to this research in the current South African context. This chapter aims to summarise the findings of the previous chapters, give explanations of whether the objectives had been achieved, provide recommendations for further research and provide a final conclusion to the study.

7.2. Research background and objectives

The objectives of this study, as described in chapter three, were to determine the potential barriers to the implementation of renewable energy projects within the South African context from the point of view of the developers and organisations implementing the projects. To ascertain whether said barriers are relevant in the South African environment, it was necessary to carry out expert interviews and make use of literature to establish current barriers and challenges as well as uncover any further challenges and barriers that may have arisen. Additionally, a framework to assist the bidders during future bidding rounds was created. These objectives were successfully accomplished and a framework was developed. The framework will enhance the understanding of the factors that should be considered and what factors can be potentially mitigated by the EPCM companies and the developer.

7.2.1. Secondary objectives achieved

The study set out to achieve three secondary objectives which were all successful accomplished. The paragraphs below describe this in more detail.

To critically review the literature relating to barriers experienced in the renewable energy sector and determine whether said barriers are relevant in the current South African environment.

The literature review on barriers and challenges pertaining to the renewable energy sector in South Africa and was presented in chapter two. The chapter discussed the barriers and challenges that have been previously encountered both locally and internationally. An extensive amount of such factors were uncovered both in the South African context and international context.

To determine whether internal or external forces are responsible for impediments experienced in the renewable energy sector in South Africa.

Theoretical background was utilised to establish this objective as Seetharaman et al. (2016) determined that internal forces were, in fact, more prevalent than external forces in the implementation of renewable energy projects. The objective was to confirm or contradict these findings in the context of the South African Renewable Energy sector.

To obtain a better understanding of the skills available in the renewable energy sector in South Africa.

Considering that the renewable energy sector is so young in South Africa and that articles and literature indicating that there is a general shortage of skills in the sector, it was imperative that the state of skills pertaining to the sector be investigated. During the in-depth interviews, skills and skills transfer was discussed and understanding of the skills within the sector was determined.

7.3. Discussion on key findings

The respondents interviewed during the in-depth interviews were positive with regards to the renewable energy sector and in particular with the DoE's initiatives pertaining to the RE IPPPP. This sentiment is supported by many including the World Wide Fund for Nature (WWF) (2014). It became clear very early on during the interview process that the barriers and challenges were mostly external of the companies implementing the projects. This is as a result of the EPCM companies gaining experienced when dealing with particular programmes such as the RE IPPPP and developing a familiarity with the requirements. The study confirmed this initial interpretation. As the industry matures, internal factors become insignificant resulting from individuals within the company acquiring experience and organisations continually upgrading procedures to suit the industry in which they operate. As this study was exploratory in nature, the number of barriers and challenges were extensive, but a pattern emerged where seven barriers and challenges became prevalent. These barriers and challenges are listed below and each is discussed in more detail in the paragraphs that follow.

- Feed-in-Tariffs

- Economic development
- Grid connections
- Capital costs
- Environmental factors
- Investment and funding
- Political landscape and policies

Additionally, skills pertaining to the development and implementation of renewable projects was investigated to determine whether there is currently a shortage within the industry. Skills transfer from international companies or international divisions of multinational companies were also considered.

Competition between organisations bidding on renewable energy projects has continually increased from the initial bidding round of the RE IPPPP. This increased competition has been so successful that the FiT's have dropped, in the case of Solar PV, by as much as 71.5 percent from round one to round four. This decrease has been welcomed by the consumer and the government as cheap energy has the effect of stimulating the economy. However, this continuous decrease in the FiT's has the effect of lowering the profitability of the projects and has started to make it unviable to bid on projects and discourages both investors and funders to commit capital. Some respondents were sceptical of the future of the programme as a whole and were unsure of how existing projects were able to make a profit with the current FiT's. Others expect tariffs to increase in the next rounds with the trend of the local currency decreasing against the major international currencies such as the USD and the Euro and the expected bid requirements to be changed to meet the need for baseload technology. Currency fluctuations forces companies to hedge their forex and either gain or lose profit depending on the exchange rate at the time the equipment is delivered (Baker, 2015b).

Creating a local manufacturing sector for renewable energy hardware has the potential to lower the risk associated with currency fluctuations and in turn create much needed jobs in the country (Walwyn & Brent, 2014). Local investment in the manufacturing sector has been slow as a result of political uncertainty and the policy uncertainty. Investors have also been reluctant to invest in the South African manufacturing sector as labour unrest and labour unions create uncertainties. Policy uncertainty in the renewable energy sector hinges around the delays experienced in the submission of the IRP.

The economic development and job creation initiatives being implemented by the RE IPPPP is considered positively by all respondents, however, there is a considerable amount of confusion regarding the implementation and the process that needs to be followed. Additionally, the expectations of the communities and other stakeholders have to be managed as many communities have the expectation that the revenues will be distributed from day one of plant production (Baker, 2015b). International companies are required to abide by the same requirements, however, there have been cases where this has not been respected and creates an unfair advantage for said companies. It is, therefore, imperative that the DoE monitor the economic development process to ensure that the playing fields are level for all bidders and that the communities benefit from the projects.

The predominant factor cited as being responsible for delays during the implementation process is that of connecting the project to the national electricity grid. This process involves Eskom, who is required to firstly supply a grid connection letter and a cost estimation before the bid is submitted. There have been a number of delays recently attributed to the parastatal who have either intentionally delayed the process, due to political reasons, or have been the source of the delays due to the department, within Eskom, not having the capacity to work on the quotes. Delays have financial implications, whether it be the cost of debt or the time value of money and therefore affects the profitability of the project.

Additionally, the favourable grid connection sites were taken up in previous rounds and as the process continues, sites become less favourable. Poor sites include those that are geographically harsh but also those that do not have ease of access to grid infrastructure and other infrastructure, and unfavourable topography. Electrical transmission infrastructure is considered to be the cost intensive as it is a requirement for the developer to include the upgrade of the transmission lines as well as substations if these are inadequate for the new connection being considered.

