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South African electricity sector: possible policy reforms

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

09 November 2015

ABSTRACT

The study investigated the potential reform of the South African electricity sector. The country has a shortage of electricity capacity and sufficient coal reserves to meet the demand. However it is, at the same time is Africa's highest carbon emitter. Climate change and the reduction of carbon emissions have prompted the country to reconsider its reliance on coal. The South Africa electricity sector is a monopoly held by the state utility Eskom, in all aspects of generation, transmission and distribution.

The research suggested that the current dominance of coal will reduce over the next 50 years and there will be an increase in renewable and nuclear technology. It was also suggested that electricity sector should transform into from an electricity sector to electricity market. Various factors such as property rights, institutions, risk, uncertainty and pricing were reviewed to understand requirements for a potential reform. It was also found that electricity generation was not an impediment but rather the major problem was access to the grid.

A policy is proposed to allow Independent Power Producers (IPPs) ownership to the transmission network and the ability to build their own infrastructure to provide power directly to private customers.

KEYWORDS

Electricity, Market-Reform, Renewable-Energy, Grid-Access, Network, Policies

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.

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1. INTRODUCTION TO RESEARCH PROBLEM

1.1. Introduction

1.1.1. The Power In Eliminating Poverty

A country can only truly prosper if there is sustained economic growth and happy citizens. There must be low levels of poverty, unemployment, inequality, and citizens must have access to basic human rights such as water, electricity and sanitation. South Africa has the highest Gini coefficient in the world and a colossal task ahead to improve the social welfare of its citizens. Electrification is crucial in achieving the goal of improving social welfare. However, the country is plagued with continual load shedding due to a lack of generation capacity - a significant problem for the future growth of the South African economy and ultimately the well-being of its citizens.

The electricity crisis in South Africa is dire however at the same time can be described as complex. Components that contribute to the complexity include; ageing infrastructure and significant investment is required for new power stations, the role of carbon emissions and abundance of coal reserves, and finally the monopolistic electricity sector. The country juxtaposes a need for development in the national electricity sector. Therefore it is imperative that the South African electricity sector solves the current crisis for both social and economic development.

1.1.2. Electricity And The Economy

Due to the shortage of electricity, the growth forecasts for the country have been reduced by 0.3% in 2015 and 0.5% in 2016 (Reserve Bank, 2015). Lack of electricity generating capacity affects the ability of the economy to grow as Odhiambo (2009) had shown that there is direct proportionality in the relationship between economic growth and electricity generation. Castellano, Kendall, Nkomarov and Swemmer (2015) have also estimated that a 1% growth in GDP will require the electricity demand to grow by an average of 1.66%. Business and society require electricity to enable growth.

Since 2008, the country has been plagued with continual load shedding due to the inability of the state utility, Eskom, in meeting current demand for electricity. Although load shedding is a safety mechanism to protect the electricity infrastructure from collapsing, it is causing severe damage to the economy. The situation is dire and further research is required to identify the ideal environment for the country to create

and environment for investment in future power generating capacity. This is a crucial variable in enabling economic growth for business in South Africa.

1.1.3. Green Energy For Economic Growth

Thopil & Pouris (2010) have estimated that, based on the projected electricity consumption, coal reserves of the country will last for at least 200 years. This argues that all new power generating capacity should come from fossil fuels. However at the same time South Africa accounts for 37% of Africa's carbon emissions (Pieters, Lotz & Brent, 2014). The Integrated Resource Plan (IRP) estimated that the country will require 85% additional power by 2030. The IRP aimed to reduce carbon emissions to 275 million tons of carbon per year by 2024. However South Africa produces 92% of its power from carbon intensive technologies which includes coal and gas turbines (DoE, 2011).

South Africa is a developing country and has abundance of coal reserves, but at the same time, it has a responsibility to reduce carbon emissions and incorporate renewable power generating technologies. The future energy mix is a crucial factor that must be clearly defined for the long term strategy of the electricity sector. Should South Africa continue to harness the available coal reserves to bolster growth or reduce carbon emissions by increasing the renewable energy footprint?

1.1.4. Ageing Infrastructure

It is evident that the majority of the current electricity generation problems lies in the country's ageing infrastructure. The average age of the existing power stations is 49.6 years and according to the South African Department of Energy ([DoE] 2011), coal fired plants have a life span of 50 years. It is therefore no surprise that South Africa is facing its current electricity crisis. The last power station to be commissioned was commissioned was in 1988, and existing power stations are at the end of their lifespan. More recently, investments were made in 2007 and 2008 to build two major power stations at Kusile and Medupi, as well as and gas turbine plants. However, for a period of 19 years, between 1988 and 2007, there was little or no investment in new power generating capacity for the country.

The country desperately requires electricity generating infrastructure and the argument lies as to who is going to build the future capacity. It is becoming increasing evident that the state does not have the funding or skills to build the new capacity. This argues that there is a need for increased private power producer's participation in the sector. Increased IPPs into the sector will imply reducing the states monopoly and reforming the South African electricity sector. Therefore in addition to reducing carbon emissions further consideration is required in ownership and investment in the desperately needed new power generating infrastructure.

1.1.5. Liberating The Electricity Sector

Overcoming a monopoly such as the South African electricity sector is not a simple and striagthforward task. Erdogdu (2014) suggested that liberation of the electricity sector is a potential solution in overcoming the problem. This involves facilitating free market conditions to attract IPPs to invest in the South African electricity sector. Ageing infrastructure poses a risk to sustainable power generation thus significant investment is required to achieve the required electricity capacity. All the above objectives can be achieved by the state utility if there is sufficient capital and resources available. Currently Eskom has a debt to equity ratio of 2.7 and accordingly to their financial statements are under liquidity pressure (Eskom, 2015). According to the 2015 Eskom Integrated Report, the recent credit rating downgrade to sub investment grade by Moody's and Standard & Poor's will "*make future funding initiatives more difficult*" (Eskom, 2015).

Increasing private power generation and investment into the electricity sector and reducing the state monopoly will require understanding and clearly defining relevant policies. The IRP has also indicated that there is a gap in polices for potential increased private power production. Clarity and understanding on policies will include property rights, stable institutions, pricing models, agreed fuel energy mix, and access to the transmission network. The background for the study will create the context for the research and includes the following:

- Role of carbon emission, analysing factors that are driving the need for renewable energy.
- The scope of future power generating capacity for renewable and non-renewable energy sources.

- The capital costs of building power generating facilities, pricing mechanisms and sources of funding.
- Liberating the South African electricity sector and investigating the environment and polices that the government should create to promote investment, reduce risk and uncertainty.

1.2. Background

1.2.1. Renewable Energy And Society

The Driving Force for Renewable Energy

According to Borenstein (2012), world data on energy suggests that in 2010, 42% of electricity generation was accomplished via fossil fuels. Apart from hydroelectric power generation, other renewable sources of energy only contribute approximately 2.5% of power generated globally. In most parts of the world fossil fuels remains the lowest cost technology for electricity generation, which is a key driver for the use of fossil fuels. Prior to the 1960's, there was no regulation on air pollution, and furthermore, recent studies have shown that 33% of anthropogenic greenhouse gases come from electricity generation (Borenstein, 2012). These greenhouse gases have been found to be a major contributor to climate change. The underlying argument for increasing renewable energy is based on its low carbon emissions and environmental impact.

Although South Africa has large fossil fuel reserves, the country has initiated policies to move towards lower carbon emissions. The state also holds a position that future investment in coal will make the country less competitive due to carbon taxes (DoE, 2011) and has prompted a commitment to reduce carbon emissions to 34% by 2020 (Pieters *et al*., 2014)**.** This is evident in the IRP 2030 plan to increase renewable energy to 27% of total power generating capacity.

Advantages and Disadvantages of Renewable Energy

Apart from low carbon emissions and environmental impact, Pieters *et al*. (2014) argued that other benefits of renewable energy include reduction of pollutants associated with fossil fuels, increased energy security by reducing dependence on fossil fuel reserves and more predictable and stable pricing as there would be less dependence on coal market dynamics. However, there are barriers to implementing renewable energy technologies. These include a lack of a coherent strategy for long

term sustainability, funding of renewable technology projects due to perceived high risk, large coal reserves, and historical bias towards fossil fuels (Pieters *et al*., 2014).

Although renewable energy is perceived to yield lower carbon emissions, it also has associated negative environmental impacts (Borenstein, 2012). Wind turbines can harm birds and have low frequency thumping noises, large solar projects require large amounts of land that can disturb wildlife in the desert areas, solar panels have metals that require proper disposal, and harnessing tidal and wave power can affect marine life. Renewable energy technologies are not 'silver bullet' solutions and thus many factors need to be taken into consideration.

The migration towards renewable energy is positive for the environment; however there are constraining factors such as limited water storage for hydroelectric plants, and location and weather condition limitations for wind and solar power plants (Borenstein, 2012). According to Pieters *et al*., (2014), IPPs of renewable energy face other constraints such as grid connection delays which can take up to 24 months, obtaining a water license from the Department of Water, and high costs for developing information to bid for renewable plants. In the South African context, it is clear that renewable energy will form part of the future of power generation however there are several constraints to be considered.

1.2.2. Generating Capacity: Non Renewables And Renewables

The Electricity Capacity Problem

It has been identified that no investment in electricity generation infrastructure during a 19 year period has resulted in low electricity margin. According to Pieters *et al*. (2014)**,** the current shortage of electricity will persist in South Africa over the next 10 to 15 years. Eskom, the state electricity provider, has two additional challenges to the current undersupply of electricity. These include reducing high carbon emissions and procuring the funding required for these new power generating facilities, (Pieters *et al*., 2014). Although renewable energy will help solve the initial problem by reducing carbon emissions, there is a concern on the reliability of renewable energy.

Most of the power generated is used for base load demand thus to reduce carbon emissions renewable energy will form part of the base load generating capacity. In South Africa, historically coal and nuclear energy were used for primary base load power generation. Renewable technologies such as solar provide peak power during

the day only, and wind provides power depending on weather conditions. Thus, consistency of renewable supply for base load is a point of concern.

Renewable Energy in Base Load and Peak Demands

Electricity demand is variable, the demand can be separated into the base load and peak demand (Borenstein, 2012). The base load runs for most hours in the day and the peak load occurs for a few hours in the day. Electricity cannot be stored cheaply and there is no buffer capacity therefore power generating units are required to adjust their output to meet consumer demand. The ramping rates of different electricity generating technologies vary. Coal fired and nuclear plants cannot be started and stopped quickly, gas fired and hydroelectric plants are flexible, and wind and solar power are dependent on the weather (Borenstein, 2012). It is evident that no single technology can satisfy the dynamic consumption of electricity.

Garcia, Alzate, & Barrera (2012) argued that renewable energy should be seen as a substitute to base load technologies. The argument of renewable energy is not as straightforward as moving towards a cleaner environment, as incorporation of renewable energy into the stability of the electricity grid is an important component. The IRP 2010 renewable energy percentage of base load demand is shown in Table 1.

Table 1: Percentage of renewable energy in base load demand.

Year	Non-Renewable	Renewable
2010	108% of peak demand	8% of peak demand
2030	90% of peak demand	35% of peak demand

Source: (Department of Energy, 2011)

Although there is a clear shift from the South African perspective of incorporating renewable energy, can renewable energy be sustainably part of the base power supply?

1.2.3. The Financial Perspective

Capital Costs of Building Power Generating Facilities

Thus far, renewable and non-renewable energy have been discussed on the merits of the environment and reliability of base load supply. It has also been identified that ageing infrastructure is a significant threat to the power generating capacity. The IRP

has placed objectives of increasing electricity capacity by 85% in 2030, hence funding will be required for the new capacity. Pieters *et al*., (2014) stated that the second challenge Eskom faced, was procuring the funding required for new power generating facilities. The IRP indicated that Eskom, the state utility, does not have sufficient funding to build the required capacity, and therefore 30% of the total power generating capacity was open to IPPs (DoE, 2011).

The initial costs for creating the power generating capacity has been largely based on the capital requirements. Generally, the capital cost is measured in the United Stated Dollars (USD) per unit of power and generating capacity measured in Kilo Watts (KW). There are also long terms costs known as levelised costs which included capital, operating, maintenance and fuel costs of power generating facilities. The cost is measured in USD and power generated per hour, kilo Watt hours (kWh). The capital and levelised costs required for different power generating technologies are shown in Table 2.

Table 2: Capital and levelised cost for power generating technologies

Technology	Capital Cost (USD/KW)	Levelised Cost (USD/kWh)
Open Gas Turbine	500	0.7
Coal	2500	0.1
Nuclear	5000	0.1
Hydro	2500	0.2
Wind	2500	0.15
Solar	2000	0.3

Source: (Gauche, Brent, & von Backstrom, 2014)

Based on capital requirements Table 2 suggests open gas turbines are the cheapest, renewable energy is as competitive as coal fired power stations and nuclear is the most expensive. However, the levelised costs indicate that coal and nuclear power are the cheapest with open gas turbines being the most expensive. The long term costs become an important variable in the argument for renewable energy. Based on the analysis in Table 2, from a financial perspective, the levelised costs indicate that future generating power should be coal based.

Pricing Mechanisms and Funding

Capital and levelised costs have an impact on the investment in new power generating capacity and end consumer pricing. Historically, electricity prices were low in South Africa and this was due to the excessive investment in the 1970's as well as the drive

for the country to provide cheap electricity to stimulate industrialisation (Eberhard A., 2009). However, the low prices were insufficient to cater for capital expansion and according to Eskom, current electricity prices were 30% lower than required (Pieters *et al*., 2014)**.** Therefore, there is the need to introduce independent producers such as IPPs into the power generation market to achieve cost reflective pricing.

The financing decision for returns on investment of new power generation projects can be achieved through various mechanisms. Once such mechanism is classical normal market instruments such as single feed in tariffs (Garcia *et al*., 2012). These feed in tariffs stimulate investment by fixed price incentives (Jenner, Chan, Frankeberger, & Gabel, 2012). This allows capital costs and internal rate of returns from investors to be determined over a fixed period. Alternatively government can subsidise power projects, but this leads to overconsumption and reduces the incentive to become energy efficient (Borenstein, 2012). Based on this argument, higher prices will drive savings though efficiencies. However, the economically marginalised in society will not have access to power which then calls for lower prices and government subsidies (Erdogdu, 2014).

Financial Trade-Offs: Short and Long Term View

Advances in environmentally friendly power generation technologies have long term benefits which must be balanced with short term trade-offs. The measurement of externalities to fossil fuel power generation is difficult to directly quantify, and therefore instruments such as carbon emission taxes are put in place. Renewable energy or carbon taxes will reduce carbon emissions, but have a negative impact on social issues. Electricity will become less affordable to poor households and affect international competiveness (Goldblatt & Davies, 2002). The cost of the renewable technology or the carbon taxes will ultimately fall in the hands of the consumer, either through direct electricity tariffs or taxes.

Investors and financial institutions require realistic tariffs to achieve acceptable returns on investment and to minimise risk, and at the same, electricity producers must be profitable (Pieters *et al*., 2014). Ultimately the consumer will bear the brunt of a large portion of these costs either through direct tariffs or taxes. Increased cost burdens on consumers impose a risk on social welfare, and reduced popularity of government (Boute, 2011). The trade-off in short term gains will result in sacrifices in the long term. However, placing economic strain in the short term for long term gains will stifle growth and result in civil discontent. Therefore, the role of government is to balance both

perspectives, to ensure growth and create a stable environment that is fair to both the investor and consumer.

The argument lies in questioning what society can afford. Should a developing economy with high levels of poverty and inequality such as South Africa be subjected to the same environmental impact conditions as those that are applied to developed first world economies that actually used fossil fuels to achieve their current growth? South Africa must be cognisant of the environmental impacts; however renewable energy should be driven by the long term agenda of fuel security. Thus the balance of renewable and non-renewable energy is crucial to achieve short term social and economic gains without impacting too severely on the environment in the long term.

1.2.4. Liberating The South African Electricity Sector

Liberating the Monopoly

Electricity markets are natural monopolies, but due to significant investments required to increase capacity, countries around the world are liberalising electricity markets (Erdogdu, 2014). The two underlying reasons are the need for capital to fund expansion, and introducing competition to achieve natural electricity pricing. Liberalisation involves including private investment into the electricity market and according to Boute (2011), investors will always require return on investments. In such a case, the economic equilibrium principle is a tool that government can use to satisfy all role players. The economic equilibrium principle states that there is a balance between decent returns for investors and pricing such that economic development is not stifled and society can cope. The economic equilibrium principle is at risk when there is a violation by government to serve the populist view to gain favour for short term positive impacts for social welfare.

High electricity prices and carbon taxes will create public outcry and government stands the risk of losing office (Boute, 2011). Ideally, if the state had sufficient funding without trading off the other social welfare needs of the country, the economic equilibrium would be much more easily obtained. On the contrary and in reality, current budget constraints are leading to the state to partially privatising electricity production (Boute, 2011).

Recent policies allowed IPPs to contribute 30% of total power demand, with government retaining control of the remaining 70% to address social concerns (DoE,

2011). This stance of the South African government does not outright promote free market conditions and can be considered as attempting to balance free markets and social interests, in the Keynesian economic view. Is the conservative view of government more than economic theory and that there are more prominent factors in play such as history, politics and risk?

1.3. Problem Statement

Research has shown that electricity generation and economic growth have a causal bidirectional relationship. Therefore, South Africa desperately needs to supply more electricity to the market. In order to achieve increased capacity, the following two arguments must be addressed:

- The country has indicated through policy frameworks the intention of migrating to a low carbon electricity sector. However, at the same time the country has an abundance of coal reserves. The use of coal will provide cheaper electricity but it will increase carbon emissions. The incorporation of renewable energy will reduce carbon emissions - however their ability to provide consistent base load has not been proven. Therefore, should all future power generating capacity be renewable energy or is there a balance with fossil fuels?
- Investment is required for the future projected electricity demand and Eskom cannot finance this future expansion. Increased private sector participation is needed, which will require a favourable investment climate with pricing that meets society's affordability. Therefore what policies are required to transition the electricity sector to an electricity market?

The problem resides in firstly understanding the balance between the use of coal and low carbon emissions, and secondly, policies required for increasing IPPs into the electricity sector.

1.4. Purpose of Study

The levelised cost of electricity indicated that non renewables are cheaper than the renewable technologies. This suggests that fossil fuels are the obvious choice, but at the same time, South Africa is responsible for over a third of Africa's carbon emissions and the proposed plan in reducing the reliance on fossil fuels. Investment is required

for increased power generating capacity and the argument is based which entities are going to make the investment i.e. state vs private. In order to facilitate private investment, reform of the electricity sector is inevitable.

The purpose of this study was to identify the policies required to enable increased participation of IPPs in the South African electricity sector.

1.5. Research Objectives

1.5.1. Primary Objective

The primary objective of the study will be to identify the policies required to reform the electricity sector for increased private power generation.

1.5.2. Theoretical Objectives

Increasing private power generation is a relatively new concept in South Africa; therefore, from a theoretical perspective, the study will focus on the following key points:

- Review literature on electricity generation in South Africa
- Review literature about the development of renewable energy generation
- Review the current regulatory regime on electricity
- Review theory on policies, institutions, electricity reform models and electricity pricing

1.5.3. Empirical Objectives

Liberalisations of electricity markets in many countries have occurred since the early 1990s, with varied results. From an empirical perspective, the study will aim to establish the following:

- Institutional contribution to the electricity sector
- Benefits of the increased role of IPPs
- Benefits of IPPs model that would help reform the electricity sector

1.6. Research Chapter Classifications

Below is a brief overview of the content for the following chapters in the study.

Chapter 2 Literature Review

Develop the argument for the study based on academic literature. This will include the history of the South African electricity sector, reliance on coal, the role of climate change and the green economy. Theory on privatisation and nationalisation, the role of institutions, property rights, risk and uncertainty required for market reforms was discussed. Core policy documents and frameworks relevant to the electricity sector were reviewed; these included the National Development Plan (NDP), IRP and the Mineral and Petroleum Resource Development Act (MPRDA). In order to understand transformation, an electricity reform model, vertical and horizontal bundling and the role of politics were analysed. Policy options for IPPs that create stability and credibility were also considered. Finally the current electricity distribution in South Africa and electricity pricing models required for private participation in the sector were reviewed.

Chapter 3 Research Questions

Clearly define the objective of the study based on the argument developed in Chapter 2. There are four themes leading research questions to meet the stated objective of the study.

Chapter 4 Research Methodology

Outline exactly the methods of data collection and analysis techniques to answer the research question. The following was also included; defining the population, sampling techniques, design of the interview and study limitations.

Chapter 5 Results

The results of the research will be presented. The interviews were analysed and grouped into themes and sub themes. Seven themes and eighteen sub themes were identified from the interviews. The views of respondent were presented to identify convergence or divergence on specific themes and subthemes.

Chapter 6 Discussion of Results

The themes and subthemes obtained from Chapter 5 were compared to the literature reviewed in Chapter 2. Discussions of results were debated with literature on both

points of convergence and divergence. The research propositions in Chapter 3 were reviewed and compared to identify which propositions were supported and which were not.

Chapter 7 Conclusion

The final chapter summarises the primary, theoretical and empirical objectives of the study. A model for the inclusion of IPPs into the electricity sector is proposed. Final conclusions and recommendations for future research were discussed.

2. LITERATURE REVIEW

Transformation of the South African electricity sector requires an understanding of how the electricity sector developed and factors that have resulted in the heavy reliance in coal. The literature also aims to understand the drivers of climate change, the move towards lower carbon emissions and the green economy. This created the basis for debate of the future energy mix that IPPs would need to consider. In order to transform the electricity, conditions for privatisation and nationalisation were reviewed. Also important to transformation is the role of institutions, property rights, risk and uncertainty. These points were analysed to understand and develop the theoretical requirements for transformation.

