

https://dspace.org/

The introduction of renewable energy into the South African energy mix without affecting the socio-economic environment of the country

Baepi, Marvin

2022-12
University of the Witwatersrand, Johannesburg
https://hdl.handle.net/10539/38837
Baepi, Marvin. (2022). The introduction of renewable energy into the South African energy mix without affecting the socio-economic environment of the country [Master's dissertation, University of the Witwatersrand, Johannesburg]. WireDSpace. https://hdl.handle.net/10539/38837

Downloaded from a DSpace repository. https://dspace.org/

THE INTRODUCTION OF RENEWABLE ENERGY INTO THE SOUTH AFRICAN ENERGY MIX WITHOUT AFFECTING THE SOCIO-ECONOMIC ENVIRONMENT OF THE COUNTRY

BY

MARVIN BAEPI

RESEARCH PROJECT

Submitted in partial fulfilment of the requirements for the degree of

MASTERS DEGREE

In

BUSINESS ADMINISTRATION

At

WITS BUSINESS SCHOOL

SUPERVISOR: DR L. MONDI

December 2022

Wits Business School
Sculpting global leaders

Student details

THIS DECLARATION IS TO BE ATTACHED TO ALL ASSIGNMENTS

Student Number: 2380369 Student name: Marvin Baepi

Email address: Baepi.thebe@gmail.com

Assignment details	
Course Code: ARP	Course Name: Applied Research Project
Exam	Due date: 14 Decemebr 2022

Career Management and Development

Student Declaration
I am aware that plagiarism (the use of someone else's work without their permission and/or without adequately acknowledging the original source) is wrong and is a violation of both the General Rules for Student Conduct and the Plagiarism Policy of the University of the Witwatersrand. I am aware that it is wrong and is a violation of both the General Rules for Student Conduct and the rules of the Wits Business School for a student to submit for a course, unit, or programme of study, without the written approval of the course instructor or the programme director, all or a substantial portion of any work for which credit has previously been obtained by the student or which has been or is being submitted by the student in another course, unit, or programme of study in the University or elsewhere. I confirm that this assignment my own unaided work except where I have explicitly indicated otherwise. I confirm that this assignment has not been nor will be submitted in whole or in substantial part in another course, unit, or programme of study in the University or elsewhere without the written approval of the course or unit instructor or the programme coordinator. I confirm that I have followed the required conventions in referencing the words and ideas of others in this assignment. I confirm that I understand that this assignment may at any time be submitted to an electronic plagiarism detection system, and may be stored electronically for that purpose. I confirm that I have received a copy of the University's Plagiarism Policy S2003/351B and a copy of the General Rules for Student Conduct and Code of Conduct C2010/27. I confirm that I understand that any and all applicable policies, procedures, and rules of the University and of the School may be applied if there is a belief that this assignment is not my own new and unaided work, or that have failed to follow the required conventions in referencing the words and ideas of others, and I understand that application of the policies, procedures, and rules may lead to the University taking disciplinary action against me. Note: The attachment of this statement on any electronically submitted assignments will be deemed to have the same authority as a signed statement..
Student Signature: Marvin Baepi | Date: 13 December 2022

Declaration of submission

I, Marvin Baepi, with student number 2380369 and Identity Number 8506015840083, do hereby declare that this research project is a preparation of my own unaided work. I hereby submit in partial fulfilment of the requirements for the Degree of MASTERS in BUSINESS ADMINISTRATION from the University of the Witwatersrand. This research project has not been submitted before for any degree or examination at any other university/tertiary institution.

Marvin Motseyathebe Baepi	13 Decemebr 2022
Signature	Date

ACKNOWLEDGEMENTS

My greatest gratitude goes to Mr Lumkile Mondi for dedicating his time and knowledge in ensuring that this dissertation is completed. I also extend my appreciation to my family, especially my wife and daughters for their unwavering support and understanding during my studies and mostly during this dissertation. Lastly I would like to thank my ancestors and high spirituals power for strength and motivation.

I would also like to thank Frank Hinda, Lonwabo Magida, Oupa Seopa and Paul Collier for their willingness and patience in providing me with the information needed.

ABSTRACT

There is no doubt that climate change is a reality, even though there is a huge disagreement on what course it. In response to this reality, in 2011 South Africa introduced the National Climate Change Response Policy White Paper (NCCR. 2011; Lukey, 2020). The policy was a mitigation response to address Greenhouse gases (GHG) emissions. It had short, medium and long term goals to stop the increasing GHG emission by latest 2025 and stabilisestabilize it by 2035 and start reducing from 2035 – 2050 respectively.

These policies among other things, aim to eradicate or reduce dependency on electricity generation using coal. They also aim to encourage businesses to reduce CO2 emissions. However, instead of businesses reducing CO2 emissions , they pass through the penalties that the government impose on them for emitting CO2 during their production processes to their customers.

South African has high unemployment rate and low skilled labour contingent, especially in the coal mining industry. The government cannot afford a fast pace eradication of coal fired power generation as this will deepen unemployment in the coal industry, especially in the Witbank area. The deployment of renewable energy requires highly skilled individuals for construction, operation and maintenance.

The introduction of renewable energy at its current form, where Eskom is a single buyer is very expensive for South Africans at large. This is because Eskom applies a pass through method for buying electricity that is more expensive than their current fleet of electricity generation plants. The industry needs to be deregulated in order to achieve a fair and workable plan for South Africans.

Table of content

Table of Contents

1. Introduction

1.2 Research Problem Statement **9**

1.3 Research Aims and Objectives **10**

1.4 Limitations **11**

2. Literature Review

2.1 Legislation and Climate Change **12**

2.2 Carbon Tax **16**

2.3 Electricity supply stability **18**

2.4 The introduction of renewable energy via deregulation and Eskom not being a single buyer **21**

2.4.1 Privatisation and deregulation of energy market in South Africa **22**

2.4.2 Privatised and deregulated energy markets globally **30**

3. Methodology **33**

4. Results

4.1 Introduction of renewable energy in a competitive way while sustaining employment and security supply **36**

4.1.1 The effect of reducing production or closing the coal-mining sector **36**

4.1.2 The introduction of renewable energy, Eskom being a single buyer (map-out the potential short-mid-term road map of introducing renewable energy) **38**

4.1.3 Discussion **41**

4.2 The effect of carbon tax when introduced at this current form **42**

4.2.1 Discussions **46**

5. Summary **48**

6. Reference **50**

CHAPTER 1

INTRODUCTION AND RESEARCH ORIENTATION

1. ***Introduction***

This paper will be covering mainly the effect of renewable energy introduction in South Africa and its impact on the socio-economic environment in the country. It will not be prudent for one to research about renewable energy while excluding the biggest drivers that resulted in the government embarking in this journey of introducing renewable energy. The biggest driver is is carbon dioxide (CO_2) emission.