Upfront costs are associated not only with the construction and development phases but also with the bid submission process. The bid process includes cost such as legal costs, EIA’s, bond costs and an upfront payment required by the DoE. There is never a guarantee that the bid will be accepted and if the project will become part of the preferred bidder's list. Both developers and the EPCM companies are put at risk of not being chosen as a preferred bidder having spent large sums of money.

The technology utilised in renewable energy projects are capital intensive as most of the hardware is imported and that the majority of the projects are small in comparison to traditional power plants, eliminating the advantage of economies of scale. However, with the ongoing technological developments and the number of projects being installed, the price of the technology has decreased dramatically (Winkler et al., 2009) and therefore costs per unit of power produced is more in line with larger power plants.

Environmental barriers and challenges pertaining to renewable energy projects are dominated by the implementation of wind turbine technology. Those implementing said projects must consider effects on the local bird and bat population, the local community and the flora and all fauna. This is not to say that there are no environmental concerns associated with other renewable energy technologies, but wind turbine technology has been seen to be prone to environmental factors that require particular attention. This may be as a result of the number of wind farms being developed compared to others such as hydroelectric plants or that the turbines are visually dominant (Reid et al., 2015). Communities living in the vicinity of the wind farms are subject to health risk associated with noise pollution (Nissenbaum et al., 2012) and visual pollution (Department of Minerals and Energy/Republic of South Africa, 2003).

Hydroelectric power plants have the disadvantage of being capital intensive particularly when new dams or weirs are built from a green field site. These costs include relocation of communities and rehabilitation of the environment once the project has been completed. The relocation of flora affect all forms of renewable energy technologies and this too can be very costly as the number of plants that have to be relocated are potentially very high and additionally, the size of the plants possibly vary from area to area. Flora relocation needs to be carried out to the satisfaction of the monitoring environmental scientists.

With the advent of a new industry come significant skills gaps that are unique to that particular sector. This was evident with the RE IPPPP in the first few rounds, but as the programme progressed through to round four extended, skills transfer and experience was gained to such an extent that some South African companies became the experts in their fields and were requested to assist foreign companies in implementing portions of their projects. However, general experience in the design and project management level has some way to go.

At the senior management level, there is a general opinion that skills are still lacking resulting of foreign developers sending their own management teams to oversee the projects. This could be a result of the lack of formal education and training and as a result, the perception by foreign developers that project management and senior management skills are poor. The skills gap is reportedly evident in the government sector, where much-needed experience and skills are required to facilitate the process.

The findings of the study have supported Resource Based Theory in so far as the EPCM company implementing the projects require the skills to give them the sustainable competitive advantage over firms that are either entering the market for the first time or those smaller companies who lack the skills and experience to carry out such a project. It was also found that the capability of the firm to finance the project off their balance sheets gave them the sustainable competitive advantage required. These types of companies are typically multi-national, large corporations that are either based overseas or that have other interests that supply the necessary funds to finance such a project.

7.4. Recommendations

7.4.1. Developers and EPCM Companies

The study revealed that EPCM companies may be coming to the end of supplying services to a government led initiatives but should start looking to the private sector for new opportunities. Opportunities such as commercial or industrial embedded renewable energy projects, partnering with financial institutions to encourage the utilisation of renewable energy or alternative fuels in domestic and commercial developments.

The government is exploring methods to promote the implementation of renewable energy projects by initiatives such as the REDZ. This initiative has the potential to decrease the red tape required to implement renewable energy projects. Coupled to that are the opportunities that exist in Sub-Saharan Africa where there is low access to electricity and a promising outlook to becoming a global powerhouse, opportunities for expansion are there for the taking.

Partnering with technology firms to develop innovative technology to create new value for the renewable industry could give the company a sustainable competitive advantage. Technologies that will enhance the storage capability of renewable energy plants and innovative means of manufacturing components for the industry that is adapted for the African market.

7.4.2. Government and policy makers

Future rounds of the RE IPPPP presents regulators and policymakers with new challenges. With the focus on baseload power and the fact that renewable energy is generally lacking in being capable of supplying sufficient baseload power, it is suggested that the DoE include the storage of power into the upcoming IPP rounds. Unfortunately, this technology is still relatively new and thus costly.

As has been found in this study, skills at a management and government are lacking. The DoE are in a position to amend the bidding requirements in future bidding rounds and should, therefore, make it a requirement that local employees be placed on management development programmes and given the chance to gain experience at a management level when implementing such projects.

The government is in a position to reassess the SOE's, including Eskom and privatise the power production division of the business. This will free up Eskom to concentrate on the transmission of power rather than competing with the IPP's. Additionally, the government should put policies and incentives in place to encourage the wheeling of electricity from embedded power to the national grid and from renewable energy power plants to municipalities as is occurring in Nelson Mandela Bay. These types of initiatives will put the power production into the hands of the private sector, stimulating competition, encouraging efficiency and consequently reducing prices to consumers.

Currency fluctuations are seen as one of the biggest risks associated with renewable energy projects in South Africa. In order to encourage investment into said projects and to encourage employment, it is recommended that government develop policies to advance the manufacturing of renewable energy technologies within South Africa's borders. CAPEX purchase for infrastructure projects will be based on the local currency and the risks associated with currency fluctuations will be reduced.

It is also recommended that government reassess their policies and legislative frameworks to stimulate Foreign Direct Investment (FDI) and the REDZ programme would be a prime opportunity to introduce such unique initiatives. Tax incentives, assistance with socio-economic matters and the guarantee of a grid connection would go a long way in encouraging developers and investors to implement projects in such areas.