The regulatory regime ultimately defines the direction of the electricity sector therefore three documents that are relevant to the electricity sector were reviewed. These included; NDP, IRP and the MPRDA. There have been many countries that have undergone transformation of the electricity sector and a model for transformation was developed, this was reviewed to identify suitability for the South African electricity sector. The monopoly of current electricity sector in all areas of generation, transmission and distribution was analysed. This aided in understanding the benefits IPPs will have in a transformed electricity sector.

Increasing private power generation will require private investment and investors will require return on capital investments. Therefore the current pricing and future pricing mechanism for private power producer participation is discussed.

2.1. History of the South African Electricity Sector

The South African electricity market has undergone significant change over the past one hundred years. This section reviews the development of the electricity market and factors that led to the current reliance on coal. The South African coal industry production and consumption of coal is also analysed.

The History on Fossil Fuels Reliance

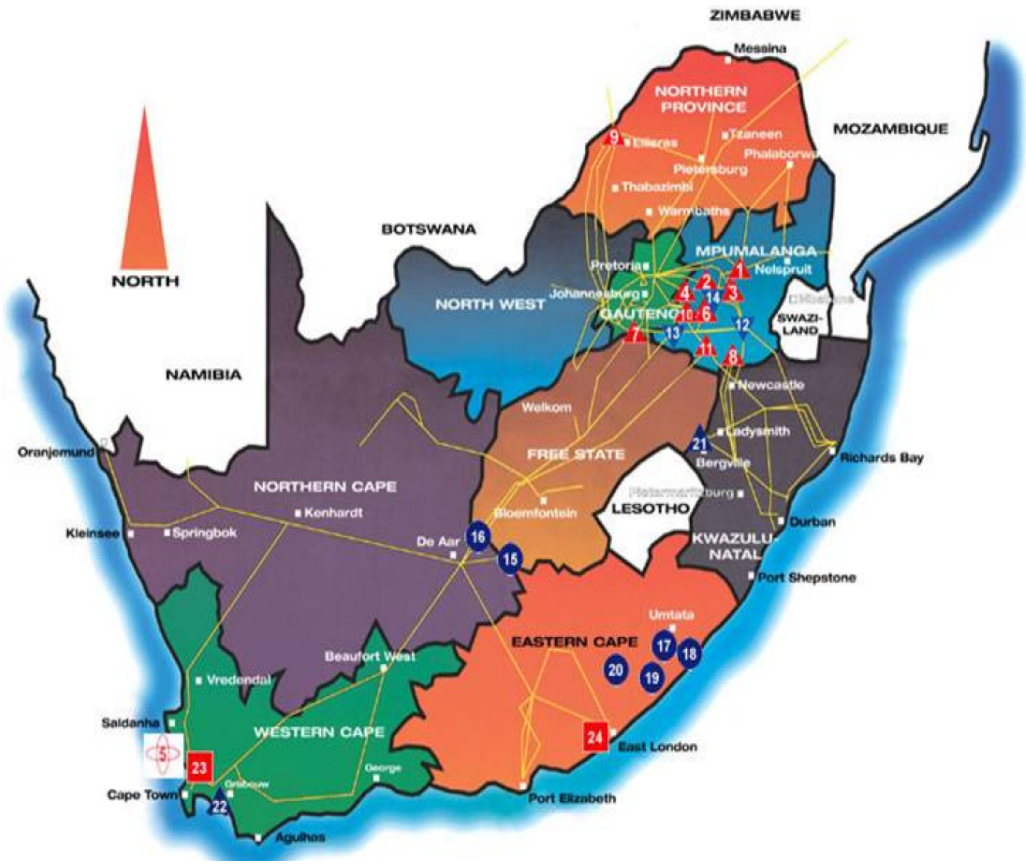
According to Eberhard (2009), the South African electricity industry began in the early 1900's to supply the gold mining industry. During this period, mines built their own power stations to cater for operational requirements. Shortly after the early 1920's, individual power stations were merged together, which led to the birth of the national

electricity grid. At the time, the government envisioned electricity as an important driver of industrialisation (Eberhard, 2009).

During this period, all electricity generating units were powered by coal and the state's objective was to ensure a steady supply of coal at low prices via low labour costs. In order to achieve this, the South African government imposed taxes on citizens, forcing black labourers to seek short term employment in mining towns (SA History, 2015). The wages were low which resulted in a low cost of mining coal relative to the rest of the world (Goldblatt & Davies, 2002). In 1922, the state created the Electricity Supply Commission, ESCOM, and by 1973 ESCOM controlled all power stations and the grid transmission. In the 1970's, the world oil crisis resulted in the state investing heavily in new coal fired power generating plants for the following decade. This investment allowed for cheap electricty prices and an extremely high reserve margin.

Geographically, many of the power stations were built near the coal mines, which are located in the north east of the country. This is evident in Figure 2 below which shows the map of the coal deposits in South Africa

Figure 1: Map of power stations in South Africa



Source: (Newberry & Eberhard, 2008)

In Figure 2 there are there thirteen coal fire power stations shown by the red triangles, there are two hydro stations shown by the red squares, there are five pump storage stations shown by blue triangles, there are six gas turbines shown by the blue circles and finally one nuclear power stations shown by the white square block. In Figure 2 it is evident that many of the power stations are located close to the coal mines in Mpumalanga as 13 of the 24 power generating facilities are within this region. This also suggests that infrastructure such as transmission networks and load centres are located in the north east of the country.

Electricity Market: Pre and Post-Democracy

Politics plays an important role in electricity generation for a country. Natural monopolies such as the electricity sector are formed due to high capital costs and national strategic agendas. In South Africa, there are two political periods that affected the role of the electricity sector; the apartheid era pre 1994 and democracy post 1994. During the apartheid era, South Africa was under international sanctions which limited international trade and the country was considered a closed economy (Goldblatt & Davies, 2002). International sanctions forced the apartheid government to become energy self-sufficient. Thus, fossil fuels were an obvious choice due to large reserves and cheap labour (Goldblatt & Davies, 2002).

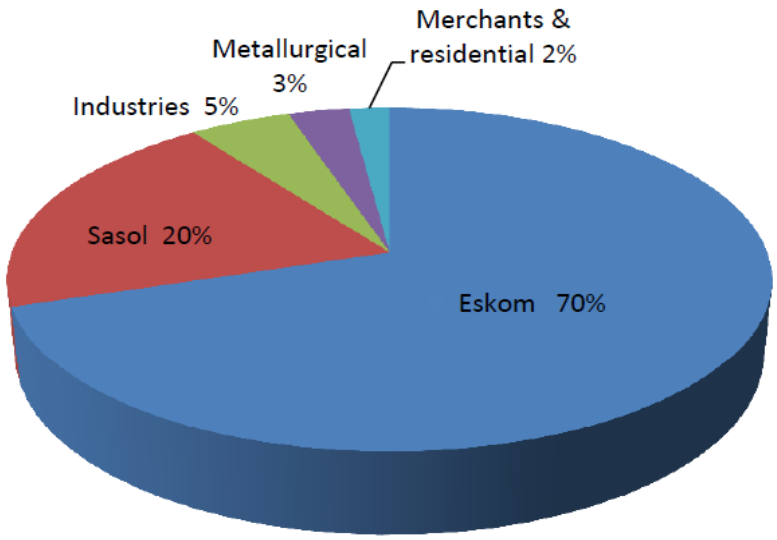
However, in 1994 the African National Congress (ANC) won the first democratic elections and the economic philosophy held was of a socialist view. The ANC-led government embarked on an electrification program which resulted in the number households with access to electricity growing from 30% in 1993 to 70% in 2004 (Goldblatt & Davies, 2002). During this period, the ANC led government had trade alliance partners that were against the privatisation of state enterprises such as Eskom, as they feared it would harm the poor and result in job losses (Eberhard A., 2009).

The role of government is critical when determining the future role of the electricity sector. The direction of government pre democracy was industrialisation and post democracy was social improvement. The IRP suggested that government will retain 70% ownership of the electricity sector by 2030. Therefore government will need to put in place adequate policies to ensure successful private sector participation for the remaining 30% ownership.

South African Coal Industry

South Africa has significant coal reserves and in 2009 South Africa was the sixth largest global producer of coal in the world, producing 247 million tonnes of coal per annum. The country was the fifth largest exporter globally, exporting 67 million tonnes of coal per annum (Eberhard, 2011). Figure 2 below shows that Eskom accounts for 70% of the country's total coal consumption which it uses to fuel power stations. Sasol makes up a further 20% of the market, while the balance is used in industries, metallurgical, merchants and residential uses as shown in the Figure 3 (Eberhard, 2011):

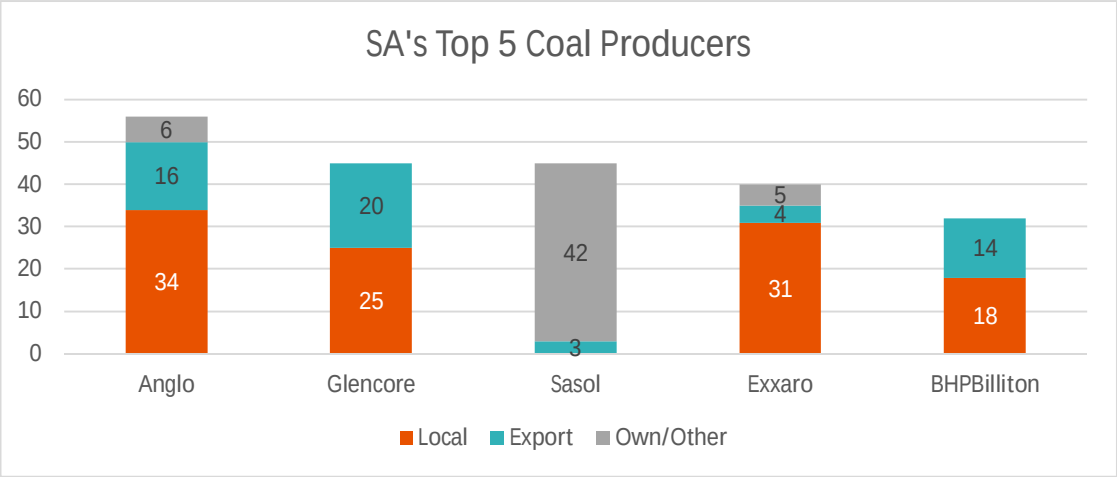
Figure 2: Coal usage in South Africa



Source: (Eberhard, 2011)

It is evident from Figure 3 that the South African coal industry is reliant on Eskom. Reducing the use of coal for power generation will negatively affect the coal industry. The coal industry is labour intensive and reduction will result in a loss of jobs. The top five producers in the country are Anglo American, BHPBilliton, Glencore, Sasol and Exxaro. They make up 84% of total coal production in South Africa.

Figure 3: Top 5 Coal producers in South Africa



Source: (Oberholzer, 2014)

It was stated by du Venage (2013) that the South Africa has a substantial value in coal and required legislative plans and policies to realise this value. Du Venage (2013) further stated that there were more than 20 prospective projects, but investors were not prepared to take the risk as government's policies towards coal were not clear. This highlights the need for adequate policies from government.

Coal mining activities have seen many power stations concentrated in the north of the country, in close proximity to their main source of fuel. Prices have been cheap due to cheap labour and close proximity to coal mines. At the same time, South Africa exports 27% of its coal. If coal export prices increase or labour becomes more expensive, then the low price of coal for electricity generation will not be sustainable. In the electricity sector, Eskom, consumes 70% of coal produced, this argues the point that the country should continue to develop future generation power from coal based sources. Ultimately the position of government on key policies will define the direction of the electricity and the coal industry.

2.2. Climate Change and the Green Economy

2.2.1. Climate Change

Although South Africa has an abundance of coal, globally the move towards low carbon economies has become increasingly important. According to Nhamo (2013), globally the position is to limit the temperature rise by two degrees above pre-industrial levels as an increase beyond this level will result in severe climate change. Trends

have indicated that natural disasters are on a sharp upward trend. Climate change also has a negative impact on the health of people due to higher temperature changes (Pegels, 2010). It is clear that climate change is taking place and while there is a correlation with increasing temperatures, there is no evidence of causation.

Climate change is one of most serious problems faced by countries, thus the emphasis on identifying ways to reduce greenhouse gas emissions, particularly in the energy sector (Pegels, 2010). The portion of carbon emissions that stems from the electricity sector accounts for the largest proportion of greenhouse gases (Pegels, 2010). Although South Africa is responsible for 1.1% of total global emissions, the carbon emissions are 2.45kg per USD 2000 Gross Domestic Product (GDP) for South Africa compared to the European Union at 0.38kg, Latin America at 0.59kg and Sub Saharan Africa at 1.53 kg (Williams, 2015). This suggests that the South African energy sector is inefficient and a high carbon emitter when compared to its peers.

Climate change is also likely to intensify the water scarcity in South Africa (Pegels, 2010). Musango, Brent, & Bassi (2014) stated that South Africa is water scarce country and the green economy approach will improve the water ecosystem. The main drivers for the green economy include reducing pressure on finite natural resources, increased awareness of energy and water security, and concerns about global climate change (Musango, Brent, & Bassi, 2014).

2.2.2. Green Economy

Development of the Green Economy

The white paper on energy policy published in 1998 outlined that the state's energy production should be sustainable, lead to the improvement of living standards of all citizens, and balance natural energy sources with environmental considerations (Energy D. o., 1998). This eluded to the development of the green economy which Musango, Brent, & Bassi (2014) have gone on further to model. The South African green economy model developed suggested that in the longer term the prices of coal will go up and prices of renewable energy will decrease. Therefore with renewable energy, electricity prices should drop (Musango, Brent, & Bassi, 2014). This is mainly achieved by reducing invasive plant species and generating electricity from the biomass. The estimated water saving is 242 million tonnes and 30 MW per year of electricity generation (Musango, Brent, & Bassi, 2014). Although electricity generation

from biomass will save water, the energy generated will be insufficient to serve the current needs of the country.

There are three pillars that are crucial for a green economy. Firstly, regulations are required to reduce carbon emissions, secondly incentives for business to develop green technologies need to be in place, and finally public awareness needs to be increased (Nhamo, 2013). However, South Africa is far from ready for the green economy transition, as more budget allocation is required for institutional capacity and alignment on the goals for the green economy (Nhamo, 2013). Although the country is not ready for a green economy, initial steps can be taken for a sustainable energy mix for electricity generation.

Sustainable Energy Mix

The White Paper on Energy policy also highlighted the following points for a sustainable energy mix for a greener economy:

- Coal will remain the major source of energy, although cleaner technologies are required
- Nuclear will depend on environmental and economic merits
- Renewable energy focus should be in mainly remote areas where the gird supply is not feasible

Newberry and Eberhard (2008) have shown that current coal power stations are located in the north of the country and future coal power stations will remain in the north of country due to transportation of coal. However nuclear power stations can be located on the coast and renewables in different locations around the country (Williams, 2015).

Currently, SA has 8% of the world's uranium reserves thus making a strong case for the use of nuclear as sustainable energy (Williams, 2015). However the investment required is over R1 trillion, therefore foreign investors need to be found (Williams, 2015). This implies that a key component to a sustainable energy mix will require appropriate investment policies. Although nuclear will contribute to reducing carbon emissions, nuclear power plants will require highly skilled labour, which in turn will result in jobs losses in the coal labour intensive industry (Williams, 2015), a view supported by Eberhard (2011).

South Africa is the sixth largest coal producer in the world with 19 coal fields with an area of 9.7 m hectares (Hancox & Gotz, 2014). According to Hancox & Gotz (2014),

coal will dominate the energy mix for the next 40 to 50 years, although remaining resources of coal are more geographically complex and require beneficiation to meet local power market specification. However according to Pegels (2010) South Africa is also well endowed with renewable energy resources, especially radiation required for solar energy. Thus renewable technologies can be used to create additional generation capacity to alleviate immediate shortage, as well as providing opportunities for economic development. This will allow the cost of electricity generation from renewable energy to fall, while at the same time contributing to the reduction of carbon emissions (Walwyn & Brent, 2015)

Williams (2015) advocated for the increase in nuclear power, Hancox & Gotz (2014) stated there are sufficient future coal reserves and Pegels (2010) argues that there is enough radiation for solar energy. It is evident that South Africa has resources to cater for a varied energy mix. Pegels (2010) also states that policies and instruments are crucial to support renewable energy technologies for the reduction of carbon emissions. Therefore the policy of government is crucial in determining the future energy mix for the electricity sector.

2.3. Policies and Institutions

The literature thus far has indicated the importance of policy for direction. The theory analyses conditions required for either privatisation or nationalisation. The role of institutions and the institutional environment are also discussed to identify how they shape behavioural norms in conducting business. Coupled with institutions are property rights and their influence on reducing investment risk and uncertainty. Also discussed are property rights and government intervention in the market.

2.3.1. Privatisation and Nationalisation

A reform is primarily based on the government's position on nationalisation or privatisation. The neoclassical approach for economic reforms involves achieving the correct prices whereby government allows profit-making participants to seek profit (Henisz, 1999). State owned enterprises are not profit driven and do not follow the classic approach for reform. This suggests that state owned enterprises such as Eskom are not efficient. Niesten (2006) stated that private enterprises are controlled by markets and competition. This indicates that private enterprises are more efficient,

hence suggesting that state assets must be privatised in order to facilitate reforms to improve efficiency. However Suharev (2015) argued that the belief that the private sector is more effective is not entirely accurate, as there is not an exact analysis of all costs and consequences. This suggests the decision on privatisation should be based more than the merits of improving efficiencies.

On the other hand, Angeles (2011) added that nationalisation occurs mainly on extractive industries and international companies are at a higher risk of nationalisation. When profits are high due to commodity prices, the citizens will have the opinion that international companies are robbing the country. This will be supported by the local elite as they would want to gain a share in the companies if nationalised. Due to these reasons, the nationalisation of domestic companies is less common. It is evident that there are many viewpoints for either privatisation of nationalisation. Suharev (2015) has outlined typical conditions that would motivate the need for the state to privatisation or nationalisation.

Privatisation should occur for the following reasons (Suharev, 2015):

- Ideological, reducing the share of public ownership and the value of the public sector. Allowing companies to participate in the economy by sharing ownership of the public assets.
- Provide payments to the country's budget via mechanisms such as taxes and royalties. This becomes increasingly important particularly when the budget is in deficit.
- The objective of increasing the efficiency of assets. Proprietors use assets differently and can yield more or less efficient assets.

Nationalisation should occur for the following reasons (Suharev, 2015):

- Solves the problem of preservation of assets and activities. It is a strategic tool to achieve the social and economic objectives of the government.
- Strengthening and development of public sector. Increasing employment in the public sector by the state having more control of assets.
- Tool to deal with crisis phenomena which include situations when social and economic development worsens. The state can use nationalised assets to absorb cyclic economic events as the state is not strictly subjected to market conditions.

Ultimately, privatisation and nationalisation are aimed at changing property structures for either the long or short term. The long term objective of change of property structures leads to change of investment streams for the state. Alternatively in the short term, the state can create an asset, augment it, free itself from it and generate income from its sale. If the state struggles to manage assets, then it should privatise and resist nationalisation. There is also a choice of increasing state management efficiency or privatising. Based on theory, the state requires investment for new electricity capacity and competition in the electricity sector. Therefore, there is a strong argument for privatising the South African electricity sector. The property rights and institutions are key components in the process of privatisation. These aspects will be discussed further in the next sections.

2.3.2. Institutions

Role of Institutions

Primarily institutions shape, mediate and channel social choices. The state's decision to privatise will rely on the strength of the country's institutional environment. According to Wirth (2014), institutions define the spectrum of typical possibilities of action; they have an impact on existing actors and can also bring about new organisations. This view was supported by McMaster (2012), as institutions are durable social rules that structure relations and provides social communication with degrees of certainty. Mair, Marti, & Ganly (2007) further stated that institutions constitute the rules of the game for doing business, social interaction and human behaviour. Miles, Scott, & Breedon (2012) went on further to state that iinstitutions define the implicit and explicit behaviour norms that provide the economic incentive to society. Institutions are required so that markets can function efficiently. Increasing private sector participation in the South African electricity sector will require strong institutions. When they do not exist, market rules cannot be applied and will result in higher cost of transactions (Mair *et al*., 2007).

An institution establishes individual's duties, roles, obligation and legitimacy. It permits individuals to behave in a certain manner to allow negotiations of daily activities (McMaster, 2012). In a society, the total income is equal to the value produced. An individual can however earn income by adding value or taking value that someone else has produced, thus engaging in rent seeking behaviour. Institutions are important to ensure that individuals or organisations do not engage in rent seeking behaviour

(McMaster, 2012). This is critical for the IPPs as Eskom owns the transmission network and can engage in rent seeking behaviour to reduce competition in power generation, where it also has a monopoly.

There are three main schools of thought on institutionalism, these include sociological, historical and political (Amenta & Ramsey, 2010). The historical institutionalism central thought revolves around explanations for why institutions emerge (Amenta & Ramsey, 2010). The political institutionalism thought is based on the formation of states and political systems which influence political processes (Amenta & Ramsey, 2010). Sociological institutionalism focuses on cultural and ideational causes (Amenta & Ramsey, 2010). Political and historical points of view see institutions as procedures, standards and traditions, whereas sociological adds cognitive scripts and moral templates (Amenta & Ramsey, 2010). The reform of the South African electricity sector will be based on political institutionalism as policies and procedures are required for increased private sector participation.