Electricity/Energy is of great importance to economic and social development. However, the value chain of electricity production, transportation and use can contribute to air pollution, which will result in climate change (Spalding-Fetcher, 2005). This leads to the energy sector having primarily two challenges. The first. would be to provide or increase access to affordable and sustainable electricity supply and the second being reducing environmental impact while providing the needed electricity (Spalding-Fetcher, 2005).

Coal mining drives the employment associated with coal power generation since the industry absorbs low skilled labour (Meridian Economics, 2018). The South African energy supply is dominated by coal which constituted 69% of supply in 2016, this is according to the country's department of energy's sector report(DoE, 2019). The COBENEFITS study suggest that the bulk of job creation in renewable power generation is within the high-skilled labour group while recognizing that the current South African energy landscape is mostly infested with low to medium skilled labour group (COBENEFITS, 2017).

According to Yuxiang Jin, by 2016 there were 36.9 million South Africans between the ages of 15 and 64, while 21.8 million were in labour force with 16 million employed and the rest unemployed (Jin, 2021).

The South African government first published a White Paper on Energy Policy in 1998. The objectives of this policy was access to affordable energy services, improving energy governance, stimulating economic development, managing energy related environmental impacts and securing diversity through diversity (Thabethe, 2010).

The objective of securing energy (electricity) through diversity is to address the vuknerabilitybof relying on a single source including renewable including renewable energy. This would help the South African energy/electricity sector to achieve a sustainable electricity generation mix. Subsequent to the White Paper on Energy Policy of 1998, the South African government then hosted a world summit on sustainable development in Johannesburg during 2002. The summit gave birth to the release of White Paper on Renewable Energy in 2003 (Thabethe, 2010).

The objectives of the White Paper on Renewable Energy of 2003 are to ensure enough resources are invested in renewable technologies, directing public resources for implementation of renewable energy technologies, introducing suitable fiscal incentives for renewable energy and creating an investment climate for the development of the renewable energy sector (Thabethe, 2010). 10 000 GWh was set as a targeted electricity generated from renewable energy generation plants by 2013.

This document laid the foundation for the promotion of renewable technologies. South Africa's commitment to a low carbon economy, Integrated Resource Plan (IRP2010) set a target of 17800 MW of renewable energy by 2030 (South African Department of Energy, 2018). Five thousand MW was planned to be operational by 2019. Currently South Africa had 5027MW of renewable

energy which is operational by end of 2020 and 2300MW in the next two years as the government has signed contracts with 27 independent power producers in 2018 (Caboz, 2018 and Malinga, 2021).

Subsequent to the signing of the White Paper on Renewable Energy, the South African government then signed the Paris Agreement as one of the 193 United Nations (UN) country members. The United Nations (UN) is an intergovernmental organization that promotes international co-operation, to create and maintain international order with 193 countries as members. The UN and its partner countries believe that greenhouse gas emissions from human activities are the reason for climate change. The UN member countries adopted the Paris Agreement at the COP21 in Paris in December 2015, agreeing to limit global temperature rise to below 2 degrees Celsius by decreasing greenhouse gas emissions.(UN sustainabledevelopment,2017).

The Paris Agreement has resulted in first world countries pledging to help developing countries in combating and adapting to the climate change effects. The pledge is in the form of money and other support. Developing countries have in turn adopted the practices of first world countries as it benefits them monetarily and will result in job creation and other essential benefit being received.

1.2 Research Problem statement

Global unemployment rate was at 4.9 percent in September 2022 while that of South Africa was at 27.9 percent (Galal,2022) , and this should not be the case considering the rich mineral resources that the country has. The signing of White Paper on Renewable Energy and Paris Agreement which resulted in the implementation of carbon tax and IRP2010 (Integrated

Resources Plan) might pose a challenge for the country to utilize its minerals for the benefit of its citizens.

Renewable energy and carbon tax are some of the initiatives used globally to cap climate change, especially in Europe. However, South Africa has different GDP drivers than those countries and the GHG emission reductions cannot be achieved at the expense of an increase in unemployment which will in turn affect socio-economic environment of the country. The other challenge of transitioning too quickly into renewable energy is the security of electricity supply which might also discourage investment. Especially, commencing in the current form where Eskom is a single buyer and it is also exempt from carbon tax.

In summary, the following questions need to be looked at closely and addressed:

- What is the socio economic impact on the coal industry with the introduction of renewable energy?
- Is the introduction of renewable energy done in a competitive way or having negative impact on the socio economic enviroment?
- What is the impact of carbon tax introduction on the consumers?

1.3 Research Aims and objectives

The aim of this research paper is to unearth the challenges of introducing renewable energy in a competitive manner to ensure security of supply and the impact of introduction of carbon tax.

The objectives are;

- To assess current challenges of introducing renewable energy, where Eskom is a single buyer.

- To qualify the impact of introduction of carbon tax and renewable energy.JH

- To analyse the decommissioning of coal power stations.

The results of this study will be valuable to the industry as well as for investors and the government. This will identify possibilities and barriers for future work.

Limitations

The limited duration available and the industry interview.

CHAPTER 2

2. ***Literature Review***

2.1 Legislation on climate change

The United Nations (UN) is an intergovernmental organization that promotes international co-reason for climate change amongst other things. The UN member countries adopted the Paris Agreement at the COP21 meeting in Paris in December 2015, agreeing to limit global temperature rise to below 2 degrees Celsius by decreasing greenhouse gas emissions.(UN sustainabledevelopment,2017).

Prior to the Paris Agreement there was the United Nations Framework Convention on Climate Change (UNIFCCC). The UNIFCCC is an international environmental treaty that was adopted on May 1992 even though it was entered into force on 21st March 1994. The treaty commits to stabilizing greenhouse gas concentration in the atmosphere at a level that would prevent human impact on the environment and climate system.(United nation, March 1994).