7.4.3. Management

It is recommended that management continuously assesses their environment in order to sustain the company's competitive advantage and to remain profitable. Within this complex environment comes volatility and ambiguity, causing uncertainty in the renewable energy sector. This leads to caution on the parts of investors and funders. Management has to be cognitive of these factors and is urged to recognise them when making a strategic decision.

Management must look to their human capital as their sustainable advantage and develop skills within the organisation. The threat is that these skilled employees will be tempted to seek employment elsewhere as they become increasingly scarce resources in the sector. These resources must be appropriately incentivised to remain with the company.

Involvement in committees that have influence over the generation of national standards, technology committees and associations is critical so that the companies implementing the projects have representation as a collective to induce policy change. With numbers comes power and this power needs to be utilised to change policies that will stimulate the growth of the sector.

7.5. Research limitations

Due to the nature of the research, a number of potential limitations have been identified. The limitations are listed below:

- As the interviews are conducted on samples in organisations of a single type, namely, EPCM companies, isomorphic characteristics are present and institutional aspects may also be present giving similar results to one another;

- Snowball sampling may also create a bias as "those selected for a snowball sample are most likely to identify others who are similar to themselves, resulting in a homogenous sample" (Saunders & Lewis, 2012).
- The interviewer has not been trained in the science and art of interviewing and therefore bias may occur due to interview technique;
- The majority of respondents were involved in the Wind and PV and not hydro or other forms of renewable energy technologies.

7.6. Recommendations for future research

In order to ascertain the barriers and challenges of each of the technologies utilised in the renewable energy sector as well as the technologies which are anticipated in the future IPP initiatives, it would be beneficial to research each of these technologies separately. A further study that should be undertaken is that of aiming to understand the expectations and perceptions of potential investors in the renewable energy sector or the IPP programmes as a whole.

Future of renewable energy technologies and the potential opportunities that exist for such technologies in the South African political and economic environment should be studied. To understand the real macroeconomic benefits to South Africa of the RE IPPPP, it is recommended that this study takes the form of a desktop study utilising secondary data.

The development of skills and the transfer thereof to those who are entering the renewable energy sector is has been a success within this young industry. Research should be carried out into why this is the case and how it can be applied to other industries.

As this study focused on the negative aspects of the renewable energy sector, further research on the future opportunities that exist for companies developing and implementing said projects should be undertaken.

7.7. Concluding statements

The RE IPPPP has been lauded by so many around the world as the flagship renewable energy programme. However, in recent months, the sector has seen much uncertainty and volatility from Eskom and the political landscape. Companies are looking at alternative ways of using their skills and experience outside the RE IPPPP. This study has attempted to simplify this complex environment and provide a framework so that cognisance can be taken of the factors that are in the control of developers and EPCM companies and to recommend alternatives to them.

Renewable energy technologies are the future of power generation specifically in Africa where micro-grids can be established in places where national transmission infrastructure is lacking. South Africa's climate and nature resources lend itself to renewable energies and therefore in order to grow the economy, renewable energy must be encouraged which must be driven from national government. National government has however been at the forefront of controversies including being influenced by external powers. The energy sector has not escaped these influences and the drive for nuclear energy as opposed to renewable energies has been seen to be politically motivated rather than in the best interest for the of the country.

This study has confirmed what has been established in the literature review but has added to it by emphasising certain aspects that are unique to the South African environment as well as ascertain that companies operating within the South African renewable energy sector have developed in such a way that the industry has shed many of its internal barriers with experience and skills transfer. The industry has had a tremendous growth path over the last few years but is at threat, from those who hold power and have the ability to cause the industry to collapse, as a result of greed and the drive for personal gain. The future of the country and the utility scale renewable energy sector lie in the hands of the powerful few.

8. REFERENCE LIST

Abdmouleh, Z., Alammari, R. A. M., & Gastli, A. (2015). Review of policies encouraging renewable energy integration & best practices. *Renewable and Sustainable Energy Reviews*, *45*, 249–262. http://doi.org/10.1016/j.rser.2015.01.035

Allix, M. (2016). Investment act may clash with SADC treaty. Retrieved June 25, 2016, from http://www.bdlive.co.za/economy/2016/06/17/investment-act-may-clash-with-sadc-treaty

Baker, L. (2015a). Renewable energy in South Africa's minerals-energy complex: a "low carbon" transition? *Review of African Political Economy*, *42*(144), 245–261. http://doi.org/10.1080/03056244.2014.953471

Baker, L. (2015b). The evolving role of finance in South Africa's renewable energy sector. *Geoforum*, *64*, 146–156. http://doi.org/10.1016/j.geoforum.2015.06.017

Baker, L., Burton, J., Godinho, C., & Trollip, H. (2015). *The political economy of decarbonisation: Exploring the dynamics of South Africa's electricity sector*.

Baker, L., Newell, P., & Phillips, J. (2014). The Political Economy of Energy Transitions: The Case of South Africa. *New Political Economy*, *19:6*(August 2014), 791–818. http://doi.org/10.1080/13563467.2013.849674

Baker, L., & Wlokas, H. L. (2014). *South Africa ' s Renewable Energy Procurement : A New Frontier* (No. 159).

Baloyi, L., & Bekker, M. (2011). Causes of construction cost and time overruns: the 2010 FIFA World Cup stadia in South Africa. *Acta Structilia*, *18*(1), 51–67.