While institutionalism focuses on the different theoretical viewpoints, common to all perspectives is the institutional environment. According to Henisz (1999), in order to facilitate any type of reform and to create institutional credibility, the institutional environment must characterised by two crucial factors. Firstly, there must be an independent, non-corrupt and respected judiciary. Secondly, there must be a number of checks and balances on executive power to identify how easily governments can change legislation to suit the populist view of the day. Miles, *et al*, (2012) went on further to clarify the environment required for successful institutions:

- Independent legal systems to uphold owners of property rights.
- Political institutions to handle conflicts that do not result in conflict or rebellion.
- Regulatory institutions to prevent monopolies and abuse of workers and consumers.

Institutions and the institutional environment are the foundations of long term sustainable change and the pillars of the reform are influenced by institutional instruments (Inderberg, 2011). Institutional instruments are formal structures that influence, channels attitudes and actions of actors within the environment. It is based on rational an actor, who does what, and how should it be done. The institutional instruments that governments put in place such as structures and regulations act as enablers or hindrances to achieve the desired result (Inderberg, 2011). In the liberalising and facilitating of electricity sector reform, regulatory instruments will

include network access, network access rules, licensing of transmission, licensing of generation capacity and end user tariffs (Niesten, 2006).

Institutional Voids

The absence of institutional structures results in institutional voids. This occurs when supporting institutions that govern regulation, adjudication, property rights and rule of law do not exist (Mair *et al*., 2007). If government structures are weak or corrupt, the conditions in which companies operate favour some over the others, and this tends not to be reliable and consistent (Mair et al., 2007). Thus institutional voids can hinder market creation or hamper market function. The institutional environment creates the platform for interaction and investment in a market. The strength of the institutions, particularly with regards to property, is the foundation that will determine long term success, thus property rights are discussed in the next section.

2.3.3. Property Rights

Role of Property Rights

Institutions establish the cost and benefits under which individuals or groups take their economic decisions, a critical juncture for private investment in the electricity sector. Public policies through institutions generate a change in property rights through their effects on incentives and transaction costs. This alters the behaviours of market exchange and economic performance (Musole, 2009). Angeles (2011) defined property rights as people who invest in capital expect to have the freedom to use and profit from their investment. Institutions relate to the security of property rights and when institutions fail, it is sign that individuals do not find it profitable to invest in the country (Angeles, 2011). When property rights are not clearly defined, transaction costs arise and market failures occur. The strength of a right is important; if the owner can freely determine the use of the asset then they have absolute right (Musole, 2009).

There are mainly two types of property rights: legal and economic. Legal rights are defined by the state and recognised by law. Economic rights are the ability of an individual to exercise their rights on an asset (Musole, 2009). Musole (2009) further categorised property rights into open access, communal property, private property and state property. Each type is described below:

- Open access is when the rights are not exclusively assigned to an individual or group.
- Communal property is when the rights are assigned to a specific community. They can excluded outsiders from using the land and regulate control by its members.
- Private property rights are when the right is assigned to specific individuals or corporations. The state or community can impose limitations on the rights.
- State ownership is when the state possesses the rights. The state can transfer some rights to communities or private entities.

Including private producers into the electricity market will require private property rights. Policies outlined by government with regard to fuel mix and allocation of power producing rights must be set for the long term. Government intervention in the long term due to change of political ideology must not occur, if it is to reassure investors about the strength of the property rights.

Risk and Uncertainty

Risk is the uncertainty of the expected rate of return for an investment. To achieve economic efficiency, the correct incentives are required. This is a function of risk reduction which in turn is a function of property rights (Musole, 2009). If investments are subjected to unilateral expropriation then there should be high rates of return to compensate investors for risk incurred (Angeles, 2011). Property rights supported by strong institutions reduce risk as they enable investors to receive future benefits from their investments, and they create incentives for markets to be developed in the long term. Privatising state assets require strong institutions, property rights and transaction costs.

Property rights create incentives to use resources efficiently, because the stronger the right to property, the more efficient the use of the resource. Ultimately, property rights reduce the role of risk and uncertainty (Musole, 2009). An investor will expect profits through their investments and this is secured by property rights. However, if institutions are weak, government intervention can occur, reducing the credibility of property rights. For investors, the sovereign debt of a country is an indicator of property rights. If the debt is high then the state will go into alternative sources of funding such as expropriation or increasing taxes to reduce debt levels (Angeles, 2011). Government can take away private capital by two ways, either outright and through taxes. If capital is expropriated by the government, then investors would be

deterred from investing (Angeles, 2011). Private sector participation in the electricity sector will require minimisation of risk and uncertainty.

Transaction Costs

Investors entering a market will incur transaction costs. Transaction costs are both fixed and variable transaction costs. Fixed cost involves setting up the institutional arrangements and variable costs are based on the volume of transactions (Musole, 2009). Transaction costs include the following (Musole, 2009):

- Cost of using the market, preparing for contracts, concluding contracts, and monitoring and enforcing contracts.
- Managerial transaction, cost of setting up and designing an organisation, running the organisation such as information and transferring goods and services
- Political transaction costs, cost of setting up, maintaining and changing the political organisation.

Ideally if transaction costs were zero, then property rights will be fully enforced. Transaction costs limit the ease of market entry as high transaction costs relate to low use of market mechanisms and are a constraint to the private sector. Lower transaction costs can lead to improved economic efficiency (Musole, 2009).

Based on theory, the state requires investment for new electricity capacity and competition in the electricity sector; therefore there is a strong argument for reducing the state monopoly of the electricity sector. Including private sector participation in the South African electricity sector will require strong institutions, institutional environment, adequate institutional instruments, properly defined property rights, reduced uncertainty and risk minimisation for investors. South Africa is a democratic country with a strong judiciary and legal system, thus the institutions and institutional environment is not a concern. However due to the current monopoly of Eskom, private property rights, government intervention and the minimisation of risk in the electricity sector is not clear. In the following section the policies that are relevant to the energy sector were reviewed to identify if there is a gap in policy regarding the fuel energy mix and increased private sector participation.

2.4. Review of Current Policies

Three key policy documents developed in the past decade that impact the electricity sector have been reviewed. These included the NDP (National Planning Commission, 2011), IRP (Department of Energy, 2011) and the MPRDA Act 28 of 2002 (Department of Minerals, 2002). These documents form the basis for the future power generating requirements for the country and the investment climate required to facilitate this growth.

2.4.1. National Development Plan

The NDP was developed in 2011 with objective of creating a 2030 vision for South Africa. The report highlights the main challenges that the country faces. Currently millions of citizens still remain in poverty, with 39% of the population living below the base poverty line of R 418 per month. This is further compounded by the fact that South Africa has the highest Gini coefficient in the world, which recently increased to 0.7. The social status of the country can be described as high inequality and high poverty levels. The NDP identified that, due to globalisation and the increasing the competitiveness of South Africa, the country must grow mining output to reach development goals. However, at the same time, mineral resources need to be extracted sensibly to benefit the people and not further drive inequality.

The NDP had outlined nine key areas to achieve the 2030 development goals. One of the nine areas was the power infrastructure required to achieve the goals, these include:

- People with access to the grid should be 90% by 2030.
- Procuring 20 000 MW of renewable electricity by 2030, decommissioning 11000 MW of aged coal fire power plants.
- Transition to a low carbon economy.
- Demand side savings by installing of five million solar water heaters by 2030.
- Simplifying the regulatory regime to encourage renewable energy and IPPs.

The NDP recognised the need to move to a low carbon economy and estimated that an additional 29 000 MW of power is required by 2030. During this process 11 000MW will required to be retired due to ageing power stations. Thus there is a need to build 40 000MW of additional capacity of which at least 20 000 MW should be renewable. The plan also acknowledged that there needs to be an accelerated procurement plan

from IPPs. The plan also highlighted the gap in policies to create a suitable and attractive investment climate for IPPs.

2.4.2. Integrate Resource Plan

The IRP was developed to guide the process for building new power capacity for the period 2010 to 2030. This was accomplished using the Revised Balanced Scorecard (RBS). The aim of the RBS was to find the optimal solution for reducing carbon emissions, dealing with new technology uncertainties, water usage required for new capacity, localisation, and job creation in both the construction and operational phases of new fleets, regional development and security of supply. The plan outlined the build of 42.6 GW of additional power by 2030, this is slightly more than the 40 GW outlined by the NDP. The mix includes 9.6 GW nuclear, 6.3 GW coal, 17.8 GW renewables, 8.9 GW other generation. The policy was guided by the 2024 emission constraint of 275 million tons of carbon per year. This seemed to be the main driver of the move towards the earlier adoptions of renewable power generation. The renewable portion is slightly lower than the NDP target of 20 GW.

The IRP policy outlined many concerns with regards to the new fleet required. Nuclear power plants will help achieve carbon emission targets; however the cost and time to build an entire nuclear fleet might not be feasible. At the same time, South Africa has the advantage of experience in industrialising the technology - intellectual property that can be used to the countries advantage. Nuclear will also reduce security of supply and operational costs are the lowest among all types of power generation technologies. This view was supported by analysis of Gauche, Brent, & von Backstrom (2014), shown in Table 2. On the other hand, building a new fleet of coal fired power plants would require the emissions target to increase.

The document advocated for building future coal fire power plants between 2019 and 2026. The main concern for the Department of Energy was the security of supply. Although coal was in abundance, the carbon taxes on additional coal options will make South Africa less competitive and put jobs and the country's growth at risk. The IRP outlined main risks for the building of new fleets and these were:

- The heavy reliance on coal fired power stations and emission constraints.
- Over stating future demand which will result in assets that are idle.

- Renewable energy plants are new technologies and the learning curves are steep. It is possible that the new plants will not deliver on name plate capacity and this will increase the overall cost of electricity.
- Currently there are long term contracts which ensure that coal for power stations is priced well below world prices. When the contracts expire there is a risk that attractive global prices will create competition for coal as a fuel.

The IRP raised key two key issues that required further investigation to facilitate the development of the projected increase in power generation facilities. This included the realistic demand outlook in the future as incorrect estimates can have a detrimental effect on the financial status and economic growth of the country. The second issue raised is the promotion of non-Eskom power generation which is also aligned to the NDP. The IRP raised concerns about the regulatory framework and policies for IPPs and streamlining the approval process for procurement.

2.4.3. Mineral and Petroleum Resources Development Act

The MPRDA is law, unlike the NDP and IRP which are frameworks that can change over time. The objective of the MPRDA was to promote equitable access to mineral and petroleum resources, with a focus is on expanding opportunities to historically disadvantaged persons. Ultimately, the Act promotes the economic growth of the country, increased employment opportunities and development of downstream industries. However there was mention of using the country's resources in an ecologically sustainable manner. Overall the MPRDA was focused on socio economic development.

The policy document outlined the procedures to follow and ministerial responsibilities. There was ambiguity in many instances within the Act. It was unclear what the requirements for promoting rights and interests of communities were: "*the Minister may impose such conditions as are necessary to promote the rights and interests of the community, including conditions requiring the participation of the community*". From an investment perspective, the guidelines to promote communities are solely based on the Minister's discretion.

The beneficiation strategy was unclear for investors, as "*if the Minister, acting on advice of the Board and after consultation with the Minister of Trade and Industry, finds that a particular mineral can be beneficiated economically in the Republic, the*

Minister may promote such beneficiation subject to such terms and conditions as the Minister may determine". The terms and conditions were again unclear and solely based on the Minister's discretion. The MPRDA is a key policy for investment; however it serves more as a procedure for the application of rights. It lacks conflict resolution and many decisions are at the discretion of the Minister and the Board.

The three documents discussed above are crucial building blocks for the future of the power generation capacity of the country. The NDP advised the future plan for the country and the reasons for the need to increase capacity. There was a strong focus on the social improvement of the citizens and the need to transition to a low carbon economy. The IRP viewed the risks of the increased capacity and delivers more in the detail of the achieving goals. There was a discrepancy between the allocation of power generation to renewable energy and future capacity.

However both NDP and IRP had the view that a transition to a low carbon economy was imminent and there is a need for a regulatory framework for increased IPP participation. However, the NDP and IRP are advisory documents and cannot be used as certainty for investment and long term property rights. It is only the MPRDA that is a legal document. The MPRDA supported the social improvement agenda and there was a very brief mention of the environment. The policy lacks clarity for investor participation in the electricity sector and renewable energy, a key component required for attracting private investment. These three documents have confirmed the gap in policies and frameworks for increase private power producer participation.

2.5. Electricity Reform Model

The South African electricity sector is monopolised in all three areas of generation, transmission and distribution. Although the MPRDA was unclear about reform in the electricity market, the NDP and IRP indicated that some form of reform should take place. Reform of the electricity sector will involve vertical and horizontal unbundling. This section discussed how this should occur, and the typical steps involved in a reform. Included in the analysis is the role of politics and private producers in the reform process.

2.5.1. Unbundling the Electricity Market

Electricity markets in the world have developed through natural monopolies and can be described as horizontal, vertical or both (Eberhard & Shkaratan, 2012). A vertical monopoly involves having a single entity owning the generation and transmission the supply, and a horizontal monopoly refers to a single entity owning the distribution of electricity. In 1982, Chile was the first country to reform its electricity market through vertical and horizontal unbundling (World Bank, 2012). Currently, South Africa can be described as having a vertical and horizontal monopoly as a majority of electricity generation, transmission and distribution is owned by the state utility, Eskom. According to Eberhard and Shkaratan (2012), reforms include privatisation, vertical and horizontal unbundling, and performance based incentives.

The objective of a reform must address supporting economic growth, improve government's fiscal position and develop affordable access to electricity for the poor (Besant-Jones, 2006). The process of unbundling can lead to efficiency and ultimately lower prices for consumers. However if electricity prices are too low as in the case of South Africa, then unbundling the monopoly may result in an increase in prices (World Bank, 2012). Ideally in unbundling the sector, the transaction cost should be lower if the system is segmented. This is only possible if the power system is large, therefore a necessary condition for reform is economies of scale (Besant-Jones, 2006).

Reform involves improving governance for participants and unbundling can also assist utilities with the common problem of non-collection of revenues (Besant-Jones, 2006). It was estimated that only 75% of revenues are collected by electricity distribution utilities in South Africa, thus forcing the Eskom to forego maintenance (Eberhard & Shkaratan, 2012). Reform through the unbundling of state owned utilities can help clarify roles and responsibilities. This will allow the separation of government and management roles, regulation of prices and quality of services.

2.5.2. Reform Model

Since the reform of the Chilean electricity market, 70 countries have followed the same route and embarked on the reform of their own electricity markets (World Bank, 2012). Thus a standard reform model was developed. The model had been developed by Besant-Jones (2006), Eberhard and Shkaratan (2012), Rabindra and Jamasb (2015) and Jamasb (2006) and there are six generic steps as outlined below:

1. Corporatisation and commercialisation - Electricity enterprises should operate according to commercial principles and be held accountable to those standards. This involves transforming the state owned utilities into separate legal entities.
2. Legislation – The role of government must be focused on the role of policy formation and execution. There must be a legal mandate for reform of the electricity sector. The reform must have a legal basis such as an electricity law or act. In the legal framework, there must be clear guidelines on property rights and conflict resolution.
3. Vertical and horizontal restructuring – There must be a separation of generation and retail activities from the monopoly. This involves breaking up the power utility monopoly into smaller units. Vertical ownership of distribution and generation can lead to discrimination to other generators, distort competition and discourage new entry.
4. Establish rules to promote efficient access to the transmission network. Distribution must be regulated to incentivise efficient generation and reduce non collection. There must be clear rules for access to the network. There must not be discrimination in terms of network access and charges, there must be a reduction of uncertainties for new entries, and there must be a clear framework for future expansion of the system.
5. Privatisation - Separating operational entities from political interference. This involves privatising the distribution network, creating an independent regulator and privatising unbundled segments of the utility.
6. IPPs – Facilitate investment in the absence of sectoral reform. Generation capacity should be split and establish a wholesale electricity market with many generating companies

A horizontal integration result in lack of competition which reduces pressure for cost saving, distorts investments in new capacity, and limits new entrants (Jamasb, 2006). Vertical integration can discriminate those seeking access to the grid as there must be a common cost for all who want to do so. The standard six step model aimed to overcome the challenges of horizontal and vertical integration to allow new entrants into the electricity market. It was evident that the reform model was based on privatisation, policies, property rights and independent institutions that minimise risk and uncertainty.

Unbundling and allowing new entrants must ultimately make the electricity market more efficient. Critical to the reform process is the presence of an energy regulator.

Without a regulator, efficiency gains in generation can be lost due to rent seeking behaviour of actors that own the distribution; this is aligned with the view of McMaster (2012). The regulator has to ensure that utilities can recover costs, increase efficiency and prevent excessive profits. The regulator has to be experienced enough to ensure efficiency gains are passed down to the consumer and not necessarily to the profit of the company. Savings generated through reforms must not be at the expense of the quality of service delivered (Jamasb, 2006).

2.5.3. Political Consideration

The six step reform would be fairly straightforward if it was based purely on economic principles; however politics play a very important role. Therefore there must be political incentives to facilitate a reform process. The reform must enhance the political support of the government in power; there must be minimal opposition from the public and it must provide benefits for supporters (Besant-Jones, 2006). If the reform results in higher prices, the public will believe that they are paying for the reform (Besant-Jones, 2006). This will create social unrest, an unfavourable scenario for the government. Goldblatt and Davies (2002) have also highlighted the importance of the role of government in the direction of the electricity sector for South Africa pre and post democracy.

The reform must suit the income levels of the country as any increase in pricing will adversely affect the poorest (Besant-Jones, 2006). South Africa faces a unique challenge as electricity prices have been historically low and any increase in prices will create a negative impression for reform. The ideal scenario for facilitating a reform would be to increase prices to cost recovering levels, create regulatory institutions, restructure the sector and lastly privatise (World Bank, 2012).

2.5.4. Role of IPPs in Reform

Unbundling power plants fosters competition and could potentially allow for a decentralised distribution model to cater for rural areas electrification (Eberhard & Shkaratan, 2012). At the same time social and political considerations are important factors in the process of reform (Besant-Jones, 2006). IPPs on the other hand can enter under any market structure. This was the approach adopted by countries such as Indonesia, Thailand, Malaysia and the Philippines, who took the route of IPPs to

reform the electricity sector (Besant-Jones, 2006). This is a key point and highlighted that the reform process can start at the inclusion of IPPs, a scenario that South Africa currently faces. The inclusion of IPPs does imply that a full scale reform of the market will not be immediately required. IPPs create additional private capacity and generally are in the form of renewable technologies, a favourable position for the political arena. However, going the route of IPPs will require partial reform of the electricity market and appropriate policies, which will be discussed in the following section.

2.6. Policy Options for IPPs

This section discusses policies required to create stability and credibility for investment. Policy instruments are analysed including the importance of a strong regulator.

The Need for Policy Frameworks

Power sectors are critical for national economic security and achieving social objectives, however the monopoly of electricity sectors means that's there is no incentive to become efficient (Besant-Jones, 2006). Increasing competition will require the addition of private entrants into the electricity sector. Private investors such as IPPs would require policies and laws to create stability and credibility (Besant-Jones, 2006). The success of IPPs' inclusion into the electricity sector is contingent on policy frameworks that are focused on planning, procurement and contracting. The governance structures need to be independent, transparent, accountable and predictable (Eberhard & Shkaratan, 2012). In 1998 a white paper policy on energy policy for the South African electricity market was developed. The policy document, although not in use, outlined the following objectives (Department of Energy, 1998);

- Addressing the needs of the poor to help address social needs.
- Improve the efficiency and competitiveness of electricity generation to provide low cost high quality energy to the industry.
- Long term environmental sustainability.
- Allowing consumers the right to choose their own electricity supplier.

The policy document addressed key outcomes of an efficient electricity sector. There was a long term view on the environment and thus the incorporation of renewable energy. The policy document highlighted that consumers should have the ability to

choose their own supplier, a policy statement that focuses on unbundling the vertical and horizontal monopoly.

Policy Instruments

According to Eberhard & Shkaratan (2012) the success of IPPs must at a minimum have an experienced regulator, timely and competitive bidding and procurement processes, and credit and security arrangements. The World Bank (2012) also argued that institutional instruments for including IPPs must include lower barriers to entry, simplifying licensing and improving incentives for investment and generation. Winkler (2005) went on further to state that government must institute policies that give renewable energy targets. A percentage of supply must come from renewable resources even though this this implies that the government will be ceding partial control of the electricity sector. This was evident in the IRP and NDP policy documents.

In the process of developing targets, government policy can either regulate the quantity of renewable energy or it can fix prices. Fixing prices would require the marginal cost of producing the power. This was also dependent on the type of technology used. Fixing volume can result in different prices and this will distort competition. Winkler (2005) outlined three policy instruments that could be used for IPPs:

- Feed in tariffs is whereby government sets prices for renewable energy. These prices are guaranteed for a specific period of time.
- Development of a renewable electricity portfolio standard (REPS) committee. Government can use the REPS committee to set the target of generation. The committee will have mainly three functions; regulate all purchase requirements, define resources that are eligible for renewable energy and trade in carbon credits.
- Setting aside the fixed generating capacity for renewable energy via the mechanism of renewable obligation. The allocated electricity for renewables is put on tender based on price per kWh.

The policy instruments outlined above have associated advantages and disadvantages (Winkler, 2005). Power purchase agreements through feed in tariffs would reduce risk to IPPs and give certainty, but they could potentially lock consumers into non-competitive prices for many years. On the contrary, setting aside a fixed

allocation and allowing it to go through the bidding process will drive competition in the industry.