The UNFCCC treaty was not legally binding. Therefore in 1997 the UN developed a legally binding Kyoto Protocol which has 37 out of the 193 member countries committing to it. Kyoto Protocol clearly lacked support because of its legally binding commitment. The UN member countries decide to adopt the Paris Agreement before the Kyoto Protocol ends in 2020.

The Paris Agreement is an agreement within the UNFCCC dealing with greenhouse gases emissions mitigation; the adaption and finance of the program commenced in 2020 upon ending of Kyoto Protocol. The aim is to curb the global temperature below 2 degrees Celsius for this century. The first world countries will help developing countries with every support needed to also achieve this goal.(Unite nations,2017).

The world Meteorological Organization and the United Nations Environmental Programme created Intergovernmental Panel on Climate Change (IPCC) in 1988 (Oreskes, 2004). The IPCC's primary responsibility is to evaluate the state of climate science as a basis for informed policy action, primarily on the basis of peer-reviewed and published scientific literature. The IPCC's latest evaluation is that climate change is being affected by human activities(Oreskes, 2004).

The UN member countries in response to commitment under the UNIFCCC have introduced what they call carbon tax in their countries. Scientist have proved that carbon is present in all hydrocarbon fuels and when combusted it is converted into carbon dioxide. Carbon tax is one of the initiatives of reducing combustion of hydrocarbon.

Climate change is now a measurable reality and developing countries are vulnerable to its impact, South Africa included. In 2011 South Africa introduced the National Climate Change Response Policy White Paper (NCCRP) 2011 (Lukey, 2020). The policy was a mitigation response to address Greenhouse gases (GHG) emissions. It had short, medium and long term plans to stop the increasing GHG emission by latest 2025 and stabilize it by 2035 and start reducing from 2035 – 2050 .

The NCCRP has two main objectives, the first being to manage the climate change impact while sustaining social, economic and environmental enviroments. Then Secondly, stabilize GHG concentrations in the atmosphere (Lukey, 2020). The short, medium and long plans are to mitigate emission in each economic sector, including incentives for those that are adhering to the mitigation strategies.

According to Hannah Ritchie and Max Roser, carbon dioxide (CO_2) emissions are the greatest drivers of climate change and the reduction of CO_2 will help the world avoid the worst impact of climate change (Ritchie & Roser, 2020). However, Figure 1 indicates that there has always been climate change even before the days of intense industrialization. The recorded temperature started to increase exponentially between 1900s -1940s, during this time there were a very few coal power stations and carbon dioxide emitting industries. The period between 1950s – 1970s most scientist and environmentalist believed that the earth was going back to the ice age period, this period was when electricity was needed because innovation was at its highest.

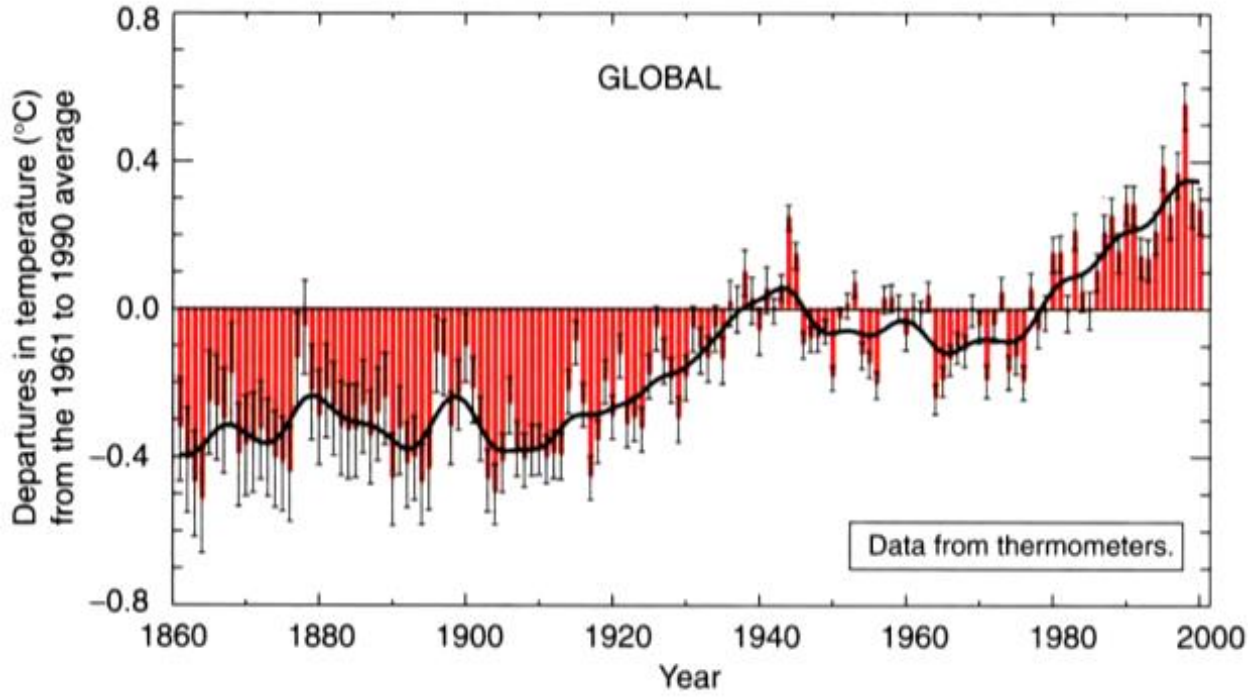


Figure 1 indicates the recorded temperatures since 1860s until 2000s ***(Dooley et al., date)***

There has always been a change in the global emission rate (Our Wold in Data, 2020) even prior and during the ice age era (Ritchie & Roser, 2020). Taking this and the above into consideration and considering that the influx of coal power stations and fossil burning industries was in the period when the earth's temperature was decreasing. It makes it difficult to believe that Carbon Dioxide is the cause of the current raise in temperature.

Our World in Data (2020). Annual percentage change in CO_2 emissions, 2020. https://ourworldindata.org/grapher/change-co2-annual-pct?tab=chart, it can be seen on the chart below that Africa contributes four percent of global CO_2 emmission indicates that Africa accounts for 16 percent of the world population and emits 4 percent of global CO_2. Compare this to North America, which is home to 5 percent of the world population, but emits 18 percent of global CO_2. The world high and upper-middle income countries emit 86 percent of global CO_2 emission while the low and low-middle income countries (which South Africa belongs to) only contribute 14 percent of the global emissions. (Ritchie & Roser, 2020).