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120. http://doi.org/10.1177/014920639101700108

Ben Jebli, M., & Ben Youssef, S. (2015). Output, renewable and non-renewable energy consumption and international trade: Evidence from a panel of 69 countries. *Renewable Energy*, *83*, 799–808. http://doi.org/10.1016/j.renene.2015.04.061

Blignaut, J., Inglesi-Lotz, R., & Weideman, J. P. (2015). Sectoral electricity elasticities in South Africa: Before and after the supply crisis of 2008. *South African Journal of Science*, *111*(9-10), 50–57. http://doi.org/10.17159/sajs.2015/20140093

Bofinger, S., Zimmermann, B., Gerlach, A.-K., Bischof-Niemz, T., & Mushwana, C. (2016). *Wind and Solar PV Resource Aggregation Study for South Africa*. Retrieved from http://www.csir.co.za/Energy_Centre/wind_solarpv.html

Brenner, P. (2008). Interview Guide. In L. Given (Ed.), *The Sage Encyclopedia of Qualitative Research Methods.* (pp. 462–464). Thousand Oaks, CA: SAGE

Publications, Inc. http://doi.org/http://dx.doi.org/10.4135/9781412963909

Brew-Hammond, A. (2010). Energy access in Africa: Challenges ahead. *Energy Policy*, *38*(5), 2291–2301. http://doi.org/10.1016/j.enpol.2009.12.016

Cherni, J. A., & Kentish, J. (2007). Renewable energy policy and electricity market reforms in China. *Energy Policy*, *35*(7), 3616–3629. http://doi.org/10.1016/j.enpol.2006.12.024

Cohen, M., & Yoo, S. (2016). Junk rating a matter of time as economy falters. Retrieved May 7, 2016, from http://www.fin24.com/Economy/junk-rating-a-matter-of-time-as-economy-falters-20160505

Creamer, T. (2016). Eskom letter sends shock waves through private power sector. Retrieved August 6, 2016, from http://www.engineeringnews.co.za/article/eskom-letter-sends-shock-waves-through-private-power-sector-2016-07-21/rep_id:4136

Cresswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches.* (4th ed.). Thousand Oaks, California: SAGE Publications.

Cummings, T., & Worley, C. (2015). *Organisational Development and Change* (10th ed.). Stamford: Cengage learning.

de Kadt, R., & Simkins, C. (2013). The political economy of pervasive rent-seeking. *Thesis Eleven*, *115*(1), 112–126. http://doi.org/http://dx.doi.org.ezproxy.uned.es/10.1177/0725513612470537

Department of Energy. (2011). *Integrated Resource Plan for Electricity 2010-2030*. Retrieved from http://www.energy.gov.za/IRP/irp files/IRP2010_2030_Final_Report_20110325.pdf

Department of Energy. Integrated Resource Plan for Electricity (IRP) 2010 - 2030 (2013). South Africa.

Department of Energy. (2015a). Renewable Energy IPP Procurement Programme (REIPPPP) for South Africa 1.

Department of Energy. (2015b). *State of Renewable Energy in South Africa*. Department of Energy. http://doi.org/9781920435080

Department of Energy. (2015c). *Strategic Plan 2015-2020*. (Submerge Publishers cc, Ed.). Pretoria: Department of Energy.

Department of Minerals and Energy/Republic of South Africa. (2003). *White Paper on Renewable Energy*. *Unfccc*.

Doukas, H., Karakosta, C., & Psarras, J. (2009). RES technology transfer within the new climate regime: A “helicopter” view under the CDM. *Renewable and Sustainable Energy Reviews*, *13*(5), 1138–1143.

http://doi.org/10.1016/j.rser.2008.05.002

Eleftheriadis, I. M., & Anagnostopoulou, E. G. (2015). Identifying barriers in the diffusion of renewable energy sources. *Energy Policy*, *80*, 153–164. http://doi.org/10.1016/j.enpol.2015.01.039

Euston-Brown, M., Ferry, A., & Giljova, S. (2015). *Municipal Wheeling Agreement for Green Power Development*.

Fabricius, P. (2016). Inga dream again deferred. Retrieved August 28, 2016, from https://www.issafrica.org/iss-today/inga-dream-again-deferred

Gakusi, A., Sartori, D., & Asamoah, J. (2015). Fostering Regional Integration in Africa : Lessons from Sasol Natural Gas Project between South Africa and Mozambique. *Open Journal of Social Sciences*, (October), 187–204.

Giglmayr, S., Brent, A. C., Gauché, P., & Fechner, H. (2015). Utility-scale PV power and energy supply outlook for South Africa in 2015. *Renewable Energy*, *83*, 779–785. http://doi.org/10.1016/j.renene.2015.04.058

Government Communication Information System. (2013). *South African Yearbook 2013/14 - Energy* (Vol. 1977).

Government Communications (GCIS). (2015). Energy and Water. In E. Tibane (Ed.), *Pocket Guide to South Africa 2014/15* (12th ed., pp. 63–74). Pretoria.

Henneman, L. R. F., Rafaj, P., Annegarn, H. J., & Klausbruckner, C. (2016). Assessing emissions levels and costs associated with climate and air pollution policies in South Africa. *Energy Policy*, *89*, 160–170. http://doi.org/10.1016/j.enpol.2015.11.026

Hlatshwayo, S., & Saxegaard, M. (2016). *The Consequences of Policy Uncertainty : Disconnects and Dilutions in the South African Real Effective Exchange* (No. WP/16/113).

Huso, M., Dalthorp, D., Miller, T. J., & Bruns, D. (2016). Wind energy development : methods to assess bird and bat fatality rates post- construction. *Human–Wildlife Interactions*, *10*(1), 62–70.

Inglesi-Lotz, R. (2015). The impact of renewable energy consumption to economic growth: A panel data application. *Energy Economics*, *53*, 1–6. http://doi.org/10.1016/j.eneco.2015.01.003

Joemat-Pettersson, T. (2015). Department of Energy 2015 / 16 Policy and Budget Speech National Assemby (pp. 1–17).

Johnson, J., & Rowlands, T. (2012). The interpersonal dynamics of in-depth interviewing. In *The SAGE Handbook of Interview Research: The Complexity of* *the Craft* (2nd ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Leke, A., & Michael, K. (2015). Reigniting South African growth. Retrieved October 21, 2016, from http://www.mckinsey.com/mgi/overview/in-the-news/reigniting-south-african-growth

Lewins, A., & Silver, C. (2007). *Using software in qualitative research: A step-by-step guide.* (1st ed.). Los Angeles: SAGE Publications.