Regulator

According to Jamasb (2006) all policies developed for the inclusion for IPPs must be supported by a strong regulating electricity authority. The regulator can be appointed by the state but it must operate as an independent body without any political interference. The regulator must have credible dispute resolution and appeal procedures. The regulator must also be transparent to reduce corruption. Sound polices and strong regulators are the key pillars for the inclusion of IPPs into the electricity market. Other issues for IPPs such as distribution of power will be discussed in the next section.

The process of unbundling must lead to market efficiency and lower prices. The reform model indicates that inclusion of IPPs is the most favourable method to introduce private sector participation. This also supports the agenda of politicians. Policies and instruments are key components to reform. The two arguments for the reform of the South African electricity sector are firstly the type of unbundling, and secondly, pricing policies. The next section aims to understand the vertical and horizontal integration present in the South African electricity sector.

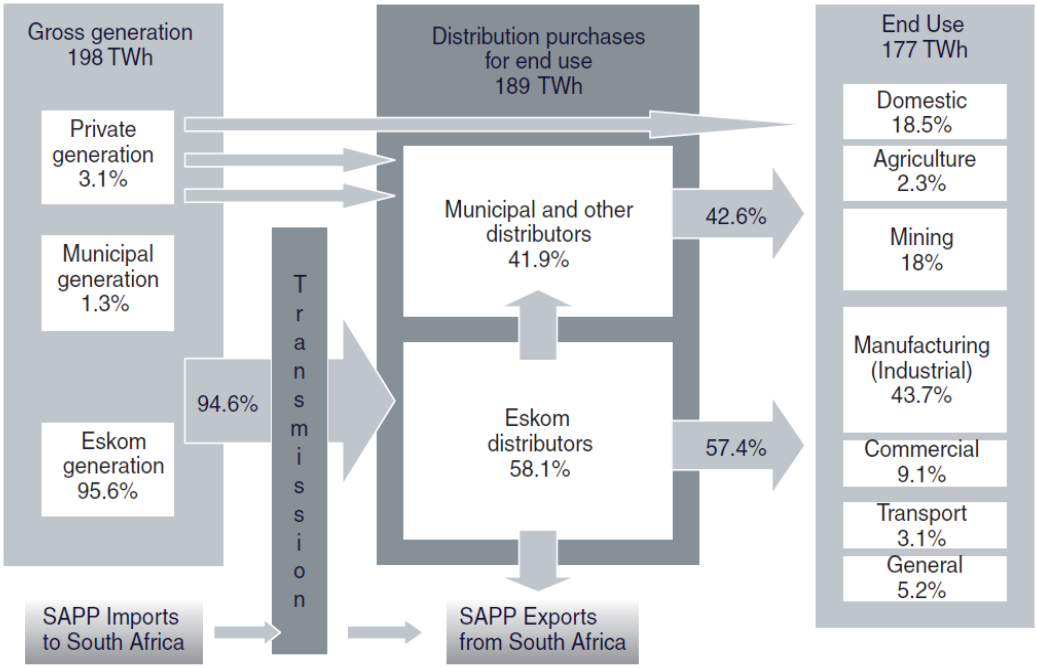
2.7. Electricity Distribution

The South African electricity market is classified as a monopoly. This section analyses the architecture of the South African electricity sector including generation, distribution and consumption. Also discussed are the increasing private sector involvement and the mechanisms to allow participation in the sector.

2.7.1. Architecture

The electricity market can be divided into four sections; generation of power, transmission of power, distribution of power and consumption of power. The electricity distribution for South Africa is shown below.

Figure 4: Overview of South African electricity generation, distribution and consumers



Source: (Newberry & Eberhard, 2008)

In South Africa the generation of electricity is accomplished via four main sources, namely the state utility Eskom, municipalities, IPPs and Imports. The power is thereafter fed into the Eskom transmission network. This power is then delivered to the consumers either through Eskom itself or municipalities. The bulk of power generation is done by Eskom. The sale of power to consumers is mostly done by Eskom with a 58.1% share. This clarifies the monopoly of Eskom on the electricity market, both vertically and horizontally. The three major consumers are mining, manufacturing and domestic. It becomes increasing evident that power shortages will create a slowdown in the economy, resulting in lower economic growth.

2.7.2. Private Sector Involvement

Accordingly to the NDP, South Africa will be procuring 20 000 MW of renewable electricity by 2030, decommissioning 11000 MW of aged coal fire power plants and demand side savings. It also stated that 90% of South Africans should have access by 2030. Increasing capacity and access to citizens will require the grid to be open to other power producers. This will involve an upgrade of the existing transmission

network for both entry and consumption. The current architecture of the South African transmission can be described as a single buyer model. Jamasb (2006) described a single buyer model whereby the independent entity purchases electricity from generators and sells to the distribution network. In the case of South Africa, Eskom is the single entity that purchases power and at the same time it owns majority of the distribution network.

Achieving the targets outlined by the NDP and the IRP will either require further expansion of the state monopoly or the inclusion of the private sector. According to Besant-Jones (2006) there are four ways the private sector can be involved:

- Management contract – The state utility delegate's part or all its operations to an outside party. This will imply that Eskom operations are operated by private entities. Terms and conditions imposed on management contracts can yield more efficient operations.
- Lease and concession – The state utility can lease assets to a third party. Eskom will not have management control of the assets but rather enter into agreements for external management of the assets. The state will remain owners of the assets but will not be directly involved in the management and operation of these assets.
- Divestiture – The state transfers ownership and assets to a third party. This is similar to vertical and horizontal unbundling of assets. This implies that Eskom will not own the monopoly in the electricity market.
- IPPs –The state allows new assets into the electricity market through third parties. The state will maintain control of current assets but reduce their market share of new power generating capacity.

The use of management contracts and leasing are forms of outsourcing and can be considered for increasing the efficiency of assets. New capacity will still be required to be funded by the state. Many countries that have implemented reforms have implemented the divestiture proposal. The use of IPPs is a cheaper option for can aid in increasing the power generating capacity; however it is a form of vertical and horizontal unbundling for future capacity.

Based on the architecture of the South African electricity sector, Eskom is the only purchaser to IPPs. Eberhard & Shkaratan (2012) proposed that IPPs could also sell directly to large customers. This can be in the form of a contract market model whereby IPPs could sell electricity directly to consumers (Jamasb, 2006). This can

reduce the costs of increasing the capacity of the transmission network - a solution that can be favourable for remote rural areas that is far from the grid.

Although IPPs are a favourable option for additional generation capacity, the state utilities are forced to pay IPPs for power generated even though the demand for power is not there (Besant-Jones, 2006). Contracts for IPPs are typically accomplished through power purchase agreements. Power purchase agreements would reduce risk to IPPs and give certainty, but it could also lock down consumers into non-competitive prices for many years if initial pricing is incorrect (Winkler, 2005). There are many factors that need to be considered for the inclusion of the private sector into the electricity distribution network. However, one of the key argument points revolves on the financial implication which is discussed in the next section.

2.8. Electricity Pricing

The reform of an electricity market will also depend on the current and future financial status of the sector. This section discusses funding private capacity and promoting competitiveness with the state utility and policies that are required to guide this behaviour. Also analysed is the pricing model of the South African electricity sector and potential private pricing policies and instruments.

2.8.1. Competitive Electricity Market

Free and fair market conditions will create competition that will ultimately provide the most efficient solution for society, although there will be various interest groups lobbying for policy to favour their interests. As long as government does not have an outright monopoly, it will need to create the right conditions for IPPs to invest. Ideally the guarantee of free market conditions will facilitate investment and free markets will be healthy for the consumer, but there is a risk of state interference (Boute, 2011). The risk factor lies in government's intervention in the long term whereby once investment is made and costs are sunk by IPPs, government might interfere to achieve short term goals. This creates investor uncertainty and project profitability as the state might also the long term change pricing structures need to protect consumer against high prices (Boute, 2011). On the other hand, economic institutional theory requires independence from both private and public actors to preventing long term uncertainty (Boute, 2011).

Funding Private Capacity

According to Eberhard & Shkaratan (2012) inefficiencies exist within current generation systems. The state owned utilities are not incentivised to become cost efficient. This is largely because the state utility has the security of state financing as the state is not profit driven, with the main objective of improving social well-being of citizens. State utilities have access to finance that the private sector may not necessarily have. This does not promote competitiveness in the industry. One mechanism to achieve increase competitiveness would require increasing private sector participation. However, there are major initial capital costs in building power generation capacity. Therefore, according to the World Bank (2012) markets and regulation must create conditions for innovative financing mechanisms. This will require technical support and equity financing to encouraging private generation capacity.

2.8.2. Increasing Prices

Eberhard & Shkaratan (2012) stated that areas that require focus are under-pricing, which must be corrected, and electrification must be nimbler and smarter. The South African electricity sector has enjoyed low electricity prices for an extended period. The low electricity prices and lack of investment are the key drivers of electricity crisis (World Bank, 2012). Eberhard & Shkaratan (2012) further highlighted that 75% of income generated by power utilities goes to operations and maintenance, with very little left for investment. South Africa faces a unique problem as collection of revenues from consumers is poor. Electricity prices must be increased to reflect cost of producing electricity.

According to Eberhard & Shkaratan (2012) poverty levels will not increase if electricity prices increase, as a 50% increase in tariffs will only contribute to 0.1% increase in poverty. Current low prices limit expansion of the electricity sector and associated benefits to the economy. In order to increase prices, the regulator is crucial as it must ensure tariffs are costs reflective and at the same time encourage utilities to increase efficiencies and reduce cost (Eberhard & Shkaratan, 2012). The regulator will act in the interest of the public as consumers can only benefit from efficiency gains through a good regulator (Rabindra & Jamasb, 2015). The principles of increasing the cost of electricity would prove to be more beneficial for the South African electricity sector.

Private Pricing Policies

IPPs can enter under any market structure as they offset the high cost of capital by maintaining better control of construction and operating costs (Besant-Jones, 2006). However, there need to be favourable conditions for this to occur (Besant-Jones, 2006):

- IPPs can enter power purchase agreements through instruments such as competitive bidding.
- Access to the transmission network, and the need for an independent transmission entity.
- Policies to prevent non-payment to IPPs in the long term contracts caused by non-payment of consumers and prices that are not cost reflective.
- The use of instruments such as feed in tariffs. Government sets prices for private power production whereby prices are guaranteed for a specific period of time. This guarantees producers a fixed tariff over long term,

Feed-in tariff policies were implemented in more than 40 countries around the world and are cited as the primary reason for the success of the German and Spanish renewable energy markets (Pegels, 2010). Pricing of electricity in South Africa has been low and required review.

There are many instruments that could be used to incentivise IPPs to enter the electricity markets. Apart from feed in tariffs and government subsidies, other pricing instruments include investment treaties, incorporating international investment law, and power purchasing agreements for long term lock down of prices (Boute, 2011). Other economic instruments such as capacity remuneration can be used whereby investors receive revenues for plant readiness. Also, integrated resource planning can be a tool to integrate supply and demand side characteristics to achieve pricing that could benefit all stakeholders (Goldblatt & Davies, 2002).

2.9. Summary of Literature

The literature review discussed the development of the South African electricity sector. Due to the large coal reserves and available cheap labour, power stations were designed to operate on coal. Historically, electricity prices have been cheap but this could change if coal export prices increased or if labour became more expensive. Currently electricity generation in South Africa uses 70% of coal produced and

reserves are estimated to last at least 50 years. This argues the point that the country should develop future generation power from coal based sources.

On the other hand, climate change, the reduction of carbon emissions and water scarcity counter argue the case for increasing renewable energy into the electricity sector. South Africa is not yet ready for a full scale green economy but steps could be taken to a more sustainable energy mix. As much as South Africa has abundance of fossil fuels, it also has the abundance of natural resources for renewable energy. Both NDP and IRP policies outlined the increase of renewable energy in the future of power generation. This balance will determine the future of IPP participation as IPPs are predominately involved in renewable energy.

Currently Eskom has a monopoly on the electricity market and is primarily focussed on generating power from fossil fuels. To move to renewable energy will require a total shift for the state utility. At the same time, investment is required to build more power capacity and it is likely that investment will come from IPPs. Based on theory, the state requires investment for new electricity capacity and competition in the electricity sector; therefore there is a strong argument for privatising the electricity sector.

Property rights and institutions are key components in the process of privatisation. Private sector participation will also require clear policies reduce investment risk and uncertainty. The literature also highlighted the need for a strong institutional environment and a regular that is not influenced by government. Both NDP and IRP highlighted the gap for policy frameworks for increased IPP participation in the electricity sector. The NDP and IRP are policy documents and not bound by law such as the MPRDA, which does not state anything about increased IPP participation.

Eskom has a monopoly on the generation, transmission and distribution of electricity. Therefore increasing private power producer participation will lead to a form of reform of the electricity sector. The reform model discussed indicated that the inclusion of IPPs is the most favourable method to introduce private sector participation as IPPs can enter under any market structure. The inclusion of IPPs implies that a full scale reform of the sector is not required. IPPs can create additional capacity and generally are in the form of renewable technologies, a favourable option for politicians.

Several models for private sector involvement have been discussed. Increased private sector participation can be in the form of management contracts, leases and divesture. IPPs can also sell directly to large customers to overcome potential grid access constraints, a favourable option for rural electrification. Increased private power

production will require competitive cost reflective electricity pricing. There are several instruments for pricing such as feed in tariffs and power purchase agreements. There is however a risk that the history of low prices is not sustainable and it is inevitable that prices will increase, irrespective if private participation occurs. Cost reflective pricing is critical for private investors seeking returns in the electricity sector.

The next chapter outlines key research questions developed from the literature reviewed in Chapter 2.

3. RESEARCH QUESTIONS

The primary objective of the study was to identify the policies required to reform the electricity sector for increased private power generation. The literature reviewed in Chapter 2 has yielded four themes:

3.1. The Role of Coal

South African electricity market has a strong reliance on coal. The abundance of coal reserves creates an argument to maintain coal as the dominant fuel for future power generating capacity. This however has to be traded off with climate change, the reduction of carbon emissions and thus the introduction of renewable power generating technologies.

The research question: “What is the future of South African coal as the world fights carbon emissions?”

3.2. Transformation of the Electricity Sector

The South African electricity market has been closed for many years, with sufficient generating capacity. This has resulted in the monopoly of the state in all three areas of generation, transmission and distribution. However investment is required for new capacity and increased private power producer participation is imminent. Therefore it the extent of liberalisation of the sector for sustainable private sector participation remains to be seen.

The research question: “South Africa has enjoyed abundant electricity for many years. Are there merits or room for transformation?”

3.3. Electricity Pricing

Electricity market prices have been historically low for South Africa. Current prices are deemed to be not cost reflective and thus have created problems for capital expansion and investment of private participants into the sector. The pricing model is critical to the investment decisions for both state and private participants.

The research question: “What is your opinion on the history of low electricity prices?”

3.4. IPPs in the Electricity Sector

Investment is required by private participants therefore adequate policies must be in place such as property rights, long term purchase agreements and grid access. This also involves reducing the state monopoly and creating policies that reduce risk and uncertainty such as minimising government intervention.

The research question: “What should be the market for IPPs?”

The study will use the four themes emerging from the literature review to fulfil the empirical objectives. Table 3 below outlines the research propositions based on the themes identified.

Table 3: Research themes and study propositions

No.	Theme	Proposition
1	The Role of Coal	Coal should dominant future power generating capacity
2	Transformation of the Electricity Sector	Partially privatise the electricity sector by increasing IPP participation
3	Electricity Pricing	Need to achieve cost reflective pricing by increasing current pricing levels
4	IPPs in the Electricity Sector	Develop free market policies for private participation

Source: (Own Research)

4. RESEARCH DESIGN AND METHODOLOGY

4.1. Choice of Methodology

The design for this study was exploratory qualitative. According to Saunders and Lewis (2012) if a researcher required to seek new insigths on a topic, exploratory research would be most suited. Exploratoy research is usually conducted by searching the academic literature, interviewing experts in the subject and conducting interviews. The research aattempted to understand the policies required to shape the future of the South African electricity sector. The motivations for choosing an exploratory qualitative approach were as follows:

- The South African electricity sector has been dominated by the use of coal. The introduction of alternative power generating technologies is relatively new. Therefore the future outlook on the fuel energy mix has not been finalised by all stakeholders in the electricity sector.
- The electricity sector has been a monopoly since the early 1900s and the outlook on future structure and transformation of the sector has not yet been clarified.
- The recent inclusion of IPPs into the electricity sector is in the early stages. There is a need to close the gap on policies required for increased future IPP participation in the electricity sector.

Therefore an exploratory approach enabled the search for new insights that could guide potential reform of the electricity sector.

4.2. Population

According to Saunders and Lewis (2012), the research design has two crucial factors. The first involves understanding the purpose of the research, as the assumptions of the context will guide the research strategy. The second involves attaining credibility for the conclusions that are presented, as the outcomes of the research must be accepted and plausible. The assumption of the context has been described above. Secondly in order to gain credibility there were a variety of stakeholders involved in the electricity market. These included the state, the energy regulator, state-owned utility, IPPs, investment institutions financing power projects, business, coal mining companies, environmental organisations and civil society.

The population included experts from each sector. The respondents used for the study were high profile professionals with more than 20 years of experience in their respective fields. Further criteria used in choosing participants were their active involvement in the energy sector, and being involved in activities such as public debates, publications and reports. The above mentioned stakeholders were considered to be key opinion leaders who will in the long term, shape potential changes to the electricity sector, and their inclusion in the study gave credibility to the results and recommendations.

4.3. Unit of Analysis

The anticipated conclusion of the study involves an understanding of whether the current environment with regards to government regulation, risk, uncertainty and decent economic returns is favourable for investment in the South African electricity sector. Therefore the unit of analysis was the opinion of respondents on the current and future state of the South African electricity sector.

4.4. Sampling Method and Size

According to Saunders and Lewis (2012) and Marshall, Cardon, Poddar and Fontenot (2013), the appropriateness of the sample is crucial to addressing the research question and lending credibility to the research results. Ideally, the sample size for qualitative research should be large enough that the information obtained reaches a point of saturation and diminishing returns (Marshall *et al.*, 2013). Here efficiency is crucial, as achieving this would be resource-intensive and time-consuming.

The research design was based on grounded theory which involved using the data obtained to develop a theory (Saunders & Lewis, 2012). According to Marshall *et al.*, (2013), grounded theory studies reaches saturation between 10 and 30 interviews. The sample size included interviews with at least 14 participants. The research question aimed to answer a strategic agenda thus the non-probability purposive sampling was used. According to Saunders and Lewis (2012) when a research selected purposive sampling, they are exercising judgement to actively chose who is best suited to answer the research question. Judgement was exercised to determine which particular group of individuals was best suited to answer the research question;.

There were 14 participants chosen from 14 different organisations. The organisations involved included:

1. Three leading mining companies that are responsible for 80% of the production of South African coal. Their view gave an insight of the current and future position of the coal industry
2. The Department of Energy, which is responsible for the creating laws and policies that govern the electricity market
3. The state utility Eskom, which is responsible for 95% of electricity produced in South Africa
4. The institution representing the regulation of energy and electricity prices, the National Energy Regulator of South Africa (NERSA)
5. Two IPPs that are currently involved in the generation of renewable energy
6. One of South Africa's largest banks involved in the financing of IPPs
7. Consultant involved in research of the electricity market
8. Environmental group World Wildlife Foundation (WWF)
9. Business journalist involved primarily in the electricity sector and economic development
10. Opinion leader and radio commentator

4.5. Measurement Instrument

The exploratory research design led to semi-structured interviews. There were four specific themes used for the interview as outlined in Chapter 3. Each participant identified in the population held a different point of view and the nature of the interview determined the flow and direction. Instruments used in the process included a Dictaphone to record conversations, and notes were taken during the interview. According to Onwuegbuzie, Dickinson, Leech and Zoran (2009), typical interviews last between 60 to 90 minutes therefore the interviews were limited to 60 minutes with each of the participants.

The cost and travel for the researchers was taken into consideration and twelve of the fourteen interviews were limited to the Gauteng province. Two interviews were held telephonically as one participant was located in Durban and another in Cape Town. Saunders and Lewis (2012) have indicated that trust is required for semi structured interviews and it was important that participants be met physically particulary for

telephone interviews. The two participants for the telephone interview were previously engaged.

4.6. Interview Design

The design of the interview was semi structured and comprised of four questions. The open ended design of the interviews allowed respondents an opportunity to communicate as much information as possible. Although there was a list of questions, the electricity sector is complex with many components, thus the interview flow was based on information discussed. Care was taken not to direct or influence the respondents answers, but at the same not to stray away from the key themes of the interview. Saunders and Lewis (2012) have outlined the following process when conducting a semi structured interview face to face:

1. Ensure consent forms are printed
2. Explain purpose of research and clearly explaining the time it will take for the interview
3. Agree on a mutally convenient place to conduct the interview
4. Arrive early for interview
5. Conduct the interview
6. At the end, thank the participant for their time.
7. Word process all notes are soon as possible

The researcher took great care when communicating with participants. In order for the participants to consider the request to be part of the research, a two phased approach was taken. Firstly, a brief telephone call was held with the potential participants with and introduction to the research and an explanation of its objectives. The second step of the process involved sending a two page overview of the research and the questionnaire via email. Once this was received by the participants, a meeting was scheduled at their convenience.

On the day of the interview, the objective of the research was clearly stated at the beginning of the interview. It was also made clear that the interview was to understand their view of the electricity sector and was not a fact finding mission. The researcher also articulated the personal motivation for conducting research in this chosen field. This helped create trust between the researchers and the participants. A confidentiality agreement was signed after the introduction and before voice recording and notes

were taken. This ensured that the participants were comfortable and had the freedom to provide in-depth answers.