The University of Cape Town's senior researcher named Dr Andrew Marquard states that there are a lot of factors that one must consider in order to get accurate figures for greenhouse gas emission, thus making it very challenging to collect such data for different countries (Marquard, 2020). However, in 2019 Global Carbon Atlas, ranked South Africa 12th highest emitter in the world and the highest in Africa. While, in 2018 Union of Concerned Scientists, ranked South Africa 13th in the world and first in Africa. Otherwise, when comparing South African emission to global emissions, one discovers that South Africa's emission are 1% of global emissions (Africa Check, 2021).

In response to mitigating greenhouse gas emissions, South Africa introduced the carbon tax and the white paper on Renewable Energy via IRP2010. The industries which are mostly affected by the carbon tax are the motor manufacturing and electricity generation industries. The problem with carbon tax is that end users carry the cost. This does not change the behaviour of the

companies. The motor industry is in a process of moving to electric cars to avoid carbon combustion and tax. The transition will mean more electricity will be needed.

The more electricity is needed, then most countries will resort to renewable energy generation to boost their installed capacity. This will be done to avoid carbon tax and subsidy. Renewable energy has its own impact on the environment. A study conducted by the University of Cape Town in 2017 shows that the largest solar plant in the Northern Cape was responsible for 4.53 bird fatalities per Megawatt per year Visser, 2016). . The large wind farms in South Africa are responsible for bird fatalities . (Perold *et al,* 2020).

2.2 Carbon Tax

A carbon tax is an environmental tax on energy sources that emit carbon dioxide. The purpose of the tax is to minimize or slow down global warming by reducing the emission of carbon dioxide or greenhouse gasses (PWC South Africa, 2018). In South Africa, 1kg of carbon dioxide is emitted for every kilowatt hour of electricity generated (The carbon report, 2018).The South African government believes that the introduction of carbon tax will help it achieve its commitment of reducing the greenhouse gas (GHG) emission.

The South African government enacted the Carbon Tax Act in June 2019, after years of deliberation and engagement with various stakeholders. The main purpose of the Act is to impose a tax on greenhouse gases that are emitted within South Africa. The government plans to tax-exempt 60% of emissions and apply some allowances up to 2022 to lessen the impact on the industries.

Carbon pricing is very crucial in driving transition to greener economy. Thus it is important to integrate carbon tax with other measures to achieve reduction in GHG emission. These kind of tax will encourage behavioral change towards abondining of intensive CO_2 emitting operations

and organizations will invest more into low carbon emitting technologies . Table 1, shows sectoral GHG emissions.

Sector	GHG emission CO_2e (Gg - gigagrams)							
	1990	% of total	1994	% of total	2000	% of total	2000 % change from 1994	2000 % change from 1990
Energy	260886	75.1	297564	78.3	344106	78.9	15.6	31.9
Industrial processes and produce use	30792	8.9	30386	8	61469	14.1	102.3	99.6
Agriculture	40474	11.6	35462	9.3	21289	4.9	-40	-47.4
Waste	15194	4.4	16430	4.3	9393	2.1	-42.8	-38.2
Total (without LULUCF)	***347346***		***379842***		***436257***		***14.8***	***25.6***

Table 1. *Sectoral GHG emissions for SA – DEA GHG Inventory Report (2009)*

Climate change is a threat to eradicating poverty as most developing countries depend on agriculture and other climate-sensitive natural resources for income and wellbeing (Hemraj, 2012). These developing countries have high illiteracy levels and low GDP, thus making it challenging to have financial and technical capabilities to deal with climate change (Hemraj, 2012). Climate change leads to not only change in temperature patterns that affects rainfalls but extreme weather shocks. The IPCC itself says that there is no link between climate change and extreme weather. Another thing that carbon tax seeks to achieve is to level advantages between carbon intensive sectors and low carbon emitting sectors i.e the fossil fuel based firms and renewable energy, including energy efficiency technologies.

A tax on carbon dioxide emission is the appropriate method and a step in the right direction for reducing GHG emissions and direct regulation technology, products and behavior (Kohlin &Sterner, 2015). This policy promotes innovation in technology, production line as it offers incentives for reduction in carbon dioxide reduction. Globally, carbon taxes have existed for 25

years. In 1990, Finland was the first country to lead and impose carbon tax (Kohlin &Sterner, 2015). However, carbon tax has its own implementation challenges.

Globally these are some of the reasons why implementation of carbon taxes failed:

- Resistance from businesses and individuals that depend on fossil fuels.
- Lack of buy-in from the broader public as carbon tax will increase commodity prices.
- The regulation not ourlining the advantages and disadvantages clearly.
- A perception that taxes reduce welfare and increase unemployment due to lower levels of consumption and production. (Sweet, 2018).

2.3 Electricity supply stability

The security of stable electricity supply attracts investment, for a country to achieve this then baseload supply is needed. Coal and natural gas are the most used resources for electricity generation baseload supply. Even though environmentalists do not recommend coal as an ideal resource for electricity generation, it still accounts for 36% of the global electricity generation resources and it is anticipated to stay like that for decades to come.

The electricity demand increased by an average of 6 percent in 2021 which was an all time high since 2010 when the world was recovering from global financial crisis (International Energy Agency, 2022).). The world electricity demand is expected to increase from 11.3 trillion kWh in 2012 to 22.3 trillion kWh in 2040 (International Energy Outlook, 2017). This is proportional to the growth in the world GDP. The world GDP growth between 2005 – 2012 was 3.7%/year with the net electricity growth being 3.2%/year ((International Energy Outlook, 2017).

South African coal reserves are based on a study conducted in the late 1980s. Established coal mines in South Africa are depleting their reserves, 2020 was expected to be a very critical tenure

for the coal industry. This will be an opportunity for neighboring country to import into South Africa.

There is a revived interest in the Springbok Flats coalfield which is located 100km north of Pretoria. The coalfield was first explored in the 1960s. However, with the surplus coal supply at the time, little interest was shown until recently (mining review Africa, 2009).

South Africa is amongst some of the countries with carbon-intensive economies. The abundance of coal resources led to the country relying on energy-intensive mining and industry as the historic drivers of economic development. As a result, these industries historically enjoyed subsidized coal-fired electricity (Alton *et al.,*2013).

South African coal resources were estimated at 100 billion tonnes 20 years ago, recently the number has reduced to 30 billion tonnes. This makes South Africa home to 11% of the world's coal reserves. South Africa is ranked sixth coal-exporting country; it accounts to 6% of the global exports (CHAMBER OF MINES of South Africa, 2015).