Lloyd, P. (2012). Restructuring South Africa's Electricity Supply Industry. *Helen Suzman Foundation Focus*, *64*(January), 4–14.

Lombard, A., & Ferreira, S. L. A. (2015). The spatial distribution of renewable energy infrastructure in three particular provinces of South Africa. *Bulletin of Geography. Socio-Economic Series*, *30*(30), 71–85.

Luthra, S., Kumar, S., Garg, D., & Haleem, A. (2015). Barriers to renewable/sustainable energy technologies adoption: Indian perspective. *Renewable and Sustainable Energy Reviews*, *41*, 762–776. http://doi.org/10.1016/j.rser.2014.08.077

Makoni, M. (2015). Lesotho's planned wind farms could endanger birds. Retrieved June 25, 2016, from http://www.scidev.net/sub-saharan-africa/energy/news/lesotho-planned-wind-farms-endanger-birds.html

Maliki, A. Bin, Jahrin, M., Kamarulzaman, N., Ali, N., Azhar, N., & Chew, B. (2012). *PESTLE Analysis on Bieichi Technology -Technology Which Turns Plastic Waste into Fuels .* Melaka.

Mashego, P. (2016). Governing party woos black middle class to regain lost ground. Retrieved October 6, 2016, from http://www.bdlive.co.za/national/politics/2016/10/06/governing-party-woos-black-middle-class-to-regain-lost-ground

Mountford, A., & Rapoport, H. (2014). Migration Policy , African Population Growth and Global Inequality. *The World Economy*, (8329), 21. http://doi.org/10.1111/twec.12268

Nakumuryango, A., & Inglesi-Lotz, R. (2016). South Africa's performance on renewable energy and its relative position against the OECD countries and the rest of Africa. *Renewable and Sustainable Energy Reviews*, *56*, 999–1007. http://doi.org/10.1016/j.rser.2015.12.013

National Planning Commission. (2010). National Development Plan (2030). *Department: The Presedency Republic of South Africa*, 70. http://doi.org/ISBN: 978-0-621-41180-5

National Planning Commission. (2011). *National Development Plan Vision 2030*. http://doi.org/978-0-621-41180-5

NERSA. (2016). *MONITORING OF RENEWABLE ENERGY PERFORMANCE*.

Nissenbaum, M., Aramini, J., & Hanning, C. (2012). Effects of industrial wind turbine noise on sleep and health. *Noise and Health*, *14*(60), 237. http://doi.org/10.4103/1463-1741.102961

Njikelana, S. (2016). Renewable energy: what has Africa accomplished thus far? Retrieved July 1, 2016, from http://www.esi-africa.com/magazine_articles/renewable-energy-africa-accomplished-thus-far/

Oirere, S. (2016). Coping with a lack of skilled solar workers in Africa. Retrieved from http://www.solarnovus.com/coping-with-lack-of-skilled-solar-workers-in-africa_N9799.html

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

Pfenninger, S., & Keirstead, J. (2015). Comparing concentrating solar and nuclear power as baseload providers using the example of South Africa. *Energy*, *87*, 303–314. http://doi.org/10.1016/j.energy.2015.04.077

Pollet, B. G., Staffell, I., & Adamson, K. (2015). Current energy landscape in the Republic of South Africa. *International Journal of Hydrogen Energy*, *40*(46), 16685–16701. http://doi.org/10.1016/j.ijhydene.2015.09.141

Reid, T., Kruger, S., Whitfield, D. P., & Amar, A. (2015). Using spatial analyses of bearded vulture movements in southern Africa to inform wind turbine placement. *Journal of Applied Ecology*, 881–892. http://doi.org/10.1111/1365-2664.12468

Renewable Energy Finance and Subsidy Office. (n.d.). Renewable energy finance and subsidy office. Retrieved from http://www.energy.gov.za/files/esources/renewables/REFSO.pdf

Renewable Energy Policy Network for the 21st Century (REN21). (2014). *Renewables 2014: Global status report*.

SASOL Gas-to-Liquid Overview. (n.d.). Retrieved August 28, 2016, from http://www.sasol.com/innovation/gas-liquids/overview

Saunders, M., & Lewis, P. (2012). *Doing research in business & management* (1st ed.). Harlow: Prentice Hall.

Sebitosi, A. B., & Okou, R. (2010). Re-thinking the power transmission model for sub-Saharan Africa. *Energy Policy*, *38*(3), 1448–1454.

http://doi.org/10.1016/j.enpol.2009.11.025

Seetharaman, A., Sandanaraj, L. L., Moorthy, M. K., & Saravanan, A. S. (2016). Enterprise framework for renewable energy. *Renewable and Sustainable Energy Reviews*, *54*, 1368–1381. http://doi.org/10.1016/j.rser.2015.10.127

Shahbaz, M., Loganathan, N., & Zeshan, M. (2015). Does renewable energy consumption add in economic growth ? An application of auto-regressive distributed lag model in Pakistan. *Renewable and Sustainable Energy Reviews*, *44*, 576–585. http://doi.org/10.1016/j.rser.2015.01.017

Smit, R. (2015). A holistic view on grid integration of renewable energy generation. Retrieved October 2, 2016, from http://www.ee.co.za/article/holistic-view-grid-integration-renewable-energy-generation.html

Smith, M., & Bowers-Brown, T. (2010). Different kinds of qualitative data collection methods. In *Practical research and evaluation : A start-to-finish guide for practitioners.* (pp. 111–126). London: SAGE Publications Ltd. Retrieved from http://0-dx.doi.org.innopac.up.ac.za/10.4135/9781446268346.n8