Prior to the interviews, pre-testing of the questions was conducted on an independent participant and the necessary adjustments were made. Each interview was planned to last for a maximum of an hour but most interviews lasted for 35- 45 minutes.

4.7. Data Collection Process

The availability and willingness of participants to participate in the interviews was crucial to the success and credibility of the study. Data can mainly be collected in one of three ways: transcripts of audio recordings; memory-based collection; and note-taking (Onwuegbuzie *et al*., 2009). The most rigorous data collection method was audio recordings; however, consent was required from the participant (Saunders & Lewis, 2012). The format of the interview was semi-structured and thus an interview guide on the themes with probing questions should was developed. Saunders and Lewis (2012) noted that the interview can be accomplished in three ways: face to face, telephonically or over the web. The preferred method for the study was to collect the data face to face. The following process was used by the researcher for the data gathering process:

1. Draft interview questionnaire
2. Conducted interviews and voice recorded participant responses
3. Transcribed voice recordings
4. Performed intensive data analysis on findings

Due to participant availability, resource and time constraints, only one interview per participant was conducted. The draft questionnaire was developed from the theory outlined in Chapter 2. The questionnaire was open ended and limited to four questions due to the nature of unstructured interviews. Prior to commencing with the voice recording, the participants were briefed to the main reasoning. It was explained in detail that the voice recorder was used to allow the researcher to play back the interview and extract important points. It was also explained that the recordings were confidential and were not to be distributed; hence the name of the participant was not recorded. The recordings were submitted to professionals for transcribing the audio into text format.

4.8. Data Analysis

The technique chosen to analyse data for the study is based on grounded theory. The goal was seeking theory that was tied with the evidence so that resultant theory is consistent with data (Lawrence & Tar, 2013). The first objective was to transfer information obtained from respondents into the format required for analysis. The data gathering process could have been in the form of text or non-text and each data collection method requires different analysis approaches (Saunders & Lewis, 2012). For this research the audio recordings were converted into text format.

Onwuegbuzie, Leech, & Collins (2012) further stated that there are four source types namely; talk, observations, photos and documents. In total there were seventeen techniques that could have been used to analyse the data. The data analysis techniques that are suited to verbal communication are ethnographic, narrative, semiotics, key words, word count, membership categorisation, classic content analysis, and constant comparison analysis.

Ethnographic analysis included techniques such as domain, taxonomic, componential and theme analysis (Onwuegbuzie *et al*., 2012). These techniques focus on uncovering the cultural meanings that people use and relationships that exist between cultures. These data analysis techniques was not be appropriate for the study. The techniques such as narrative and semiotics use stories and a system of signs to give the meanings to the research findings (Leech & Onwuegbuzie, 2008). Neither of these two techniques was be suitable for the data analysis. Membership categorisation was similar as the technique aims to research how terms and concepts are communicated. Keywords in text and word counts are used to understand the underlying meanings of words used and their relevance through frequency of use (Leech & Onwuegbuzie, 2008). This may have been useful for the study in highlighting common terminologies, however would have be insufficient in achieving the desired outcomes.

Other techniques such as qualitative comparative use a truth table in the process of reduction of variables in data. The main objective is to identify causal relationships (Onwuegbuzie, et al. 2012). The study did not aim to find causal relationship and thus the technique was not applicable.

The technique of classic content analysis aims to reduce source information into codes then counts the codes. This was more applicable to the study to identify the codes or themes common among respondents (Onwuegbuzie *et al*., 2012). However according to Leech and Onwuegbuzie, (2008), Onwuegbuzie *et al*., (2012) and Lawrence and

Tar (2013), the constant comparison technique was most suited for grounded theory. The constant comparison method generates sets of themes in three stages which are as follows:

1. Open coding – chunk data into smaller segments
2. Axial coding – groups codes into similar categories
3. Selective coding – integrating categories and developing theory

The constant comparison technique was used for the study data analysis. The response from interviews was grouped into themes and sub themes. These themes and sub themes were used in Chapters 6 and 7 to facilitate discussion and conclusion for the study. The process shown in Figure 7 was used to analysis the data from the interviews.

Data Preparation

1. The interview recordings were submitted for professional transcription services
2. Transcripts were received in batches
3. Once all transcripts were received, they were reviewed
4. After reading all transcripts, the interview recordings were reviewed
5. Consistency was observed between interviews and transcripts, there were few instances where incorrect use of technical terminology were rectified

Open Coding

6. An overview of all interviews was developed
7. The content of each transcript was coded i.e. paragraphs, salient points made

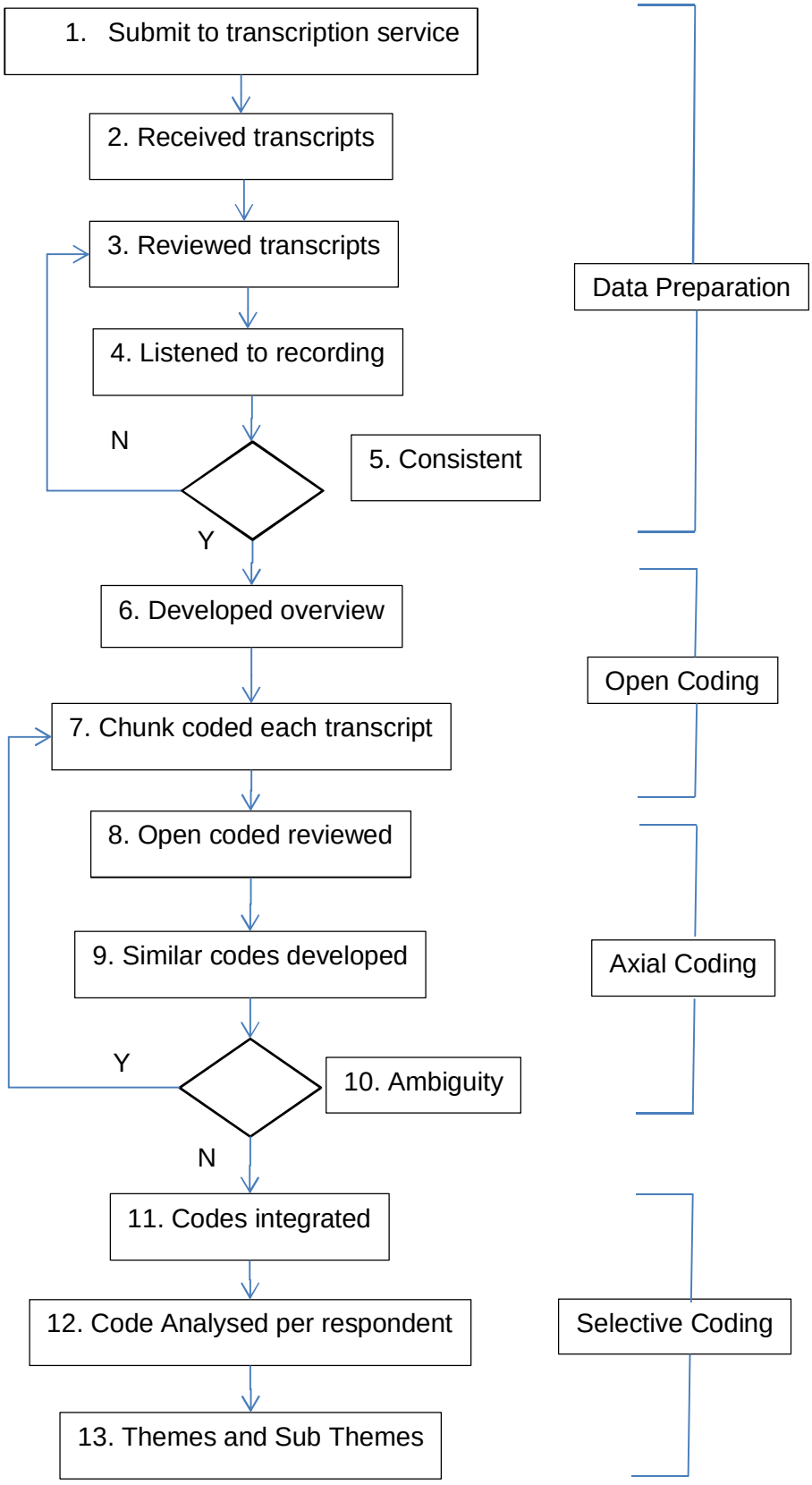
Axial Coding

8. All open codes were exported into Excel and reviewed
9. Codes with similar meaning were grouped together
10. Codes that were unclear suggested that the open code in the associated transcript required review

Selective Coding

11. The grouped codes as per step 9 were integrated
12. The grouped codes were analysed per participant to gauge response rate
13. Themes and sub themes relevant to the research were developed from the grouped codes developed in step 11.

Figure 5: Flow chart of data analysis process



Source: (Own Research)

4.9. Research Limitations

The time constraints under which the research was conducted resulted in various limitations:

- Although the sample of the study included various stakeholders, only one participant was taken from each stakeholder group. The view of one individual is assumed to be generalised as the view of the stakeholder group. Additional or slightly different information could have been obtained if more participants from each stakeholder group were involved.
- Twelve of the fourteen participants were in the region of Gauteng due to travel limitations. Although most organisation head offices are located in Gauteng, the experience of participants may be biased due to geographic location.
- Due to availability of participants, interviews were limited to one hour. Questioning and discussions were limited to the time allocated.
- Participants were aware the information they were providing was confidential. However the information discussed was of a strategic nature, and this could have resulted in participants not disclosing sensitive information.

The next chapter discusses the results obtained from the interviews.

5. RESULTS

5.1. Introduction

This chapter presents the data obtained from following the research design set out in Chapter 4. The research methodology for this study was qualitative and was accomplished by conducting semi structured interviews. A total of 14 interviews were held with industry experts whereby each respondent was asked questions from the four themes discussed in Chapter 3. The research yielded 7 major themes and 17 sub themes.

5.2. Presentation and Data Analysis

5.2.1. What is the future of South African coal as the world fights carbon emissions?

The participants responded to the question in three parts, including the role of carbon emissions, efficiency of renewable energy and future fuel energy mix. The initial response was that the current electricity crisis is negatively affecting the economy,

Respondent 2: "*For every day that you do not have power when it is needed you are affecting your economic growth.*"

Respondent 6: "*At the moment we're in the hands of a monopoly generator called Eskom that is failing to perform, that poses huge risks to the economy of South Africa.*"

Respondent 11: "*I think these problems are not unique to South Africa, not at all, but our electricity shortage definitely makes us less competitive.*"

Respondents viewed the current shortage of electricity was affecting economic growth and resulting in South Africa being less competitive thus has emerged as a sub theme.

Role of Carbon Emissions

The view of the current electricity crisis suggested change was imminent in the South African electricity sector. The respondents shared their views on the role of carbon emissions in the future of the electricity sector.

Respondent 1 had the view that carbon emissions and politics play a role in the future of the South African electricity sector by stating "*South Africa is one of the most carbon intensive and coal intensive economies in the world*" and "*it's almost as if the South*

African government, the ANC said, we're going to try, we're going to prove our exceptionalism in maintaining pro climate change mitigation policies."

Respondent 4 shared a similar view that electricity sectors are responding to carbon emissions by stating "*the developed countries have this very bias and proper response to world global warming but it is very easy for them to do that because they have actually developed the economy and that is why they have developed country*". However at the same time Respondent 4 questions the position of South Africa as a developed country, "*So for me I consider South African as somewhere between the two, it is not undeveloped but it is certainly not fully developed*".

Respondent 6 went on further to state that the move towards low carbon emissions was driven by international pressure: "*South Africa is going to face international pressure to reduce its carbon footprint which stands out at the moment on the African continent like a sore thumb….I think we're going to face commercial political pressure from Europe, United States and Japan, western countries to reduce our carbon footprint*".

The views of Respondents 1, 4 and 6 were echoed by Respondent 7: "*We understand that we are obliged by the protocol, we are bound by the protocol, well not necessarily bound by the protocol because it's not binding as such on developing countries, it only targets developed countries like the America, China*".

The consensus among respondents was that the intensive use of coal for power generation has led to South Africa being one of the most carbon intensive industries in the world. This has emerged as a sub theme. Although South Africa is a large carbon emitter, reducing carbon emissions was driven more by politics than climate change. There was evidence from the interviews that international perception of the country was prompting the need to move towards a low carbon economy. Therefore international perception of South Africa being progressive and moving towards a low carbon economy has emerged as theme.

Renewable Energy

The comments from respondents indicated that the South African electricity sector will be moving towards low carbon emissions. Respondents also highlighted that technologies such as solar and wind energy were the most popular forms of renewable energy. The respondents viewed coal as the preferred technology for base load and renewable technologies for peak loads.

Respondent 1 was clear that renewables will be part of the base load: "*Renewable will be part of the base load, the daily base load.*"

Respondent 2 had an alternative view and stated that coal was the preferred choice for base load demand: "*Generally coal based power has been the most reliable source of power and generally today it has been the only source of base load power*. *We can run it 24/7 and even if the alternatives are green there have not been many that give you 24/7 base load power.*"

Respondent 3 stated that it was possible to have renewable energy as part of the base but at the same highlighted the risk of using renewable energy entirely for base load requirement: "*If you have enough of it, it can become a part of the base load yes, now can it become the total base load. Germany in 2007 on the 24th of December ran out of electricity, can you believe it for two hours they had a blackout across the country, why, because there was no sun and no wind and they had taken all their coal fire stations off line."* Respondent 3 went on further to comment on the efficiency of renewable energy, "*I think the energy output factor for wind is about ten to fifteen percent so it is very low.*" The above response suggests that Respondent 3 was not keen on the idea of renewable energy as an option for base load power.

Respondent 4 illustrated the availability of wind and solar renewable technologies. "*When you are generating power from wind you can only do that when it is windy, when you are generating power from solar you can only do it when it is sunny and during those times in some instances you are not using all that energy.*"

The view from Respondent 5 was in stark contrast to Respondent 1, stating "*solar pv is a joke.*"

Respondent 7 had the view on the sustainability of renewable energy and shared the similar view to Respondent 4 on the role of weather. "*Renewable energy is not sustainable, in the sense that, when I say sustainable, don't get me wrong, what I'm trying to say is, that it depends on the weather*".

Respondent 8 commented on the use of technologies other than coal in meeting the electricity demand, "*so we use some of the coal what we tend to do during the peak time we also now using open cycle gas terminals (OCGT) which is diesel, here we use some of the hydro's to fill up this gap.*"

The view from Respondent 10 stated that base load should not be determined by technology. "*It's not a technology profile, it's a demand profile. How you fill that*

demand profile is entirely up to you. Base load is not a technology choice; base load is a demand profile."

The response from Respondent 11 was similar to Respondent 3's views on the efficiency of renewable energy. "*Eskom said the other day when they recorded that the load factor of the renewable is 31%, in other words, those plants are only working for 31% of the day on average.*"

Similarly to Respondents 3 and 11, Respondent 14 commented on the efficiency of renewable energy. At the same time Respondent 14 commented on the role of weather, views also shared by Respondents 4 and 7. "*Ya, and that include sun, so for wind it's even lower, wind is lucky if they reach 26% and that technology keeps you power at the time of the day when you don't need it, when the sun is shining midday, when the demand is low. So I know there are people who are trying to argue that you can supply the whole country with renewable, I'm sorry, I don't believe that.*"

The response from the participants highlighted the inefficiency of renewable energy, particular solar and wind whereby the efficiency for solar and wind ranged between 10% – 31%. A crucial factor for renewable energy was the time of day the power was available and weather played a major role in the efficiency of renewable energy sources. Therefore the impact of weather on available of renewable energy emerged as a sub theme. The efficiency of renewable energy for base load generation had mixed views and thus emerged as a sub theme.

Future Energy Mix

When asked the question on the future role of coal and carbon emissions respondents answered in three parts.

Respondent 1 had the view that foreign policy and the inclusion of nuclear will play an important role in the future energy mix by stating: "*That's another one. This is also partly driven by foreign policy and here you've got two foreign policy elements, you've got the element of climate change too acting on principle because nuclear energy is very, very carbon efficient and then the second element is status in the BRICS*". Respondent 1 went on further to state that renewable energy implementation was quickly making it a favourable choice for incorporating renewables into the future energy mix: "*Looking at the renewable energy execution, it's very good, it's all come in, on time, on budget, it's running, everybody's happy*". Respondent 1 did not see a favourable future for coal in the long term: "*the coal fired power stations are coming to*

the end of their lives. So if I were in the coal industry, I would be making plans to get out."

Respondent 2 shared the view of Respondent 1 on the topic of quick implementation of renewable energy projects: "*In particular renewables I think they have managed to run a very successful program and produce roll out power very quickly and I think with where the tariffs are now it is phenomenally successful ….I think in terms of the future and I think it is also a very interesting one because everyone wants to be clean and green*".

Respondent 3 shared the view that South Africa had significant coal reserves however the move towards low carbon emissions will see the reduction in the use of coal. *"We have in the country of the quality of coal that we burn there is certainly more than one hundred years, it could easily be up to two to three hundred years … looking into the future just from an environmental perspective what one would like to see is that the fuel source should change overtime*". Respondent 3 also indicated that "*there are also undeveloped coal fields in neighbouring countries such as the Mamabula and Matlese reserves*", thus making a point for the use of coal as primary energy source.

Respondent 5 stated that the country was going to use coal in the short to medium term, "*the short of it is I think we are married to coal on a large scale to at least 2040, some people say 2050.*" Respondent 5 went on further to discuss the role of gas and nuclear in the future energy mix, "*the biggest threat I see to coal or the biggest opposition to coal is gas, gas could be the game changer for coal totally … we have a government that is now hell bent on nuclear.*"

Respondent 6 shared the sentiment of Respondents 3 and 5 on the reduction of coal as dominant fuel energy source, *"Well, firstly just say, I believe that coal power is going to be with us for many, many, many years to come. It's not going to suddenly stop, but the growth may be less than what we think.*" Respondent 6 also shared the view of Respondent 5 on the role of gas in the future energy mix, *"I didn't mention of course the gas sector, and this is going to be an important part of the energy mix in South Africa. So what I see is that the new generation capacity, you're coming on stream is going to be a mix of coal, gas, nuclear, hydro, so the growth of coal is going to be much slower than what it has been in the past.*"

Respondent 7's opinions on the reduction and not total elimination on the use of coal was aligned to Respondents 3, 5 and 6: "*So having to take out coal from the system, I don't think it will happen any time soon. But maybe, I'm not saying it will never happen,*

maybe it will happen after we've introduced gas …actually what we're striving towards, it's more to bring the balance in the generation system and it's not to say coal will be taken out of the system." Respondent 7 also highlighted the lifespan of the current fleet of coal fired station "there is a concern about the life span of coal fired power stations."

Respondent 9 also shared the view on the reduction but not total elimination of coal: "*I think the pressure will be such that in 30 or 50 years you will not use it anymore or the use of it will be reduced greatly so that is where the future energy mix of South Africa comes in, what will it look like, I doubt whether we will have only coal.*" Respondent 9 also commented on the role of nuclear in the energy mix: "*coal will come back in favour if you have a nuclear incident, somewhere in the world if you have a huge nuclear incident that makes nuclear fallout of favour*".

Respondent 10 share the view of Respondents 1 and 2 on the quick turnaround of implementing renewable energy and the associated investment horizon: "*once I decide to build a nuclear plant, I'm locked into a 15, 20 year investment decision. If I decide to build a coal base load, I'm locked into, probably a 5 to 7 year timeframe. If I buy into a gas or renewable, I'm locked into a 2 to 3 year investment. So each one has different horizons to each one*" – Respondent 10

Respondent 12 echoed the views of Respondents 5, 6 and 7 on the role of gas as the game changer for the future energy mix. "*Game changer that is a threat to coal is fracking, what should carbon tax be – people do not want coal, frack or nuclear but they do not want to sit in the dark either but we are blessed with natural resources.*" Respondent 12 painted a bleak future for the role of coal in the future energy mix. "*Coal mines are reaching the end of the lives……..Coal has a very murky future.*"

Respondent 13 shared similar sentiments on the role of gas, inclusion of nuclear and the reduction of the use of coal in the future energy mix. "*I think harnessing our coal bed retain is definitely up there, using the shield rock as well I think that is a great juice…….we made heavy commitments towards nuclear so I think nuclear is definitely on the cards. My personal opinion is that it is very difficult to get what they call hundred percent renewable energy penetrations. I think as a long term forecast coal will actually continue to be reduced but never really given up all together.*"

In commenting about the future energy mix, the execution of renewable energy has been very quick and on time as opposed to current coal fired power station projects. The investment period for renewable energy is much shorter than coal and nuclear

power stations and the quick turnaround of the renewable plants makes it a very attractive investment. There was a general consensus that coal will play large role in the energy mix however the role of coal will reduce over time. Thus the large coal reserves available in South Africa emerged as a sub theme.

There was also the view that gas will play a major role in the future of the electricity market as gas had extremely low emissions. Gas was viewed as the biggest threat to coal for the South African electricity market and gas as a game changer and an alternative to coal has emerged as a sub theme.

The responses also indicated that nuclear was a popular alternative source of electricity. Respondents highlighted the strong push from government to increase the percentage of electricity generated by nuclear. Therefore the role of nuclear has emerged as sub themes.