Coal accounts for over 85% of the country's power generation. The coal industry made a turnover of R101.4 billion in 2016 (CHAMBER OF MINES of South Africa, 2015). The coal mining industry employs 91 605 individuals which is 17% of the total mining workforce (statssa, 2015). Even though mining has considerable number of unskilled position, some of the coal mining region have high number of unemployment.

83% of the country's coal is mined in Mpumalanga province, the rest of the 13% is mined in Limpopo, KwaZulu-Natal and Free State. This can be seen in Figure 1. However, Mpumalanga had 68000 unemployed residents in 2016 (Bosman Grobler, 2017).

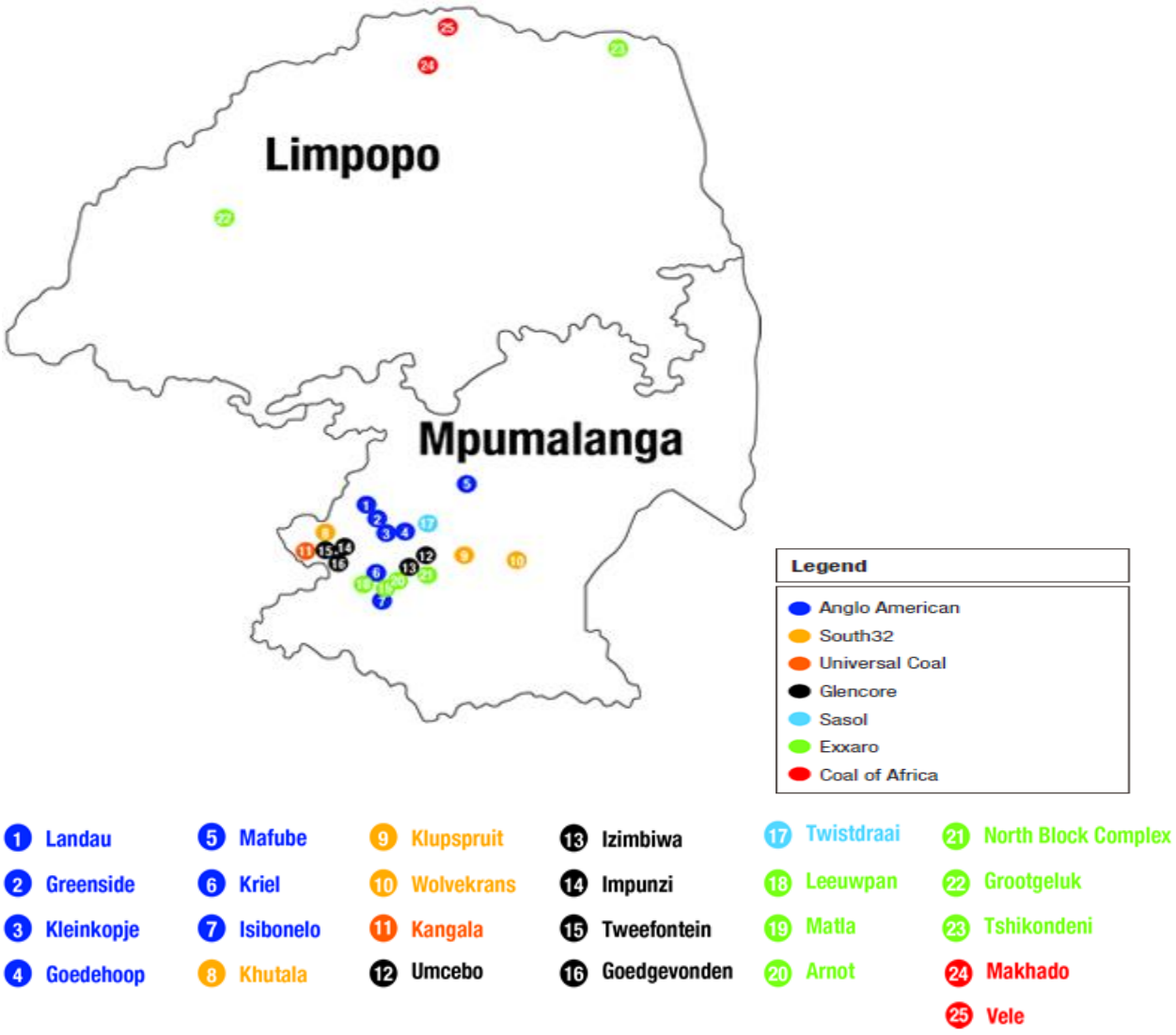


Figure 1.

The coal industry supplies 77% of South African primary energy needs and accounts for 93% of the country's electricity generation (Barradas, 2010). Security of electricity supply is one of the main factors that attract investors, making coal integral contributor in the economic growth of the country.

There are nine interconnected countries in the Southern African Power Pool with three not connected, the three are Angola, Malawi and Tanzania (Beta, 2016). SADC has an electricity shortfall of 6 514 MW; this shortfall is based on electrified industries. The weighted average electrification access in SADC is 36%. Taking the shortfall, electrification and development factors into account, and the shortfall will grow.

2.4 The introduction of renewable energy via deregulation and Eskom not being a single buyer

The electricity power industry has operated as a monopolies through government owned utilities for more than a century, this has been an international practice (Folly, 2017). The integral reason for this practice is that stability in electricity supply has been considered as the main investor attraction. However, the industry has been undergoing deregulation in the past two decades.

Deregulation means that the generation (wholesaler) and distribution (retail) of the electricity is not under the government regulations, as the regulations have restrictions (Folly, 2017). The advocates for deregulation believe that this will give customers more choices, and bring innovation which will result in lower prices. However, this has not been the case in all countries as some have reversed the decision and others are struggling to deal with it.

The deregulation will attract investors in the industry. This cannot always be a good thing as Investors model has always been return on investment while the government is about service delivery. This makes it difficult to keep the supply stable in real-time, especially if the demand increase during off-peak (when the price is low).

2.4.1 Privatization and deregulation of energy market in South Africa

Generation

Electricity is very different from other household commodities, water and air are sourced from nature but electricity is manufactured. However, this must be done at the least cost so that prices are kept at minimal. Eskom is a South African state owned electricity company, it produces 95% of South African electricity (Eskom website, 2017). 90% of Eskom's electricity is produced from coal fired power stations.