Sosibo, K. (2016). Land access issues stall wind energy plan in South Africa. Retrieved from http://www.scidev.net/sub-saharan-africa/energy/feature/land-access-issues-stall-wind-energy-plan-in-south-africa.html

South African Energy Department. (2013). Draft 2012 Integrated Energy Planning Report. *World Wide Web*, (June), 2–160. Retrieved from http://www.energy.gov.za/files/coal_frame.html

Stremke, S. (2015). Sustainable Energy Landscape: Implementing Energy Transition in the Physical Realm. *Encyclopedia of Environmental Management*, (September), 1–9. http://doi.org/10.1081/E-EEM-120053717

Sustainable Innovation Forum 2015. (2015). Retrieved May 6, 2016, from http://www.cop21paris.org/

The proposed South African carbon tax. (n.d.). Retrieved May 6, 2016, from http://www.thecarbonreport.co.za/the-proposed-south-african-carbon-tax/

Thopil, G. A., & Pouris, A. (2015). Aggregation and internalisation of electricity externalities in South Africa. *Energy*, *82*, 501–511. http://doi.org/10.1016/j.energy.2015.01.059

Thorpe, R., & Holt, R. (2008). *The SAGE dictionary of qualitative management research*. SAGE Publications Ltd. http://doi.org/http://dx.doi.org.uplib.idm.oclc.org/10.4135/9780857020109

Toor, S.-U.-R., & Ogunlana, S. (2008). Problems causing delays in major construction projects in Thailand. *Construction Management and Economics*, *26*(4), 395–408. http://doi.org/10.1080/01446190801905406

Tshehla, M. G. (2015). *Renewable Energy - 2015 - Market Intelligence Report*. Cape Town.

Utility-scale Renewable Energy Generation Sites - South Africa. (n.d.). Retrieved July 10, 2016, from http://energy.org.za/knowledge-tools/map-south-african-generation-projects

Walwyn, D. R., & Brent, A. C. (2014). Renewable energy gathers steam in South Africa. *Renewable and Sustainable Energy Reviews*, *41*, 390–401. http://doi.org/10.1016/j.rser.2014.08.049

Wee, H.-M., Yang, W.-H., Chou, C.-W., & Padilan, M. V. (2012). Renewable energy supply chains, performance, application barriers, and strategies for further development. *Renewable and Sustainable Energy Reviews*, *16*(8), 5451–5465. http://doi.org/10.1016/j.rser.2012.06.006

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180. http://doi.org/10.1002/smj.4250050207

Winand, J. (2016). The dawn of wind energy in Africa. Retrieved June 30, 2016, from http://www.esi-africa.com/magazine_articles/dawn-wind-energy-africa/

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

World Economic Forum. (2012). *The Global Energy Architecture Performance Index Report 2013*. Geneva.

World Wide Fund for Nature (WWF). (2014). Enabling Renewable Energy in South Africa : Assessing the Renewable Energy Independent Power Producer. *WWF Technical Report : Enabling Renewable Energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme*.

Zalk, N. (2014). What is the role of manufacturing in boosting economic growth and employment in South Africa? Retrieved October 2, 2016, from http://www.econ3x3.org/article/what-role-manufacturing-boosting-economic-growth-and-employment-south-africa

9. APPENDICES

9.1. Appendix I: Semi-Structured Interview Plan

1. Give me your impressions of the renewable energy sector in South Africa.

2. During the bidding process, what barriers and challenges did you encounter?

3. What challenges specific to your organisation were encountered?

4. Do you find that the challenges experienced during the project implementation are due to internal factors or external factors?

5. What skills are lacking in South Africa to efficiently execute renewable energy projects?

6. What environmental factors are considered when planning and executing renewable energy projects?

7. As the sector become more competitive, what will the impact be on the implementation of such projects?

9.2. Appendix II: Letter of consent

Gordon Institute of Business Science
University of Pretoria

MBA 2015/16
INTEGRATIVE BUSINESS RESEARCH PROJECT

Dear participant

I am conducting research on firms in the renewable energy sector, and am trying to find out more about the barriers and challenges experienced by such firms in South Africa. Our interview is expected to last about an hour, and will help us understand how South African firms, particularly those involved in the planning, engineering, procurement, construction management and operation of renewable energy plants have experienced the RE IPPPP programme thus far. Your participation is voluntary and you can withdraw at any time without penalty. Naturally, all data will be kept confidential. If you have any concerns, please contact my supervisor or me. Our details are provided below.