The responses to question one has led to three themes and seven sub themes. The themes are as follows:

- Perception as a driver for lower carbon emissions
    - Electricity shortage and the impact on investment and the economy
    - Role of South Africa as Africa's largest carbon emitter
- Efficiency of renewable energy
    - Role of renewable energy to form part of the base load supply
    - Impact of weather on the availability of renewable energy
- Future energy mix
    - Large coal reserves available in South Africa
    - Gas as a game changer and an alternative to coal
    - Increased role of nuclear in the future energy mix

5.2.2. South Africa has enjoyed abundant electricity for many years. Are there merits or room for transformation?

The participants responded to the question in two parts, unbundling Eskom by introducing competition into the electricity sector and the role of the electricity grid in facilitating transformation.

Unbundling the Electricity Sector

Respondent 1 had the view that the electricity sector should unbundle: "*I do not think that Eskom will unbundle, I think that it's seen as a vital state asset, both in terms of, in a technocratic sense. We do not have market liberalisation, we have procurement liberalisation. Yes, and we're talking about this already, the government is very interested in having an unbundled Eskom, that has primary responsibility for generating power in the country and there by pursuing a transformation agenda. Which I fully understand, it's right that it should have some of those aspects. You don't have to go to a pure market solution and to shred Eskom, let's call it*".

Respondent 2 shared the same sentiment as Respondent 1: "*I think even without looking at a crystal ball I think politically and economically government wants a strong electricity utility so I think there will be partial either unbundling, I think Government is seeing the clear answer on that, I think they have come out very clearly so Eskom alone cannot do the job.*"

Respondent 6 echoed the views of Respondents 1 and 2 of transforming the electricity sector into an electricity market. "*So I would see a competitive ideal scenario being a competitive generation sector incorporating Eskom and IPPs generating into a grid, operated by an independent system and market operator …I certainly believe the generation of electricity should be a competitive market with multiple generators competing against each other.*"

Respondent 7 added to the view of increasing competition into the electricity sector: *"The Department of Energy wanted somebody to bring some competition in the system and take away transmission from Eskom and let Eskom deal with generation of electricity and compete with the rest of the industry, but that was not the case. So we're back where we were and then we can only do so much within what the law allows us to do. I don't see any change in the near future … it's not healthy for the country to have only a company doing generation, transmission and distribution, it doesn't make sense. So you should bring some competition."*

Respondent 13 also agreed that Eskom should be unbundled and competition must be introduced into the electricity sector: "*The idea of separating Eskom into its three sort of functions with those being generation, distribution and transmission have been around since the '80s, it is very important for them to be almost as they say a separation of church and state so I think Eskom should be unbundled, it should be unbundled in a safe manner because at the end of the day strategically it is our major*

energy source, I think a good step is to start off with the generation that we have in terms of privatizing the generation through the IPP program starting with renewables and moving into fossil fuel IPPs."

From the comments above respondents stated that Eskom should be unbundled, thus the introduction of competition into the electricity sector emerged as a sub theme.

Transformation of the Grid

Respondents had the following views of the current electricity grid.

Respondent 2 had the view that access to the grid was a problem and thus created the need for off grid solutions. "*You have to sell to Eskom, they are the sole off take under the renewables, it could be either two options if it is coal base load but now at the moment the big issue has always been access to the wires… what we have also seen is we are seeing some more interest which will happen overtime is possible off grid solutions it is basically dedicated off take for mines etc*."

Respondent 3 built on the view of Respondent 2 and further stated that the grid problem was also associated with geography: "*If you built all your power stations on the North and you feed it everywhere and you have to feed it out of the South you overload the system, it is like a pipe you cannot put too much electricity into one place, in my opinion the biggest hurdle to IPPs has been the distribution and the access to the network rather than the generation*."

Respondent 4 stated that off grid solutions such as mini grid were cheaper than extending the grid in instances such as remote rural areas. "*There are certain areas for example in very remote areas that are very difficult to access, very rough terrain where these houses are sparsely populated a solar home system makes sense, whereas if you are in a community that was of a medium density that will then allow you to deploy a mini grid system cost effectively with fuel cell power systems supplying to that community for like fifty to two hundred homes. Then the levelized cost of electricity for that is much lower than the levelized cost of electricity of extending the grid.*"

Respondent 8 went on further to state that the private sector could build its own transmission infrastructure and off-grid solutions but warns that there were no polices that could support this in the long term: "*Yes they can invest in what we call a self-built for transmission infrastructure and distribution infrastructure to enable them to even grid their power solidarity. Yes, off-grid solutions is a brilliant thing but then there is no*

policy yet, the question is any kind of initiative that happens there has to be a proper policy for it purely for one reason as an investor they can do it at a risk but they do not know what will happen if Eskom gets their ducks in a row and all of a sudden there is an oversupply of electricity."

Respondent 10 echoed the same sentiment as other respondents and also highlighted the point that IPPs wanted to build their own grids. "*Remember there's PV in wind which can produce power very quickly, you've got to connect load just as quickly as you connect generation. IPPs want as much freedom of access to the grid, for IPPs grid is everything. So the issue is probably very clear, transparent information in terms of the ability for the grid, where the grid can connect, where it can't connect. I think they want visibility, predictability as to how the grid will expand, if not, they want to have the ability to build their own grid.*"

Respondent 11 had the view that there is insufficient access to the grid and many consumers are moving off the grid. "*Obviously the carbon emissions, but the practicality of that, I don't think it's been thought through properly. The bigger the percentage renewable, the more instability there is on our grid, and that is going to create problems, there isn't enough places to connect onto the grid. You see it's very interesting the way the industry is changing and the reality is overtaking structures and models. For examples, more and more people are moving off the grid, this whole model of one big utility with a few big power stations, transporting electricity over hundreds of kilometres to somewhere far away, it's not working anymore*."

Respondent 14 shared the view of Respondent 3 on the geography affecting the transmission network. Respondent 14 also echoed the sentiment of Respondent 11 on consumers moving off the grid: "*The first thing I think is the making sure the transmission lines are upgraded and new ones in place to allow for transmission of electricity, particularly in the south of the country. So I think an interesting question perhaps is whether we allow private players to help build the transmission line? That is a real opportunity in the future for example we did a survey last year of 100 companies and one of the astonishing things for me is the level of interest and investment going on by private companies in self-generation. From mining companies to property companies and so on, and this wasn't just CSI, this was serious energy.*"

The respondents converge on the view that access to the grid was the current bottleneck. Therefore opening access to the transmission network for IPPs has emerged as a sub theme. The problem with the grid was also forcing consumers to start moving off the grid. Therefore the migration of consumers to off grid solutions has

emerged as a sub theme. The responses to question two has led to one theme and three sub themes. The themes are as follows:

- Unbundling of the electricity sector
    - Introducing competition into the electricity sector
    - Opening access to the transmission network for private producers
    - The migration of consumers to off grid solutions

5.2.3. South Africa has had a history of low prices and will this impact the market in the future?

When asked the question, Respondent 1 gave a background of cheap electricity pricing and the impact of cheap labour in the coal mining industry: "*I think that given that you have two foreign policy elements there, in addition to the need to generate cheap power because the South African economy was driven by cheap labour and cheap power. You can't have cheap labour anymore, so you've got to get cheap power from somewhere.*" Respondent 1 went on further and stated that there was some form of government subsidiary particularly in nuclear and that wheeling cost of electricity was the biggest contributor to pricing. "*Nuclear energy is a subsidised source of power around the world. You've almost got a license to subsidise it, you can subsidise it a bit further and then continue to have cheap power. I do not think we will see major power generation or electricity generation by the private sector because of the issue of wheeling costs and the simply the distance between generation assets, like coal, coal field and the point of consumption*."

Respondent 2 had the view that current electricity pricing was cost reflective; the view was supported by the large capital investment in the electricity sector: "*They are fully cost reflective and they are extremely aggressive, the size and the capital that is going in is huge that has to be pretty much guaranteed that you will get paid, you cannot take that retail risk, that is another issue, that is what Eskom has faced, Eskom buys the power but they have the retail risk and the industrial risk of people who are and are not paying*." The response above also highlighted the risk in retail with non-paying consumers.

Respondent 5 had a slightly different view to that of Respondent 2 and were in the view that current electricity prices had many subsidies built into the price, particularly for the low or no income persons. "*Eskom prices have a whole lot of cross subsidies*

built into them, now if I sell power directly to you this cross subsidization falls away. Then there are the subsidies that are in place for indigent households where people get below a certain income level get a certain tranche of electricity for free, this does not come from the fiscal…..Yes there are a lot of cross subsidies built into the Eskom price, one of the big things is the wattage differentials, the higher the voltage you take your electricity at the less you pay, there is a voltage charge, if you take an extreme voltage say like at 132 and there are only two places that take it then your voltage charge then your voltage is very low as your voltage goes down that charge goes up".

Respondent 6 added that electricity prices had not been cost reflective due to the political history of South Africa: "*You know, ultimately, the price of electricity will be driven by supply and demand and it has been artificially low for many years, it's been kept artificially low for political reasons … And it's not going to come out of the Eskom management's pocket, it's going to come out of the mass of the population and industry and commerce effects the economy. So the questions you ask is are we going to get to this market based approach*? *Eskom entered into a compact with the new government to reduce the price of electricity year on year in real terms for a decade and that's exactly what it did. It didn't build any new power stations, it didn't put money aside into a capital fund to build new power stations, it just ran its existing fleet into the ground and now we're in a situation with the shortages of power, Eskom's prices are rising sharply in order to pay for this new capacity. So I believe the price of electricity will move and should move to its natural place and that's why we need competition to establish what the natural is*".

Respondent 7 had the view that as long as Eskom had the monopoly, prices were going to increase. "*Eskom is having the monopoly and they're obviously having problems financially. And they can do whatever it takes to ensure that the price goes up. So you can see that the price, if the current situation continues, it's going to be going up, I don't know for how long but it doesn't seem like it's going to go down anytime soon, as long as Eskom is having the monopoly.*"

Respondent 8 went on further to explain that the price of electricity did not only lie within the generation but the entire value chain, a view that was not fully understood in the pricing mechanism: "*There are merits but then those merits as we harness them we must also make sure that the price pie is properly reflective of what is the real cost of electricity throughout the whole value chain generation, transmission and distribution so throughout this whole value chain there must be price reflectivity… Here in short effectively my opinion would be historically we could afford to have a low cost*

of electricity to be implemented because we have an abundance of electricity but now our demand it much higher than what we can generate so for us to be able to move forward we really need to make sure that the low prices has to be properly reflective because in the past there was literally no increase and there was no inflation at all so for us to justify the existence of the new infrastructure those that attract investment into the country in terms of electricity we need to have proper price reflective prices, not necessarily higher prices but cost reflective prices."

Respondent 10 shared the same sentiments as Respondent 1, reflecting that the political history of South Africa has led to current situation of low non reflective pricing. "*No, it hasn't been for ever because pricing in the apartheid era was done as a way of ensuring that cheap electricity was going to be available for the mining sector. When the new dispensation took over, one of the critical political objectives was connecting people to the grid and they wanted to keep electricity as cheap as possible and Eskom were very happy to maintain that myth, because it prevented IPPs from coming in. Remember all the generation plant was built in the 80's, was built with massive subsidy ok, from the apartheid government … we've never dealt effectively with the transition from where we are now to cost effective pricing. So when you hear Eskom asking for 25%, it's because we've got to get to cost … and we've got to get to cost reflective pricing.*"

Respondent 11 had the view that current prices are cost reflective and shared the same view as Respondent 5 in the fact that electricity prices were subsidised: "*But affordability is a serious problem. No, Eskom says it's still not cost reflective….. Your bottom guys are sorted because they get government subsidies, but it's the middle class who can't afford it, or lower middle class, who can't afford to refit their houses, who will end up carrying the burden*".

Respondent 12 discussed in detail the independence of the electricity sector and the influence on pricing. Respondent 12 maintained that Eskom had a good financial model prior to 1994 and should have continued with their financial model and not be influenced by the government: "*During 1922 – 1994 Eskom was not a government entity; Eskom did not belong to the government. Eskom was like Old Mutual and Santam, the government guaranteed loans but did not provide them. Government requested Eskom to switch off supply to Soweto in the apartheid era and Eskom did not do that. It showed independence from the state. Eskom started decreasing prices after 1994 and should have increased prices through inflation; prior to 1994 Eskom had the most efficient model*".

Respondent 14 shared the view of many other respondents and also reinforced the view of Respondents 5 and 11: "*Ya, it's already becoming expensive, and the municipalities are worried about this because we've had some meetings with them, they're worried about, particularly rich people who buy a lot of electricity from them, they need that … municipalities are reliant on electricity sales. They are worried that the private households that can afford are going to defect. So what you have is a decline in consumption of electricity and of course that means, less revenue and they can't subsidise in the poor areas who gets affected the most, both the municipality and poor people, and the ability to then provide services.*"

The above responses indicated that current electricity pricing is complex. There was consensus that pricing was not cost reflective and there were many factors that led to this. Therefore the political history of low prices and subsidiaries has emerged as a sub theme. Also the price of electricity was not considered to be cost reflective and thus has emerged as theme. The responses to question three has led to one theme and two sub themes. The themes are as follows:

- Low Pricing of Electricity
    - Political history of low prices and subsidiaries
    - Current pricing is not cost reflective

5.2.4. What should the market be for IPPs?

The respondents answered the above question as follows.

Respondent 1 stated that the electricity sector should move to an electricity market. "*They want to move to a market, and your word market is exactly right, they want market conditions, they want … they don't even mind so much about tariffs, they want fully cost reflective power pricing and they want some form of sort of traded feed in. It has excellent, very mature policies in place in certain areas within the ambit of the IPP office and renewable energy policy, very mature, world leading.*"

Respondent 2 had the view that IPP projects were increasing, however highlighted at the same time policies for accessing the grid and property rights needed to be in place for long term sustainability: "*The only issue about that is there is no template around it and the issue is unless you are building the power plant right on the mine you are back to the problem of how do you access the transmission network for doing wheeling. We have a number of our clients and we are seeing a lot of the big developers, big and*

medium size and small maybe more big and medium that are very keen still to pursue this. Also how to secure real rights of your project, the bottom line is you have to secure real rights so you can actually enforce your security so issues like land servitudes, licences, regulate all of that stuff needs to be in place so you could argue that all the stuff is already in place and has been implemented otherwise the deals would not have closed."

Respondent 6 shared the sentiment that the current policy document, IRP, was not updated regularly, thus creating uncertainty. "*By law we should have an integrated energy plan published every single year since 2008, and we don't have one. That means the investment community don't know what the country plan is for energy, our integrated resource plan for electricity is 5 years out of date, it's based on outdated information. No intelligent decisions can be made; no proper decisions can be made in that environment.*" Respondent 6 went on further and stated that the electricity sector needs to change to an open market system and not the control and command structure.

"*In an IPP environment the shareholder takes the responsibility, there are cost over runs, there's only one person that pays for those cost over runs, the shareholder, because the price of electricity is determined by contracts, by long term power purchase agreements. The sooner we liberalise our electricity market, level the playing fields, introduce an independent system and market operator, encourage the wide spread use of IPPs, introduce an energy market, and get rid of the command and control economy which we are stuck in at the moment, the better it will be for this economy.*"

Respondent 7 shared that in order to generate or transmit electricity one would need permission from the Minister of Energy in writing, "*because for your own use, if you generate it for your own use, you don't need any assets, but if you're going to sell it to somebody then you're going to need a license but should be within the IRP. So meaning that you're going to have to write to the minister and say, this is what I want to do, am I allowed doing this thing?*"

Respondent 7 went on further to state that there were frameworks for electricity generation but nothing in law and this gave Eskom the power over who can join the grid. "*Framework is there but not in the law, because the law doesn't provide for anything. But Eskom as a company, remember they're governed not only by their legislation, but also by the memorandum of incorporation, but possibly it gives them that power to say, as an owner of the grid, you should come to me and I will give you*

approval to use the grid. And obviously the challenge around the legal framework is going to be something that with the support of the politicians we will be able to unblock some of the challenges that we face. Because you can identify the technology but if the law doesn't allow you to explore or to issue any procurement documents on that then it's useless."

Respondent 10 shared the view of Respondent 6, stating that policy frameworks were not updated timeously and not followed rigorously. Respondent 10 went on further to state that current policies were not aligned to each other: "*We have the policy framework, whether we adhere to the policy framework is another thing. So I would say we have the policy framework, but if we applied it properly you'd have a very different outcome, it's because we don't apply the policy properly, and probably more importantly we don't apply timeously so we have something called the National Development Plan, all policies and all procurement processes should ultimately talk to the NDP. So the problem with RIEEEP is it doesn't actually talk to the NDP. It talks to it if you want to just say, electricity should just be a...it should be something that enables economic development, but not actually in itself be an agent of economic development.*"

Respondent 11 added that policy framework development was slow. The issue of obtaining a license to generate electricity and access to the grid was highlighted: "*And the regulatory framework can't keep up, poor NERSA is trying its best to publish, they have to publish this month, a paper on or guidelines on small scale embedded generation, which is your rooftop generating for yourself, or a shopping centre generating for itself. So if you want to do more than that then you need a generating license, then it becomes slow and tedious to get a license. You have to go to NERSA to get approval for everything, for generation first, then for commercial operation, then for connecting to the grid, then for your tariffs if you sell to anybody. All along the way there are...you know you have to comply with the grid code*".

Respondent 13 was of the opinion that the policy documents on electricity generation should be longer term, thus reducing investor uncertainty: "*I understand this but it would be nice if we were allotted more megawatts in the outset stage and not necessarily as much during this midterm stage in these last two years but a more consistent rollout so our plan for a full ten years. Then you have the national integrated resource plan and that is an evolving document so it changes like the wind but we could have had a more long term IPP program looking at it after ten years and revisiting it every five years just to give business some sort of security and stability*."

Respondent 14 shared the same sentiment as Respondent 13, stating that polices should be long term to create investor certainty. Respondent 14 also echoed the view of Respondent 10 on the lack of adherence to policy timelines. "*I think the main thing is three things, the one is the current IPP process is well run, so they should keep that going, but I think the main thing is they should stick to timelines and not delay that and keep postponing financial closing dates and so on, that really disrupts the financial models of these IPPs. Second thing is they should create long term policy certainty on how much in store capacity will be procured from IPPs and that will also give confidence. The first thing I think is the making sure the transmission lines are upgraded and new ones in place to allow for evacuations of electricity, particularly in the south of the country.***"**

Comments from respondents highlighted that there was policy uncertainty in the future of the electricity market. This, together with the lack of timeous delivery of policies, created investor uncertainty in the electricity sector, this emerged as sub theme. There was also a view that there were only policy frameworks and not laws, this emerged as sub theme. Therefore, policy framework has emerged as sub theme. The respondents also indicated that the electricity sector should transform into an electricity market, which has also emerged as a sub theme. The responses to question four has led to two themes and four sub themes. The themes are as follows:

- IPPs in the electricity sector
    - Move away from a command and control sector to open market conditions
- Policy requirements
    - Current policy frameworks are creating investor uncertainty
    - There are policy frameworks but nothing in law
    - Misaligned policies, delays in policy development and low confidence in policy implementation

5.3. Themes and Sub Themes

The themes and sub themes emerging from the interviews can be summarised as follows:

Table 4: Themes and subthemes emerging from data

THEMES	SUB-THEMES
Perception as a driver for lower carbon emission	• Electricity shortage and the impact on investment and the economy • Role of South Africa as Africa's largest carbon emitter
Efficiency of renewable energy	• Role of renewable energy to form part of the base load supply • Impact on weather on the availability of renewable energy
Future energy mix	• Large coal reserves available in South Africa • Fast turnaround of renewable energy projects • Gas as a game changer and alternative to coal • Role of nuclear power in the energy mix
Unbundling the electricity sector	• Introducing competition into the electricity sector and unbundling the state utility • Opening access to the transmission network for private producers • The migration of consumers to off grid solutions
Low pricing of electricity	• Political history of low prices and subsidies built into the current electricity prices • Current pricing is not cost reflective
IPPs in the electricity sector	• The need to move to away from command and control economy towards an electricity sector based on open market conditions
Policy requirements	• Current policy frameworks are creating investor uncertainty • There are policy frameworks but nothing is in law

- Misaligned polices, delays in issuing of policies and low confidence in policy implementation

Source: (Own Research)

In the next chapter the results of Chapter 5 are compared with the literature reviewed in Chapter 2.

6. DISCUSSION OF RESULTS

The study was motivated by the current state of the South African electricity crisis and the negative impact on the economy. The country requires more generating capacity and although blessed with an abundance of coal reserves, the electricity sector needs to move to lower carbon emissions. The electricity sector is controlled Eskom which has the monopoly in generation, transmission and distribution. The primary objective of the study will be to identify the policies required to reform the electricity sector for increased private power generation.

Based on the literature reviewed in Chapter 2 and to achieve the primary objective the following themes were developed in Chapter 3 for the research:

- Future role of coal
- Transformation of the electricity sector
- Electricity pricing
- Increased IPP participation in the electricity market

The response of participants to the questions led to 7 theme and 17 subthemes. The results obtained in Chapter 5 were discussed in detail by drawing connections with the literature reviewed in Chapter 2.

6.1. Role of Coal

There were 3 themes and 7 sub theme relevant to the role of coal and were as follows:

- Perception as a driver for lower carbon emissions
    - Electricity shortage and the impact on investment and the economy
    - Role of South Africa as Africa's largest carbon emitter
- Efficiency of renewable energy
    - Role of renewable energy to form part of the base load supply
    - Impact of weather on the availability of renewable energy
- Future energy mix
    - Large coal reserves available in South Africa
    - Gas as a game changer and an alternative to coal
    - Increased role of nuclear in the future energy mix

6.1.1. Perception as a Driver for Lower Carbon Emission

Electricity Shortage and the Impact on the Economy

Four of the respondents explicitly referenced that the electricity crisis had a negative impact on the South African economy. Respondents 2, 6 and 11 made comments such as "*affecting your economic growth", "poses huge risks to the economy of South Africa"* and *"electricity shortage definitely makes us less competitive"* respectively. The fact that these comments were made in spite of the question not being asked indicated that electricity shortages and their impact on the economy were topical.