Coal fired power station takes between 4 – 10 years to build, this is depended on the size of the power station. This is twice the time it takes to build a wind or solar farm, as these plants take between 12 – 18 months. The wind and solar farms are also cheaper to construct, operate and maintain as compared to coal (White & Chambers, 2017). However, coal is much more reliable, it guarantees supply 24 hours a day.

The world leading climate scientists think that human activities are responsible for climate change. The Intergovernmental Panel on Climate Change(IPCC) analyzed 928 abstracts, published in refereed scientific journals between 1993 – 2003.The papers were divided into six categories namely, explicit endorsement of the consensus position, evaluation of impacts, mitigation proposals, methods, paleoclimate analysis, lastly the rejection of the consensus position. Serventy five percent of the papers fell into the first three categories, accepting that climate change is caused by human activities,25% dealt with methods or paleoclimate, taking no position on current anthropogenic climate change (Oreskes,2004).

The South African government signing of the Paris agreement was discouraging for private investors to enter the coal electricity generating market. This is because coal fired power station is already the most expensive to build, operate and maintain, with the government having the leverage to introduce penalties. This will result in Eskom monopolizing the market. South Africa has 44 billion tonnes reserves of coal (mining review Africa, 2009). This would make coal fired

power station the cheapest baseload investment for private investors, if the carbon dioxide penalties were eased.

Eskom's current surplus electricity during peak is at 5600MW (Koko, 2017) and South Africa's electrification access is at 85.5% (African News Agency, 2016) with the economic growth at projected to grow by 2.2 by 2019 (South African Treasury, 2017). Considering all this factors, deregulation of the electricity generation would not attract private investors. However, most Eskom's power station fleet is nearing its lifespan. All of them are more than 27 years old except for Majuba power station which is 16 years old.

Eskom was supposed to commence decommissioning Camden and Hendrina power stations in 2020 and decommissioning of a power station takes between 3 – 5 years, this is according to their decommissioning planned schedule (Njobeni, 2017). The two power stations are 3454MW which is less than 10% of the installed 40000MW Eskom's installed capacity. However, considering South Africa's unemployment rate of 27.1% (Ferreira, 2017). Since Eskom is a state owned company, any act that will result in job loses will be a very difficult decision for Eskom to make.

Eskom has two coal fired power stations with a combined installed capacity of 9600MW. This will further discourage private investors in the South African coal fired electricity generating industry. Eskom will have an advantage over private companies since its mandate is to ensure supply of electricity to South African and industrial customers, while private investors' priority will be return on investment (ROI).

In the 1990s Eskom alerted the South African government of a possible electricity shortfall by 2007, they also requested to invest more in the electricity generation (Phaahla, 2015). However, since Eskom had supply electricity by then, the government declined their request. In late 2007

South Africa started having electricity shortage and implementing load shedding in Western Cape and by January 2008 load shedding was implemented throughout the whole country as a result the DoE (South African Department of Energy).

Eskom needs government approval to invest in their business. This delays Eskom's time to address the population's immediate needs. Private investors just need a good business plan for banks to give them funding. This enabling private investors to quickly response to the customer's immediate needs.

The coal fired electricity generation industry will need both privatization and deregulation. However, in order to attract investors, the c/kWh have to be evaluated too.

Transmission

Electricity transmission is a set of wires, called conductors and they carry electricity from generation to distribution. However, there is a system operator prior to the electricity reaching the distribution network. Eskom's power stations send electricity into the transmission network from different place, the system operator's duties are to control the transmission network in real-time. Thereafter send the electricity to the distribution network (Eskom, 2017). Figure 2 is a picture of a transmission line (Minnesota Electric Transmission planning, 2017).



Figure 2.

The South African government introduced an Independent System and Market operator (ISMO) bill, the bill was before parliament before being withdrawn. The bill was to end Eskom's vertical intergrated monopoly business by establishing an indepent market operator that will be responsible for trading of electricity and market clearing (National Assembly (proposed section 75), 2011). However, the ISMO would not have assets, Eskom would still have owned the transmission assets.

However, the ISMO setting up process is not a cheap one especially in third world countries like South Africa. The American state spent several million dollars to set up ISMO and between $100 - $200 million per year to operate it (Baneyto, 2010). This will be challenging to set up, for a country that is dependent on loans to run the government.

The transmission assets are geographically fixed. However, it is possible to enable competition by fixed term management and operating contracts (Fitzsimons, 2014). The United Kingdom has had numerous discussion around the transmission deregulation process, as generation companies have been accused of creating internal middlemen before on-selling the electricity to the customer. This has resulted in electricity prices going up.

Eskom transmission supplies all South African metropolitan municipalities; these municipalities are the economic hub of the country. In 2014 City Power of the City of Johannesburg, Ekhurhuleni Metropolitan, City of Tshwane Metropolitan, Nelson Mandela Bay, Baffalo City Metro and Ethekwini Metropolitan, owed Eskom transmission R1.07billion(bn), R972339million(m), R793000, R292m, R128m and R813m respectively. These are 99% of the country's metropolitan municipalities (Fin24, 2014). However, by early 2017 Eskom was owed R12bn by municipalities in South Africa (Koko, 2017).

Eskom informed the indebted municipalities of its intentions to cut off supply in a bid to recover the debt and AfriForum filed and urgent court bid to prevent Eskom from doing these. However, Judge Hans Fabricius ruled that Eskom may cut off power supply as a means to recover outstanding debt (Fin24, 2017). The electricity supply cut to municipalities will have severe consequences on those municipalities economy and in some cases resulting in job losses.

Eskom's is incapable to recover/collect their revenue as these debts have been in existence for more than five years. This exposes the company to default in executing their essential duties i.e maintenance, upgrading and innovation on their network. The inability to execute duties will lead to network collapse and putting the South African economy at risk. The inclusion of private investors in this electricity transmission industry might help minimize this risk and ensure that Eskom concentrate on the core business than revenue collection.