Dr Kenneth Mathu
Supervisor
E-mail: mathuk@gibs.co.za
Phone: 083 982 5597

Don Forsyth
Researcher
E-mail: 15388192@mygibs.co.za
Phone: 082 579 1649

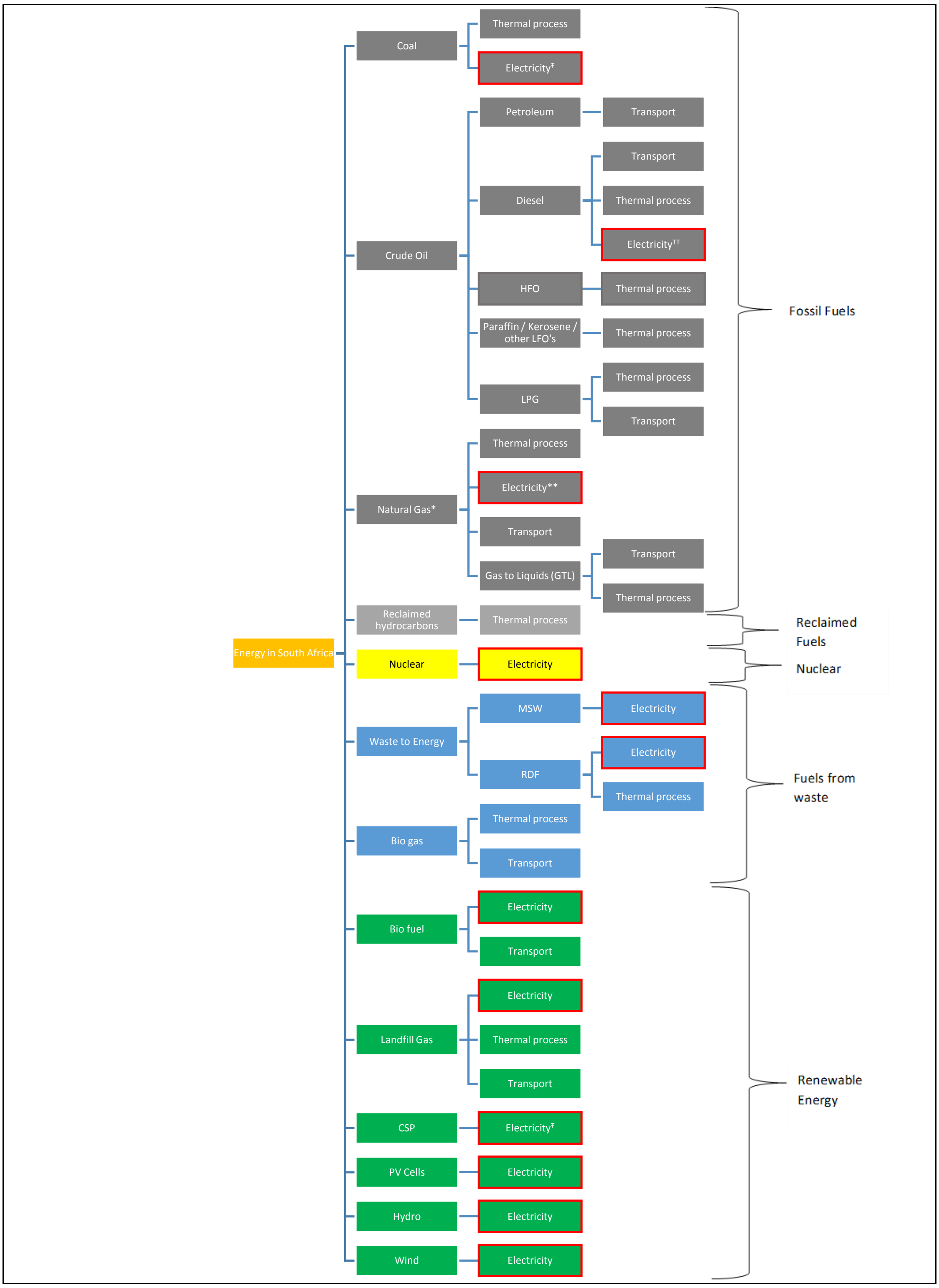
Participant Signature

Date:

Researcher Signature

Date:

9.3. Appendix III: Overview of South Africa's Energy Sector



* = Refers to Mozambique Natural Gas, Coal Bed Methane (CBM), Methane Rich Gas (MRG), Hydrogen-Rich Gas (HRG), Biogenic Methane and Natural Gas derived from the fracking process of extraction.
** = Combined Cycle, Gas Engines and Gas Turbines
Ŧ = Steam Turbines
Ŧ Ŧ = Diesel Generators – Not to be considered in this research

Source: Adapted from *Energy and Water - Pocket Guide*, 2014

9.4. Appendix IV: Code Review Stages

9.4.1. Original set of codes

	Codes
1	Africa
2	Alternative Energy Sources
3	Alternative to the RE IPPPP
4	Awareness
5	Base load
6	Bidding
7	Black Economic Empowerment
8	Capacity
9	Client Satisfaction
10	Community Engagement
11	Competition Act
12	Competition for existing players
13	Competition from large players
14	Competition from overseas companies
15	Compliance
16	Cost
17	Cost Estimate Letter
18	Cost of Capital
19	CSIR
20	Cultural Differences
21	Currency Fluctuations
22	Decision Making
23	Deemed Power
24	Delays
25	Department of Environmental Affairs
26	DoE
27	Domestic Consumer
28	Economic Development
29	Economy
30	Education Institutions
31	Embedded Power
32	Employment
33	Skills - Engineers
34	Environment
35	Environmental Impact Assessment
36	Eskom
37	Feed in Tariff
38	Financial
39	Fraud and corruption
40	Funding
41	Future Recommendations

42	Governance
43	Government
44	Grant Funding
45	Grid Availability
46	Grid Connections
47	Grid Infrastructure
48	Grid integration
49	Guarantees
50	Hydroelectric
51	Infrastructure
52	Innovation
53	Integrated Resource Plan
54	Interest Rates
55	Investment
56	Land Access
57	Legislation
58	Loadshedding
59	Local content
60	Local manufacture
61	Local municipality
62	Macroeconomic
63	Mal-administration
64	Market
65	Micro Grids
66	Negative
67	NERSA
68	New Opportunities
69	Past
70	Penalties
71	Photovoltaic
72	Political
73	Positive
74	Pre-paid
75	Present
76	Procedures
77	Profit
78	Project Performance
79	Project Quality
80	RE IPPPP
81	Rebates
82	Regulated Pricing
83	Risk
84	Rooftop Embedded
85	Skills - Internal
86	Skills - Transfer
87	Technology - Storage

88	Supply
89	Sustainability
90	Tax incentives
91	Technical
92	Time-Based Tariffs
93	Time Zones
94	Uncertainty
95	Water licenses
96	Wind Turbines

9.4.2. Codes added in second round

	Codes
1	Alternate - Gas to Power
2	Alternative - Nuclear
3	Cost of debt
4	Expectations
5	Processes
6	REFIT
7	Renewable Energy Development Zones
8	Skills - Administrative
9	Skills - Construction
10	Skills - Legal
11	Skills - Operational
12	Skills - Project Management
13	Special Purpose Vehicles (SPV)
14	Splitting of contract
15	Technology
16	Technology - Awareness
17	Technology - Storage