This was confirmed by the Odhiambo (2009) who had shown a directly proportional relationship between economic growth and electricity generation, and this was further supported by Castellano *et al*,(2015) who had shown that a 1% growth in GDP will require the electricity demand to grow by an average of 1.66%. Finally, the reduction of the GDP growth for the country being reduced by 0.3% in 2015 and 0.5% in 2016 (Reserve Bank, 2015) converges with the view of respondents. Therefore the electricity shortage is a crisis that is negatively affecting the growth of the country.

The finding of this sub theme does not support nor did object to the fact that coal shall dominant future power generating capacity.

The role of South Africa as Africa's largest carbon emitter

Pieters, Lotz & Brent (2014), stated that South Africa accounts for 37% of Africa's carbon emissions and Pegels (2010) Borenstein (2012) also stated that the electricity sector accounts for the largest portion of carbon emissions. Four respondents shared the view that South Africa was a large carbon emitter. Respondent 1 and Respondent 6 commented that South Africa was one of the "most carbon intensive economies in the world" and the carbon footprint "stands out like a sore thumb" in the context of Africa. According to Williams (2015), in a global context South Africa was responsible for 1.1% of total global emissions and emits twice as much carbon emissions as Sub Saharan Africa as and more than six times than the EU. The literature and respondents agreed that South African electricity sector was carbon intensive.

The IRP outlined the intention to limit emissions to 275 million tons of carbon per year by 2024. Further support of the reductions of carbon emissions is seen in the REI4P

program that aimed to reduce carbon emission from 912 g/kWh to 600 g/kWh by 2030 (Walwyn & Brent, 2015). Although South Africa was a high carbon emitter and policies are in place to support the reduction of carbon emission, there were different motivating factors to move to lower carbon emissions.

Respondents raised the point that South Africa was a high carbon emitter however their view made no mention of South Africa's desire to limit climate change. Their view was that South Africa was motivated by international perception. Respondent 1 had stated that South Africa was proving a point through lower carbon emissions: "*we're going to prove our exceptionalism in maintaining pro climate change mitigation policies".* Similarly Respondent 4 stated that the country has a mixed identity by embracing developed world climate change ideologies while it is still a developing country. Respondent 6 went on further to state that the country is going to face "*commercial political pressure"* from developed countries.

The above comments were aligned to position of the state that future investment in coal will make South Africa less competitive due to carbon taxes (DoE, 2011). Pieters *et al*. (2014) also argued that other benefits of moving towards a low carbon economy were increased energy security by reducing dependence on fossil fuel reserves, and more predictable and stable pricing as there was less dependence on the fossil fuel market dynamics. Musango, Brent, & Bassi (2014) also indicated that one of the main drivers for the green economy was concerns about global climate change.

It could be argued that the motivation for South Africa to move towards a low carbon economy was irrelevant so long as the move occurs. This however may not be entirely true as the country is rich in coal reserves, and thus the motivation will influence long term polices for the sector. At the moment the view of South Africa move towards a low carbon economy was largely driven by international pressure to reduce carbon emissions. If South Africa continues an upward trend of high carbon emissions, it will become less competitive globally and the international perception of the country will be damaged and could negatively affect future foreign direct investment.

The finding of this sub theme does not fully support the fact that coal should dominant future power generating capacity.

6.1.2. Efficiency of Renewable Energy

The South African electricity move towards lower carbon emissions requires inclusion of renewable energy technologies into the energy mix. The IRP indicated that renewable technology such as wind and solar will account for 27% of total power by 2030. This was positive for reducing carbon emissions as according to Pieters *et al*., (2014), renewable technologies will help reduce greenhouse gas emissions in the electricity sector. Ten of the respondents foresee a place for renewable energy but there was a concern highlighted about the role that renewable energy has in base load demand.

Eight of the ten respondents viewed coal as the most reliable source for base load demand, stating "*Generally coal based power has been the most reliable source of power".* Their view was in agreement with the argument of Garcia, Alzate, & Barrera (2012) stating that renewable energy should be seen as complementary to peak load technologies. On the other hand, two respondents favour renewable energy as part of the base load by commenting "*Renewable will be part of the base load"* and *"Base load is not a technology choice; base load is a demand profile."*

The major concern was the reliability of renewable power generation. The views from respondents indicated that wind and solar plants offer low efficiency. Responses included, "*those plants are only working for 31% of the day", "wind is lucky if they reach 26%"* and "*energy output factor for wind is about 10% to 15%."* Respondents stated that weather conditions played a significant impact on the role of renewable energy in base load application - "*it depends on the weather"*. Respondent 3 also pointed out that the world leading country in renewable energy, Germany, experienced a blackout due to unfavourable weather conditions for the renewable solar and wind.

Borenstein (2012) stated that the migration towards renewable energy was positive for the environment; however there were constraining factors such as weather conditions for wind and solar power plants. Borenstein (2012) went on further to state that coal fired and gas plants cannot be started and stopped quickly, whereas renewable technologies have faster ramp up rates.

Although renewable technologies have a limited impact on the environment, there is a strong argument that renewable technologies are not yet reliable and efficient enough to satisfy the requirements of being part of the base load demand, and are currently more suited to complement peak load demand. The finding of this sub theme does not

fully support the fact that coal should dominant future power generating capacity as there are reservations of efficiency and reliability of renewable energy.

6.1.3. Future Energy Mix

Future of Coal

Although there was international pressure to move towards low carbon electricity sectors, the research had shown that renewable technologies were not yet ready to replace fossil fuel technology. Nine of the respondents saw a reduced reliance on coal in the future of electricity generation. Comments made by respondents indicated coal will definitely be part of the energy mix, "*the short of it is I think we are married to coal on a large scale", "the country will be using coal in the short to medium term*", "*coal power is going to be with us for many, many, many years to come"* and "s*o having to take out coal from the system, I don't think it will happen any time soon."* There was a view that the role of coal will be reduced - "*coal will actually continue to be reduced"* and *"use of it [coal] will be reduced greatly".* Some respondents went as far to say that the coal industry is at the end of its life, and statements made included "*if I was in the coal industry, I would be making plans to get out*" and "c*oal has a very murky future.*" This suggests the future use of coal for energy generation is on the decline.

Literature indicated that South Africa was blessed with an abundance of coal reserves, thus making this resource the obvious choice for future energy generation. Both Eberhard (2011) and Hancox & Gotz (2014) stated that South Africa is the sixth largest producer of coal globally, producing on average 320 million tonnes of coal per annum, of which 70% is consumed locally by Eskom. Hancox & Gotz (2014) went on further to state that there are 19 coal fields with an area of 9.7 m hectares and coal will dominate the energy mix for the next 40 to 50 years. This was also consistent with the view from Respondent 3: "w*e have in the country of the quality of coal that we burn there is certainly more than 100 years, it could easily be up to 300 hundred years… there are also undeveloped coal fields in neighbouring countries such as the Mamabula and Matlese reserves*".

However Hancox & Gotz (2014) also stated that remaining resources of coal are more geographically complex and require beneficiation to meet local power market specification. This is a view shared by Respondents 1 and 12 with both stating "c*oal mines are reaching the end of the lives."* This suggests mining coal is becoming more difficult and under these conditions becoming more expensive.

Respondents had the view that the role of coal should reduce, while literature indicated that the country has significant coal reserves. Historically the driving forces for using coal as the main energy source were primarily two factors. Firstly, labour was cheap, and secondly, due to apartheid sanctions the country had little option other than to use coal (Goldblatt & Davies, 2002). These conditions have since changed and according to the Hancox & Gotz (2014), coal was becoming more expensive to mine.

The earlier discussion on climate change indicated that South Africa is under international pressure to reduce carbon emissions. Aalthough there were significant coal reserves, the role of coal in electricity generation will be reduced but not eliminated. The finding of this sub theme does not fully support the fact that coal should dominant future power generating capacity as it views coal as a majority but reduction from current levels.

Role of Nuclear and Gas

The role of coal will be dominant but reduced in the future and renewable technologies such as wind and solar require are not very efficient and reliable. Two other technologies were discussed, nuclear and gas. Five of the respondents discussed the role of nuclear in the future energy mix. Respondent 1 had the view that nuclear is a niche that South Africa brings to their inclusion in BRICS by stating "*you've got the element of climate change too acting on principle because nuclear energy is very, very carbon efficient and then the second element is status in the BRICS*". The country has had experience with installed nuclear for a long period. This was a view that is further substantiated by Williams (2015) who stated South Africa has 8% of the world's uranium reserves, making a strong case for the use of nuclear energy.

Respondents 5 and 13 had the view the South African government already has plans to add additional nuclear capacity, and comments included "*we have a government that is now hell bent on nuclear"* and "*we made heavy commitments towards nuclear so I think nuclear is definitely on the cards."* The IRP stated that nuclear will also increase security of supply and operational costs are the lowest in all types of power generation technologies. At the same time the IRP outlined concerns with the cost and time to build an entire nuclear fleet. Williams (2015) added that the investment required is over R1 trillion - therefore foreign investors are required to build nuclear power plants.

Williams (2015) went on further to state the introduction of nuclear power generation will result in job losses in labour intensive indsutries such as coal. There was

convergence between the literature and respondents that nuclear energy would play an increased role in the future energy mix. It was driven by political factors within BRICS, current uranuim fuel reserves, and past successful safety records of nuclear energy.

Respondents also had the view that gas was an important fuel source that could disrupt the future energy mix. The fracking of gas took place in the Karoo between 1960 and 1970. Gas also causes low carbon emissions and could provide an alternative to coal. Comments from respondents included "*gas could be the game changer for coal totally", "game changer that is a threat to coal is fracking",* and *"I think harnessing our coal bed retain is definitely up there, using the shield rock as well I think that is a great juice."* The IRP and NDP policy documents made no mention of gas as part of the energy mix, however there is a strong view from respondents that South Africa has an abundance of gas reserves and this could be the preferred fuel choice for power generation.

The finding of these two sub themes does not fully support the fact that coal should dominant future power generating capacity as the role of nuclear will increased and gas might change the game overall.

6.1.4. Summary: Role of Coal

The initial response from participants were consistent with the literature was that the electricity shortage is a crisis that is negatively affecting the growth of the country. On the other hand there was divergence between literature and the research on the motivation for moving towards low carbon emissions. Literature stated that the electricity sector should move towards lower carbon due the impact on climate change, while respondents viewed South Africa's motivation based on international pressure and perception that South Africa was a progressive developed country.

The increased demand for renewable technologies highlighted that renewables are not yet suited for base load power supply. This was largely due to low efficiency and reliability of renewable plants based that are subject to weather conditions. Although South Africa had a long history of reliance on coal and the literature indicated that there was an abundance of available reserves, the research indicated that coal was becoming more expensive to mine and the dominance of coal will reduce over time. This also implied that other technologies such as nuclear will play an increased role in

the future energy mix - a view that was consistent with both literature and response from the research. At the same time the research indicated that gas could be the next disruptive technology in the energy sector.

The finding of 6 out of the 7 sub themes did not fully support the fact that coal should dominant future power generating capacity. The findings also did not indicate that all future energy will come from renewable or low carbon technologies. Coal will play a large role in the future energy mix but reduced from current levels. The energy mix will be balanced with an increased inclusion of renewables and nuclear. Both literature and research suggests that the reduced reliance on coal implies increased participation from IPPs.

6.2. Unbundling the Electricity Sector

There were 1 theme and 3 sub themes relevant to the transformation of the electricity sector and were as follows:

- Unbundling of the electricity sector
    - Introducing competition into the electricity sector
    - Opening access to the transmission network for private producers
    - The migration of consumers to off grid solutions

6.2.1. Introducing Competition into the Electricity Sector

There was consensus from respondents that Eskom should unbundle and that competition should be introduced into the electricity sector. Five respondents commented directly on increasing competition and the unbundling of Eskom, with the comments including: "*We do not have market liberalisation, we have procurement liberalisation",* "*it's not healthy for the country to have only a company doing generation, transmission and distribution, and it doesn't make sense. So you should bring some competition"* and *"it is very important for them to be almost as they say a separation of church and state so I think Eskom should be unbundled."*

The above views from respondents were supported by Niesten (2006) who stated that private enterprises were held accountable by markets and competition, factors that are required in the electricity sector thus prompting the need for privatising the electricity sector. Henisz (1999) went on further to state that a reform was based on the government's position on nationalisation or privatisation. One of the reasons for

privatisation outlined by Suharev (2015) included increasing the efficiency of assets and leading to increased competition. From an efficiency perspective, the literature and research are aligned on the view of introducing competition into the electricity sector.

The NDP outlined that by 2030 the country should be procuring 20 GW of renewable electricity, whereas the figures of the IRP are slightly lower, stating 17.8 GW of energy should be produced via renewables. Overall the IRP states 42.6 GW of additional power will be required by 2030. In spite of the difference in numbers, neither policy documents explicitly stated if the additional power should be generated by the state or private producers. However Respondent 5 stated, "*I think there will be partial unbundling, I think Government is seeing the clear answer on that, I think they have come out very clearly so Eskom alone cannot do the job.*" There was evidence that more power was required and Eskom's alone will not be able to provide this.

In 1982, Chile was the first country to reform its electricity market through vertical and horizontal unbundling and since then 70 countries have followed suit (World Bank, 2012). Since then a reform model has been developed by Eberhard & Shkaratan (2012), Besant-Jones (2006) and Rabindra & Jamasb (2015), and Jamasb (2006). This six step reform model suggested that the inclusion of IPPs is suitable to be introduced private participation without a full scale reform. This view was supported by Respondent 6: "*I certainly believe the generation of electricity should be a competitive market with multiple generators competing against each other.*"

Although respondents had the view the electricity sector should unbundle, they also noted caution to be taken when considering reform. Comments included: "*I think even without looking at a crystal ball I think politically and economically government wants a strong electricity utility", "it should be unbundled in a safe manner because at the end of the day strategically it is our major energy source"* and "*I think that it's seen as a vital state asset, both in terms of, in a technocratic sense… You don't have to go to a pure market solution and to shred Eskom."* This suggested politics must be taken into account when considering a reform. Besant-Jones (2006) also stated a reform must enhance the political support of the government in power; there must be minimal opposition from the public and provide benefits for supporters.

Besant-Jones (2006) stated that a reform will improve governance and can help clarify roles and responsibilities. This allowed the separation of government and management roles. However a full reform required IPPs to collect revenues directly

from consumers, and Eberhard & Shkaratan (2012) have estimated that only 75% of revenues are currently collected by utilities.

The literature and research indicated that more power was going to be required for the future. It was unclear who was to build this extra capacity, or how the monopoly will be reduced and competition introduced. This suggested the electricity sector should open up to private producers, however research indicated that due to political consideration, partial liberalisation was favourable and should occur. Therefore based on the step six of the reform model outlined by Besant-Jones (2006), Eberhard and Shkaratan (2012), Rabindra and Jamasb (2015) and Jamasb (2006), the inclusion of IPPs into the electricity sector for South Africa was the most appropriate.

The literature and research support the proposition of partially privatise the electricity sector by increasing IPP participation.

6.2.2. Opening Access to the Transmission Network for IPPs

Increased power generation by IPPs will require access to the electricity transmission network to supply power to end consumers. Seven of the respondents had the view that access to the transmission grid was more of a concern than generation capacity. This was a new finding from the research. Comments from the respondents included: *"you need to build a new transmission line"* and *"there isn't enough places to connect onto the grid"* and "*The first thing I think is making sure the transmission lines are upgraded and new ones in place to allow for transmission of electricity."* Although the country needs more renewable power to move towards lower carbon emissions, the same sentiment of grid access was echoed by respondents: "*now at the moment the big issue has always been access to the wires, in my opinion the biggest hurdle to IPPs has been the distribution and the access to the network rather than the generation",* and *"the bigger the percentage renewable, the more instability there is on our grid, and that is going to create problems."*

According to Newberry & Eberhard (2008) and the illustration of Figure 5 in Chapter 2, it was evident that Eskom had the monopoly. Currently Eskom was responsible for 94.6% of generation, 100% of transmission and 58.1% of distribution. The IRP and NDP policy documents estimate that a further 40GW of additional power was required, and assuming most of the extra power was generated by IPPs, the monopoly of Eskom in the area of generation will reduce. However there has been no mention of

increasing access to, or of the increased capacity of the transmission network. A view echoed by Respondent 10: *"you've got to connect load just as quickly as you connect generation. IPPs want as much freedom of access to the grid, for IPPs grid is everything."* It was becoming increasingly evident that the transmission network was the current system bottleneck.

The literature and research support the proposition of partially privatise the electricity sector by opening access to the grid transmission network. This was seen as the largest bottleneck to the current electricity crisis.

6.2.3. Migration of Consumers to Off Grid Solutions

The constraint of access to and capacity of the transmission network had also resulted in business moving towards off grid solutions. Respondent 1 had the view this was a reality: "*what we have also seen is we are seeing some more interest which will happen overtime is possible off grid solutions"* and Respondent 11 had a similar view: *"more and more people are moving off the grid."* Respondent 4 added cost as a variable to promote off grid solutions by stating that after a specific distance it becomes cheaper to provide mini grid solutions: "*remote areas that are very difficult to access … will then allow you to deploy a mini grid system."* Respondent 14 even went on further and stated that research conducted by his organisation indicated the possibility of private producers to develop their own transmission lines "*So I think an interesting question perhaps is whether we allow private players to help build the transmission line?"*

Although respondents had the view that off grid solutions were a possibility to overcoming the problem of grid access and grid capacity, the view from Respondent 8 was slightly different: "*Yes, off grid solutions is a brilliant thing but then there is no policy yet….. What will happen if Eskom gets their ducks in a row and all of a sudden there is an oversupply of electricity?"* The concern of oversupply was also stated as a risk for the IRP as the document outlined that over stating future demand will result in assets that are idle.

The literature and research supported the proposition of partially privatise the electricity sector. The current constraint on the grid had caused consumers to seek alternate off-grid solutions.

6.2.4. Summary: Unbundling the Electricity Sector

The NDP and IRP have estimated 42.6 GW extra power was required by 2030, although it was not specifically stated if the power will be generated by the state or private producers. It was clear that renewable energy will play an increased part in the future energy mix. Research indicated that competition was required in the electricity sector therefore prompting that extra power should be generated privately. Increasing private participation required reform of the electricity sector. The reform model suggested a full scale reform was not required if IPPs play an increasing role. An approach that was favourable for politicians.

The research highlighted that the current problem was access to and the capacity of the transmission network. Currently Eskom holds the monopoly in generation, transmission and distribution. The future electricity plans and the inclusion of IPPs indicated that the monopoly on generation will be reduced. However transmission remains a problem, even to the extent of consumers moving towards off grid solutions. It was also highlighted that polices are not in place for off grid solutions. This highlighted that transformation was not required in generation or distribution, but rather in the access to transmit of electricity. Clear policies and guidelines are required for private access to the grid and for off grid solutions.

All three sub themes from the research and the literatures supported the proposition of partially privatise the electricity sector with specific focus on access to grid transmission network.

6.3. Low Pricing of Electricity

There were 1 theme and 2 sub themes relevant to the low pricing of electricity and were as follows:

- Low Pricing
    - Political history of low prices and subsidiaries
    - Current pricing is not cost reflective

6.3.1. Political History of Low Prices and Subsidiaries

Inclusion of IPPs requires electricity pricing that was cost effective to allow profitability and sustainability of future power projects. The view from respondents suggested that

political history played a role in the development and calculation of electricity pricing. Respondent 1 stated "the *South African economy was driven by cheap labour and cheap power. You can't have cheap labour anymore, so you've got to get cheap power from somewhere."* This view was consistent with Goldblatt & Davies (2002) who stated that wages were low which resulted in a low cost of mining coal relative to the rest of the world, and thus low electricity prices.

According to Eberhard (2009), the South African electricity industry began in the early 1900s to supply the gold mining industry, a view that was aligned with Respondent 10: "*pricing in the apartheid era was done as a way of ensuring that cheap electricity was going to be available for the mining sector."* Cheap electricity began with the need to supply the mining industry; however over time the South African government used low electricity prices to stimulate industrialisation (Pieters *et al*., 2014)**.** This was also echoed by Respondent 6: "*the price of electricity has been artificially low for many years; it's been kept artificially low for political reasons."* The above responses and literature indicated that low electricity prices stemmed from the political history of the country.

The current electricity pricing showed that the prices are not cost reflective and have many subsidies built in. This was the view from Respondent 5: "*Eskom prices have a whole lot of cross subsidies."* Respondent 6 went on further and stated "*Eskom entered into a compact with the new government to reduce the price of electricity year on year.*" This comment was not far fetched, as according to Goldblatt & Davies (2002), the ANC-led government embarked on an electrification program which resulted in the number of households with access to electricity increasing from 30% in 1993 to 70% in 2004. In order to achieve increased electrification, prices had to be affordable to the poor and hence the subsidiaries. Respondents 8 and 12 went on further to state; "*in the past there was literally no increase"* and *"Eskom started decreasing prices after 1994 and should have increased prices through inflation".*

The literature and research for this subtheme does directly support the proposition for the need to achieve cost reflective pricing by increasing current pricing levels. It does help understand the reasons for non-cost reflective pricing.