Distribution

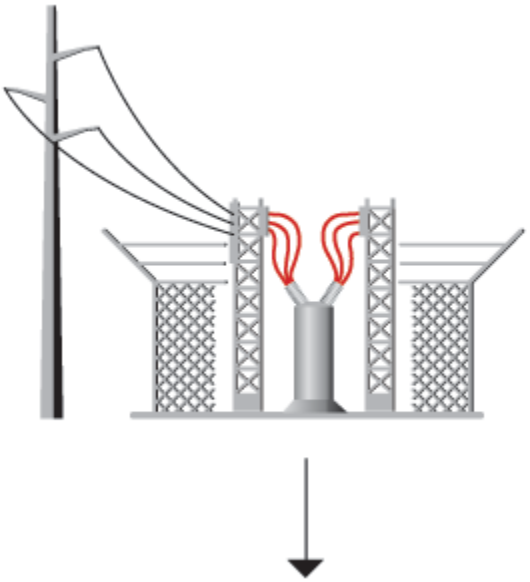
The electricity distribution industry is a vital link between electricity supplier (in the South African context, it is Eskom) and end-user (Eskom, 2017). This process ensures that the consumer receives electricity at an appropriate voltage that can address their needs. Figure 2 reflects an electricity distribution process.

The distribution assets, just like the transmission ones are geographically fixed. However, it is possible to enable competition by fixed term management and operating contracts (Paul Fitzsimons, 2014). These will give consumers a choice for their preferred supplier. The electricity distribution license is not solely granted to Eskom but to Municipalities and 13 private distributors.

NERSA has licensed a total of 188 distributors as follows: 6 metropolitan municipalities, 2 metropolitan electricity service providers (City Power and Centlec), 164 local municipalities, 1

district (uMkhanyakude District Municipality), 13 private distributors and Eskom (SALGA, 2014). However, Schedule 4B and Section 155 of the South African constitution states that municipalities have the executive authority and right to administer electricity reticulation in there are of jurisdiction subject to legislation and regulation by the national and provincial government (SALGA, 2014).

The Municipal Systems Act (Act 32 of 2000) make municipalities responsible and accountable for operating and maintenance of electricity network, including providing electricity to its residence. (SALGA, 2014).



Lines belonging to local electric co-ops carry electricity to transformers that reduce power levels to 220 volts for use in schools, farms, small businesses and homes.

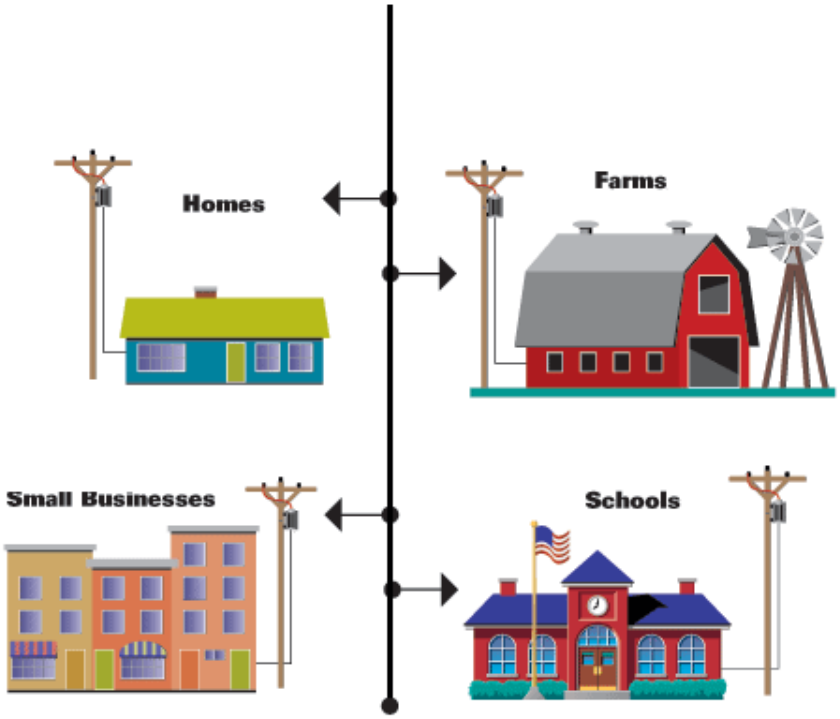


Figure 2.

The NERSA licenses the provision function while the South African government minister of local government is the only individual that is authorized to confer municipalities with authority status. The private distributers only operate in areas where municipalities are unable to supply. This is still not giving consumers the choice to choose their preferred supplier.

According to National Energy Regulator of South Africa's (Nersa) 2015 report, one municipality managed only 2% compliance with the Nersa scorecard. This is a risk for any investor to start business in such a municipality. Considering that in the past 7 years, municipalities country wide have only spent 60% of the benchmarks for maintenance of municipal infrastructure (Nevin, 2017).

Municipalities are owed more than R120bn by households, businesses and government offices (Magubane, 2017). These might be one of the reasons for a backlog in infrastructure maintenance and upgrade. However, this does not exonerate the risk of infrastructure collapsing

and plugging the country's economic at risk. The inability to collect debts might force municipality to utilize money that was meant for other services being used for electricity supply purposes.

The full deregulation/privatization of the distribution industry will allow private investors into the industry. These will ease the challenge on the municipalities inability of revenue collection or carrying the debts on their own and exposing other services to risk.

The South African government established a company called electricity distribution industry (EDI) holding on 1 July 2003. The EDI mandate was to project manage the restructuring of the electricity distribution industry (Yelland, 2010). However, the process was abandoned in 2010 (Eberhard, 2012).

2.4.2 Privatised and deregulated energy markets globally

Different countries/continents use different methods in the deregulation process. The United States of America (USA) is deregulating the electricity market on a state-by-state basis, while Europe is attempting to deregulate using an integrated grid (Electric choice, 2016). Some countries like Japan, deregulated their market partially. However, despite the different deregulation methods. The one common fact in deregulated markets is that consumers have a choice.

In 2015 USA had 6 million residential households switching providers, Ireland energy consumers were the highest in Europe with 303,187 customers switching in 2015 (Electric choice, 2016). This proves the willingness of consumers to exercise their right to choice. However, the deciding factor in consumer switching is service more than the electricity itself.

The USA utility was responsible for electricity value chain from generation to end user until the 1990s (Electric choice, 2016). The derogation decision came as the government realized that

without competition there was no urgency to keep the electricity rates low or reasonable. The most recent factor is to encourage private investors to invest in renewable energy within the USA.

The Asian and Pacific region energy demand is expected to double by 2030. This has prompted most countries in those regions to deregulate their electricity industry, to help with operational efficiency and sustainability (Asian Utility Week, 2017). The other reason is that the government is encouraging private investors to explore other technologies of electricity Generation, Distribution and Transmission without it having to spend for the experiment/research phase.