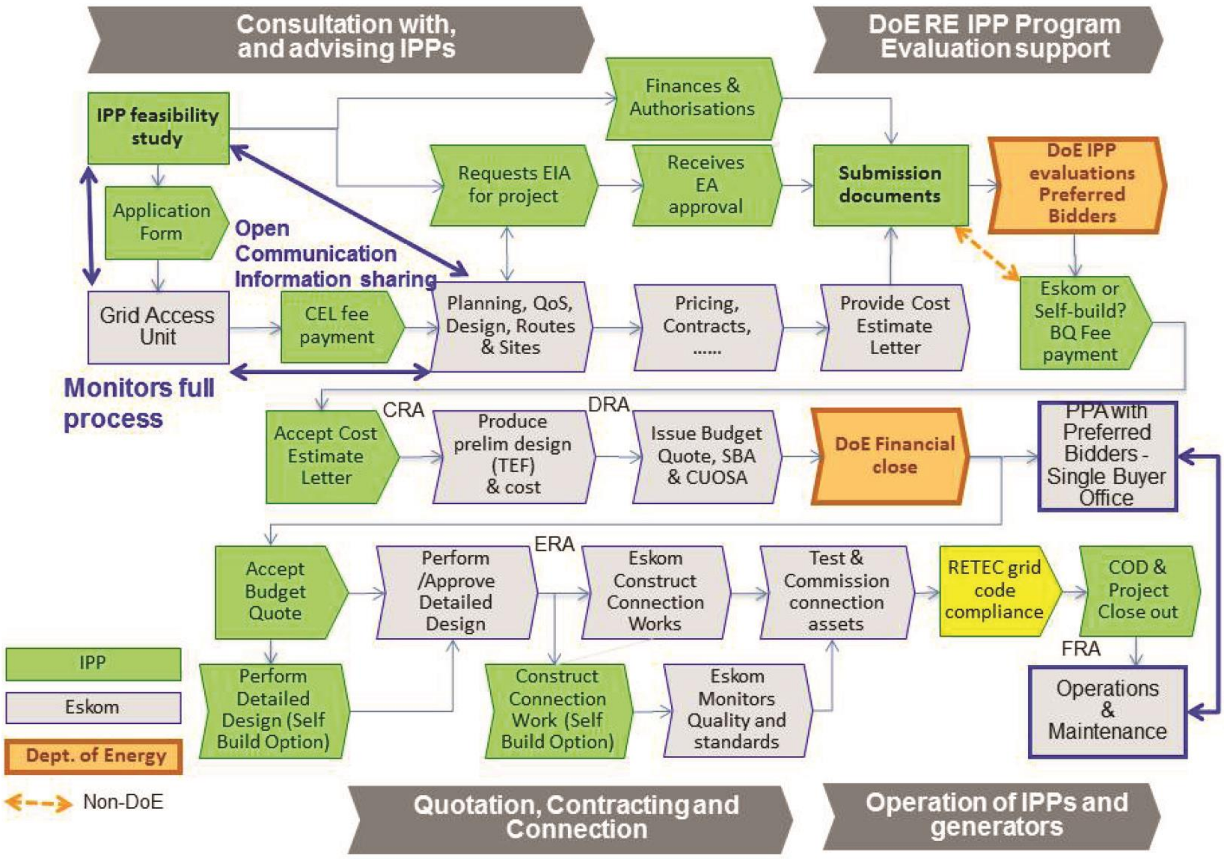
9.4.3. Final code list

	Codes
1	Africa
2	Alternative to the RE IPPPP
3	Awareness
4	Base load
5	Bidding
6	Black Economic Empowerment
7	Capacity
8	Capital Cost
9	Client Satisfaction
10	Community Engagement
11	Competition Act
12	Competition for existing players
13	Competition from large players

14	Competition from overseas companies
15	Compliance
16	Cost
17	Cost Estimate Letter
18	Cultural Differences
19	Currency Fluctuations
20	Decision Making
21	Delays
22	Department of Environmental Affairs
23	DoE
24	Domestic Consumer
25	Economic Development
26	Economy
27	Employment
28	Environment
29	Environmental Impact Assessment
30	Eskom
31	Expectations
32	Feed in Tariff
33	Financial
34	Fraud and corruption
35	Funding
36	Future Recommendations
37	Governance
38	Government
39	Grid Connections
40	Guarantees
41	Hydroelectric
42	Infrastructure
43	Innovation
44	Integrated Resource Plan
45	Interest Rates
46	Investment
47	Land Access
48	Legislation
49	Local content
50	Local manufacture
51	Local municipality
52	Macroeconomic
53	Mal-administration
54	Market
55	Micro Grids
56	Negative
57	NERSA
58	New Opportunities
59	Past

60	Penalties
61	Photovoltaic
62	Political
63	Positive
64	Present
65	Procedures
66	Processes
67	Profit
68	Project Performance
69	Project Quality
70	RE IPPPP
71	Rebates
72	REFIT
73	Renewable Energy Development Zones
74	Risk
75	Skills
76	Skills - Construction
77	Skills - Engineering
78	Skills - Legal
79	Skills - Operational
80	Skills - Project Management
81	Skills Transfer
82	Splitting of contract
83	Storage
84	Sustainability
85	Technical
86	Technology
87	Uncertainty
88	Water licenses
89	Wind Turbines

9.5. Appendix V: Eskom IPP Process.



Source: Smit, 2015

9.6. Appendix VI: Ethical Clearance Letter

Dear Mr Donald Forsyth

Protocol Number: **Temp2016-01046**

Title: **Impediments implementing renewable energy projects in South Africa**

Please be advised that your application for Ethical Clearance has been APPROVED.

You are therefore allowed to continue collecting your data.

We wish you everything of the best for the rest of the project.

Kind Regards,

Adele Bekker