6.3.2. Current Prices are not Considered Cost Reflective

According to Eberhard & Shkaratan (2012) the situation of under-pricing must be corrected and respondents also felt the price of electricity was going to increase. Respondent 8 called for more cost reflective pricing: "*we need to have proper cost reflective prices",* Respondent 7 stated "*So you can see that the price, if the current situation continues, it's going to be going up",* Respondent 14 said *"we've got to get to cost reflective pricing"* and Respondent 6 said *"Eskom's prices are rising sharply."*

Cost reflective prices are needed for investment into new capacity. In these scenarios, according to Respondent 2, investors needed to be sure that they will get paid - hence consumers will need to pay for the electricity. Besant-Jones (2006) outlined that long term contracts, competitve bidding and feed in tariffs can be used to protect private investors that enter into the electrcity sector. At the moment Eskom was taking the risk with Respondent 2 stating "*they have the retail risk and the industrial risk of people who are and are not paying."* Eberhard & Shkaratan (2012) highlighted that South Africa faces a unique problem as collection of revenues from consumers was poor.

Borenstein (2012) argued that government should not subsidise power as this led to overconsumption and reduced the incentive to become energy efficient. Respondent 5 stated that cross subsidies help the poor "*where people get below a certain income level get a certain tranche of electricity for free."* This is also a view shared by Respondent 11: "*Your bottom guys are sorted because they get government subsidies".* Increasing the electricity prices will be beneficial to investors in a new capacity so long as consumers pay and government reduces subsidiaries. Respondent 5 highlighted the risk of off grid solutions and non-paying consumers: "*now if I sell power directly to you this cross subsidization falls away*."

The increase of prices has two opposing objectives: the state concerns for the welfare of citizens, and the private sector seeking returns on investment. Thus the role of the regulator becomes increasing important. According to Jamasb (2006), all policies developed for the inclusion for IPPs must be supported by a strong regulating electricity authority. The regulator can be appointed by the state, but it must operate as an independent body without any political interference. The regulator will be best suited to determine price increases that are both fair to the investors as well as the consumers.

The literature and research for this subtheme does support the proposition for the need to achieve cost reflective pricing by increasing current pricing levels.

6.3.3. Summary: Electricity Pricing

The history of South Africa has played a role in low prices and government subsidies. In the pre democracy era the motivation was to stimulate industrialisation, and post-democracy, the motivation was to increase electricity access to citizens. Both approaches have led to the state subsidising electricity prices. However, investment was required to build new capacity and prices were not cost reflective. It was evident that electricity prices will increase, but there was also the problem of non-paying consumers.

Eskom faced the retail risk of non-payments and if IPPs went the route of off grid solutions then they too will face the retail risk of non-payment. In order for increased private sector participation in the electricity sector prices will be needed to be increased gradually. Consumer affordability will be needed to be taken into account for the price increases. IPPs will need to take this into consideration when performing feasibility and profitability of new power generating capacity, suggesting return on investments will be longer due to a slow price increase.

One sub theme gave context to the problem and the second sub theme supported together with the literature supported the proposition for the need to achieve cost reflective pricing by increasing current pricing levels.

6.4. IPPs in the Electricity Sector

There were 2 theme and 4 sub themes relevant to IPPs in the electricity sector and were as follows:

- Conditions for IPPs
    - Move away from a command and control sector to open market conditions
- Policy requirements
    - Current policy frameworks are creating investor uncertainty
    - There are policy frameworks but nothing in law
    - Misaligned policies, delays in policy development and low confidence in policy implementation

6.4.1. Conditions for IPPs

Command and Control

The initial view from respondents was that the electricity sector should be transformed into an electricity market. The view from the Respondent 1 was "*They want to move to a market, and your word market is exactly right, they want market conditions".* Erdogdu (2014) outlined one mechanism to liberalise the electricity market, was to facilitate free market conditions to attract IPPs to invest. Respondent 6 shared similar sentiments by stating "*the sooner we liberalise our electricity market, level the playing fields, introduce an independent system and market operator, encourage the wide spread use of IPPs, introduce an energy market, and get rid of the command and control economy which we are stuck in at the moment, the better it will be for this economy.*" This is supported by the view of Adam Smith, who argued that free market conditions will lead to economic equilibrium (Miles, Scott, & Breedon, 2012). The free market discussion draws parallels with the reduction of the state monopoly and more access to and ownership of the transmission network.

The literature and research for this subtheme does support the proposition to develop free market policies for private participation.

6.4.2. Policy Requirements

Current Policy Frameworks

Even though property rights are not full free market, policies need to be place to ensure the security of long term investments in the sector. Respondent 2 was of the opinion that policies guiding the access of the transmission network do not exist: "*the only issue about that is there is no template around it and the issue is unless you are building the power plant right on the mine you are back to the problem of how do you access the transmission network."* Besant-Jones (2006), outlined that private investors such as IPPs would require policies and laws to create stability and credibility. The success of IPPs' inclusion into the electricity market was contingent on policy frameworks that are focused on planning, procurement and contracting. This was also highlighted by both the NDP and IRP that there future policy development was required for increased IPP participation.

Respondent 7 highlighted an important point which supported the view of Besant-Jones (2006) by stating "*the framework is there but not in the law, because the law*

doesn't provide for anything. Because you can identify the technology but if the law doesn't allow you to explore or to issue any procurement documents on that then it's useless." This also has implications for property rights as laws that secure investments do not exist. Winkler (2005) outlined three policy instruments that could be used for IPPs:

- Feed in tariffs, whereby government sets prices for renewable energy. These prices are guaranteed for a specific period of time.
- Development of a renewable electricity portfolio standard (REPS) committee. Government can use the REPS committees to set a target for generation.
- Setting aside the fixed generating capacity for renewable energy via the mechanism of renewable obligation. The allocated electricity for renewables is put on tender, based on price per kWh.

The above policy instruments mentioned by Winkler (2005) are indeed policies and not law. Respondent 10 added a futher risk with policy frameworks: "*So we have something called the National Development Plan, all policies and all procurement processes should ultimately talk to the NDP. So the problem with RIE4P is it doesn't actually talk to the NDP."* This is suggesting that current polices which are being used for investment into the electricity sector are not aligned, indicating a significant gap.

The literature and research for this subtheme does support the proposition to develop free market policies for private participation.

Property Rights

Although respondents had the view that the electricity sector should have market principles, concerns were raised with regards to property rights. Respondent *2* had the view that *"the bottom line is you have to secure real rights so you can actually enforce your security so issues like land servitudes, licences, regulate all of that stuff needs to be in place."* This view was supported by Musole (2009) who stated that public policies, through institutions, generate a change in property rights through their effects on incentives and transaction costs. This essentially alters the behaviours of market exchange and economic performance.

Angeles (2011) went on further to state that property rights are used by people who invest in capital, and they expect to have the freedom to use and profit from their investment. When property rights are not clearly defined, transaction costs rise and

market failures occur. Musole (2009) added that the strength of a right was important - if the owner can freely determine the use of the asset then they have absolute right.

According to Respondent 7, investors in the electricity sector do not have absolute rights as these rights are determined by the Minister of Energy: "*Because for your own use, if you generate it for your own use, you don't need any assets, but if you're going to sell it to somebody then you're going to need a license, but that should be within the IRP. So meaning that you're going to have to write to the Minister and say, this is what I want to do, am I allowed doing this thing?*"

Therefore according to Musole (2009), when it comes to the catergorisation of property rights, the electrcity sector will be classified as private property rights when the right is assigned to specific individuals or corporations, and the state or community can impose limitations on the rights. Respondent 11 also stated "*So if you want to do more than that then you need a generating license, then it becomes slow and tedious to get a license."* The above comments and literature indicate that property rights in the electricity sector are in the hands of the Minister, and hence part of a command and control economy as opposed to a free market system.

The literature and research for this subtheme does support the proposition to develop free market policies for private participation.

Uncertainty

The major gap in polices and lack of law create investor uncertainty. Respondents have noted two specific areas that create uncertainty, i.e. not applying existing frameworks timeously and uncertainty in the policy itself. Respondent 10 had the view: "*We have the policy framework, whether we adhere to the policy framework is another thing. So I would say we have the policy framework, but if we applied it properly you'd have a very different outcome."* Respondent 6 had a similar view "*By law we should have an integrated energy plan published every single year since 2008, and we don't have one. That means the investment community don't know what the country plan is for energy".* According to Musole (2009), policies create incentives to use resources efficiently and reduce the impact of risk and uncertainty. A comment from Respondent 11 indicating the current state of keeping policies updated: "*And the regulatory framework can't keep up, poor NERSA is trying it's best to publish."*

The lack of updating policies and creating a clear direction was also creating uncertainty, supported by comments from Respondent 6: "*Our integrated resource*

plan for electricity is five years out of date, it's based on outdated information. No intelligent decisions can be made; no proper decisions can be made in that environment." This view was echoed by Respondent 13: *"You have the national integrated resource plan and that is an evolving document so it changes like the wind but we could have had a more long term IPP program looking at it after ten years and revisiting it every five years just to give business some sort of security and stability*."

Concluding remarks from Respondent 14 strengthened the case for more robust policies and direction: "*They should create long term policy certainty on how much in store capacity will be procured from IPPs and that will also give confidence."* This view was supported by Angeles (2011) who stated that an investor will expect profits from their investments and this is secured through property rights. However, if institutions are weak, government intervention can occur, reducing the credibility of property rights and ultimately investment. The second gap for an electricity market has been highlighted as the lack of direction from the state to afford private investors' confidence in future investments.

The literature and research for this subtheme does support the proposition to develop free market policies for private participation.

6.4.3. Summary: IPPs in the Electricity Market

The current view from respondents was to move to free market conditions, particularly in the access to the transmission network, an argument which was strongly made during the discussion on the transformation of the electricity sector. There was strong consensus between respondents and literature that property rights are required to encourage investment into the electricity sector. Many of the rights and licenses issued in the South African electricity sector were still determined by the Minister, suggesting a market based approach was not in place.

There was concern about existing policies, firstly because there was evidence that key polices do not align. There was also the view that there are only polices and nothing that was actually written in law with regards to power generation, transmission and distribution. Respondents also highlighted that existing policies were implemented slowly and change too frequently, thus creating investor uncertainty. This section highlighted three gaps, no polices for access to transmission network, changing policies and an absence of law, which creates uncertainty.

All four sub themes in this section have together with the literature supported the proposition to develop free market policies for private participation

6.5. Propositions and Supporting Evidence

The data presented in Chapter 5 was compared to the literatures reviewed in Chapter 2. The similarities and differences were discussed earlier in Chapter 6. Table 5 below compares the discussion of the results with the research propositions that were outlined in Chapter 3, Table 3.

Table 5: Research propositions and supporting evidence

Propositions	Supported by Research	Evidence
Coal future dominant energy source	Partially supported	There is also consensus South Africa was a large carbon emitter and the use of coal led to high emissions. International pressure resulted in the country moving towards a low carbon economy. Thus renewables will be included in the future energy mix but not for base load demand. Nuclear will play an increased role, and the role of coal will be dominant but decreasing over time.
Partially privatise the electricity sector by increasing IPP participation	Supported	All respondents agreed on increased competition in the electricity sector. The current bottleneck was access to the transmission network and transformation was required. The full reform model was not required however the inclusion of IPP's will introduce competition and be politically acceptable. It was also identified that off grid solutions were becoming increasingly popular.
Need to achieve cost reflective pricing	Supported	History and current social agendas have resulted in subsidized electricity prices. Respondents agree electricity prices must return to cost reflective levels for future investment and sustainability.
Develop supportive policies for	Supported	Respondents agreed that current policies are insufficient, slow and do not create investor certainty. There are currently no laws pertaining to

private participation	private power production. The need for clear policies when dealing with access to the grid and off grid solutions was highlighted.

Source: (Own Research)

The analyses from Table 4 above suggest three propositions were fully supported by the research and one was partially supported. The new finding from the research was that access to the transmission network was the current bottleneck to the system. It has also highlighted that policies are required for access if there is to be increased IPP involvement in generation. The next chapter includes the conclusions and recommendations for a model of potential reform for the South African electricity sector.

7. CONCLUSION

7.1. Aims and Objectives of the Study

7.1.1. Primary Objective Achieved

The aims of the study were outlined in Chapter 1 with the purpose to identify if the South African electricity market should reduce its reliance on the abundance in fossil fuels, and increase private sector participation by reducing the state monopoly in the electricity sector. The primary objective of the study will be to identify the policies required to reform the electricity sector for increased private power generation. The study indicated that most important was policies for access and ownership to the transmission network. It was also found that property rights are at risk as there are frameworks such as the NDP and IRP but these are not law abiding. A policy documents such as the MPRDA is required for the electricity sector and future plans.

Therefore it can be concluded that the primary objective was achieved. It is hoped that the proposed model developed will help facilitate private sector participation in the South African electricity sector.

7.1.2. Secondary Theoretical Objectives Achieved

Theoretical Objective 1: Review literature on electricity generation in South Africa

The theory described the development of the electricity generation from the use for mining in early 1900s to the driver of industrialisation in the mid-1970s to electrification of citizens in the 2000s. The literature also described the reliance on coal, the development of Eskom and the role of politics in the electricity sector. Therefore theoretical objective 1 was achieved.

Theoretical Objective 2: Review literature in the renewable energy generation development

The theory described the role of carbon emissions and the potential impact on the environment and society. There was also a discussion on the readiness of South Africa to move towards a green economy and the international migration towards renewable energy. Therefore theoretical objective 2 was achieved.

Theoretical Objective 3: Review the regulatory regime on electricity

The theory discussed at length the role of privatization, institutions, polices and the regulator required for transformation of the electricity sector. The relevant documents were analysed in detail and those included the NDP, IRP and MRPDA. The theory also discussed typical electricity reform models and the current generation, transmission and distributions architecture of the South African electricity sector. Also reviewed was the electricity pricing mechanisms for IPPs. Therefore theoretical objective 3 was achieved.

Theoretical Objective 4: Review theory on policies, institutions, electricity reform models and electricity pricing

The theory discussed property rights and institutions are key components in the process of privatisation. The literature also highlighted the need for a strong institutional environment and a regular that is not influenced by government. The monopoly of Eskom and the six step reform model were reviewed. The increased participation of private power production and the impact on competitive cost reflective electricity pricing was discussed. Therefore theoretical objective 4 was achieved.

7.1.3. Secondary Empirical Objectives Achieved

Empirical Objective 1: Institutional contribution to the electricity market

There were currently two policies in existence that guide the future electricity market - the NDP and the IRP. The IRP was used as a guideline for investment into the South African electricity sector. These documents only covered the generation of electricity and there were no policies guiding transmission of electricity. Access and ownership of the grid has emerged as an impediment to the development of the electricity sector. Therefore empirical objective 1 was achieved.

Empirical Objective 2: Benefits of the increased role of IPPs

There was a desperate need for competition in the current monopolistic electricity market. Following the example of Chile, 70 others countries have embarked on the reform of their electricity sector via horizontal and vertical unbundling. The six step reform model outlined by Eberhard & Shkaratan (2012), Besant-Jones (2006), Rabindra & Jamasb (2015) and Jamasb (2006) suggested that the inclusion of IPPs will foster competition, achieve increased capacity and create diversity into the electricity sector without the need for a full scale reform. This approach was congruent

with outcomes from the research and is also politically favourable. Therefore empirical objective 2 was achieved.

Empirical Objective 3: Benefits of IPPs model that would help reform the electricity sector

There was a need to migrate the electricity sector away from a control and command to free market conditions whereby the electricity sector becomes an electricity market. To do this, the current subsidies on electricity prices will need to be removed, for prices to become cost reflective. The role of IPPs will help reduce the current monopoly, increase competition and ultimately result in efficient electricity pricing. IPPs will at the same time introduce carbon friendly generation technologies such as renewables into the electricity market. The following section will outline the model to possibly partially liberate the electricity sector through the increased inclusion of IPPs and the policy requirements to facilitate this proposition. Therefore empirical objective 3 was achieved.

7.2. Partial Liberalisation of the Electricity Sector

The literature review conducted in Chapter 2 suggested that due to the abundance of coal reserves, coal should play a dominant role in electricity generation. At the same time, there was recognition that the electricity sector required transformation to increase competition and reduce the state monopoly. The literature indicated that reform of the electricity sector should occur. This required strong institutions, strong property rights, and clear policies to reduce investment risk and uncertainty. Lastly, there was the need for cost reflective pricing.

Respondents had the view that the move towards low carbon emissions was driven largely by the international perception of South Africa. Although they had the view that coal was in abundance, its dominance in the future will reduce and alternative technologies such as nuclear and renewable energy will increase. There was also a view that there was transformation in electricity generation, however there was a gap in policies supporting access to the grid and off grid solutions.

Due the history of the country, current prices have subsidies built in and thus there was a need to move towards cost reflective prices. There was also a need to transform the electricity sector into an electricity market. However, currently policies were not supportive of free market conditions and misaligned policies created investor

uncertainty. There was a need for laws that govern private participation, and more policy direction on grid access and off grid solutions.

Future Energy Mix

The Reserve Bank estimated that electricity shortage has resulted in a downward forecast for South Africa's GDP growth. South Africa at the same is Africa's largest carbon emitter, although it is blessed with large coal reserves. Climate change has resulted in the countries in the world moving towards greener economies, and as a developing country, South Africa is under pressure to follow the same direction. Therefore the use of coal will reduce over time. Technologies such as nuclear and renewable energy will play an increasing role in the future of electricity generation.

There were concerns about the role of renewables in providing base load power - therefore renewable technologies will require development to ensure increased availability and stability. Currently the state utility's focus and skills lie predominantly in coal generating technologies.

7.3. Proposed Policy: Transmission Network Access

The increased capacity will be built by IPPs and hence the monopoly of the state's generation will reduce. Therefore it can be considered that the generation of electricity will be partially liberalised. However the state still owns the transmission network and IPPs will require access to the grid to transmit the power they generate. Therefore it can be concluded that the transmission network will need to be liberalised, and there is a need to introduce competition and appropriate policies. Through the literature review the study identified the gap in policies for increased IPP participation and through the research it was identified the policy gap is in the access to the transmission network.

Based on literature and the research the proposed policy framework should include the following

- Equitable access
- Leasing current grid infrastructure
- Demand side management
- Regulatory Body

Equitable Access

Based on the increased participation of IPPs in the generation of electricity, the proposal that the transmission of electricity should be reflective of the percentage generated. This implies that the monopoly of Eskom in transmission will reduce from 100% to 70%. Therefore for every KW an IPP produces they should be allowed to rent or build their own transmission network. The model also suggests that power generators should be allowed to sell directly to industrial consumers directly via off grid solutions. Therefore IPPs should be allowed to build their own transmission network to the private customer they intend to sell electricity.

Leasing Current Infrastructure

The reduction of the state monopoly to 70% and if equitable access if followed then the state will be require to transferred transmission assets to IPPs. Besant-Jones (2006) had suggested three ways in which this could be accomplished. The most appropiate way would be for the state to enter into lease and management contract with IPPs. In this case the current transmission assets will not be given away but rather managed. This will increase competition and reduce problems of access to the grid.

Demand Management

Power generators should also be allowed to sell directly to industrial consumers via long term power purchase agreements. In order for this to occur, a policy must tier the power allocated for off grid generation can be regulated. There is a concern that availability of off grid solutions will place a strain on the existing infrastructure. If the off grid solution is not available, consumers will revert to the grid, placing strain on the network. Therefore risks should be outlined to consumers who take power direclty from IPPs. This also highlights the need for an electrcity demand and supply management system, smart grid. The smart grid system must be able to determine the current supply capacity of all generators, the demand of grid consumers and the demand of off grid consumers. This will enable planning and implementation of the proposed policy.

Regulatory Body

Regulation will involve the state regulator NERSA as well as an IPP electricity portfolio standards committee, as suggested by Winkler (2005). The roles of the regulatory and standards committee are aligned to the definition of Jamasb (2006), and that is to

ensure dispute resolution, and to manage procedure to maintain transparency to prevent corruption.

7.4. Recommendations for Future Research

The study highlighted the need for the transformation of electricity transmission. Therefore more research should be conducted on the capacity of the electricity transmission grid. An in-depth study is required to identify if the capacity proposed by 2030 will be able to accommodate the existing grid. The current grid has been place since the development of the electricity sector in the early 1900s, which implies that the grid is ageing, and apart from expansion, it will require repair. In order for the development of a policy for access to the transmission network will require identifying what percentage of transmission network should be allocated per KW. It will also be required to identify the impact building new transmission network will have on the pricing of electricity and the return on investment for IPPs.

Electrification was identified as a crucial vehicle in achieving the goal of improving social welfare. The proposed policy and recommendations for future research for IPP access and ownership of the transmission network will help the South Africa electricity sector to transition to lower carbon emissions, bolster economic growth and continue to be the leader in power generation within Africa.

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APPENDIX A – RESEARCH QUESTIONS

P Rambalee

Research Project: Questionnaire

Topic: South African electricity market: possible institutional reforms

The respondents for the interview are executives in the energy industry. The questions are as follows:

1. How would you explain the future of South African coal as the world fights to reduce carbon emissions?
2. South Africa has enjoyed abundant electricity for many years. Are there merits or room for transformation?
3. What is your opinion on the history of low electricity prices?
4. What should be the electricity market for Independent Power Producers?
5. Describe the electricity role in regional co-operation?

APPENDIX B – ETHICAL CLEARANCE

Gordon Institute of Business Science
University of Pretoria

Dear Previen Rambalee

Protocol Number: **Temp2015-01311**

Title: **South African electricity market: possible institutional and instrumental reforms**

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