The Philippines's National Power Corporation (NPC) worked very well in the urban areas but poorly in the rural areas. This prompted the Philippines's Energy Regulatory Commission to facilitate the privatization of the NPC (Asian Utility Week, 2017). However, China and Japan are targeting high electricity cost and pollution with deregulation (Asian Utility Week, 2017).
On 11th March 2011, , Japan experienced an Earthquake of a magnitude 9.0. The Earthquake damaged the Fukushima Daiichi reactors, causing the loss of 4.7GW of electricity from the plant (Asian Utility Week, 2017). This resulted in the electricity prices reaching undesirable and unaffordable prices. This was due to the fact that Japan had to depend on their coal generation and to import coal. However, had the country invested in other electricity generation technologies prior to the incident then the prices would have been much cheaper as this technology would be used as a backup.

China's wind and solar plants are being under-utilized by private investors under the regulated system as the government dictates the prices. This fluctuating injection in the national grid, exposes the grid to a trip risk. China introduced electricity deregulation pilot project in Shenzhen and five more regions in 2014 and 2015 respectively. This resulted in enterprises seeing savings of $845.6 million (Asian Utility Week, 2017).

The deregulation has attracted private investors and innovation. However, there has been compelling evidence of discontentment from consumers. The UK has extensive records of non convincing price savings, lack of competition which result in high prices of electricity to lower income households (Baneyto, 2010).

In 2006 Germany experienced local congestion which resulted in a major blackout in Western Europe. This was due to the absence of centralized management of the network (Baneyto, 2010). In March 1998,California launched its deregulated electricity market, due to costly and inefficient electricity market. That did not help much as the evrage price doubled two years later. This resulted in a crisis for the regulated utilities to conduct electricity trading as they had to increase prices for their consummers.

The average monthly wholesale prices increased ten times by 2001. This resulted in the state's largest utility, Pacific Gas & Electric declaring bankruptcy. This prompted the government to take over the wholesale electricity purchasing and spending $1 billion per month (Baneyto, 2010).

2.5. Conclusion

There is risk that the energy, industrial processing, agriculture and waste sector's employment will be negatively affected which might result in job losses. The uncertainty in the commercial aspect of the policy needs to be addressed. The alignment of the industries with the South African Department of Environmental Affairs' (The Department has a new name now) greenhouse gas management processes should be addressed as South Africa already has an environmental levy.

The current electricity demand in the SADC region affords Eskom an opportunity to reconsider demolishing the power plants. Considering the current electrification percentage of 36% in SADC, it would be beneficial for Eskom to refurbish the plants and invest in interconnectors within the

region. This will save jobs in the coal industry and improve the current high unemployment rate in South Africa (Ferrei, 2017).

South Africa is currently exporting 4 million tonnes of coal per year within the African continent, the number is expected to grow by 34 million tonnes to 38 million tonnes in 2030 (Kretzmann, 2017). Investment in exporting infrastructure is paramount.

Deregulation of the electricity industry in South Africa will attract investors. It must be taken into consideration that the economics of demand and supply will dictate the price, unlike the current regulated industry where Eskom's price is controlled by the regulator. However, it has also been proven that deregulation gauratees security of supply, thus ensuring job security.

CHAPTER 3

3. Methodology

This section explains how the researcher will achieve their aim and objectives. The methodology is broken down into four sub-section, which are research design, data collection, and data type and data analysis.

Research Design

There are two types of research methods that are quantitative and qualitative categories (Dudovskiy, 2018). Qualitative is a method of solving or compiling a numerical solution while qualitative is based on words, non-numerical and unquantifiable elements. However, both have been equally proven as reliable methods of problem solving.

This research utilizes both qualitative and quantitative methods, commonly known as mixed methods. Mixed methods research has been practiced since the 1950s but formally began in the 1980s (Mckim, 2017). Most authors argue that usage of mixed methods approach gain a deeper and broader understanding of the topic than those that uses one of the two methods (Mckim, 2017). A study made by reviewing studies published in the field of business, illustrate that mixed method added value by increasing validity in the findings, informing the collection of the second data source and assisting with knowledge creation (Mckim, 2017).

The study mainly uses information that has been recorded by other sources that have researched the implementation of renewable energy and carbon tax, globally and in South Africa, most commonly known as secondary data. This information has been used for investment, fund sourcing and decision making thus making it reliable. Questionnaires will also be sent to different subject matter experts.

Secondary data

Secondary data includes data collected by those that have done the study in the field of interest. Secondary data includes government policies and legislature, Journals, subject matter reports, newspapers. The benefit of using secondary data is that it is readily available and inexpensive to obtain (Liu, 2018).

Data Collection

Questionnaires will be sent to experts from City Power and Kelvin as the parties have a power purchase agreement which Kelvin use coal-powered power station to generate electricity and City Power is the buyer. The other questionnaires will be sent to two households, one in the affluent area and one in the township as this will help to analyse and understand the impact of high electricity increment. The final questionnaires will be sent to a commercial business. The reason for open questions was to try to analyze their understanding of the impact of carbon tax and renewable energy rollout.

Grey area reports will be an integral contributor in data collection. Reports from organizations like the World Bank, South African treasury, energy departments. However, only reports from reputable, respected and recognized global organizations will be used.

Type of Data

The employment in the high intensive carbon emission and their suppliers' e.g coal mines. The impact of renewable energy that resulted high electricity tariff increments.

Data Analysis

This section illustrates an overview on how data was analyzed by the researcher. The purpose of secondary data analysis is to ask different questions of the data from the data set analyzed in the original work (DePoy, 2016). This process required a good understanding of the research

objective from the researcher. The understanding of renewable energy and carbon tax implementation, socio-economic, political and other challenges of the SADC was needed from the researcher.

Primary data

The experts understanding of the impact of high electricity tariffs and implementation of carbon tax was analyzed. They were also requested to share their understanding and thoughts of the introduction of renewable energy with Eskom being a single buyer.Their understanding and answers was compared to the Eskom application input cost which included carbon tax and the industry norm of including the carbon tax payment on the pass through cost..

Secondary data

The data collected will be combined and reflected in a graph format. These will be achieved through mathematical calculations. The fourteen year employment trend in the mining industry was compared with that of the renewable energy industry. The South African energy transition was analaysed and indicated that jobs will be lost in some provinces while being created in other.

CHAPTER 4

4. Results

4.1 Introduction of renewable energy in a competitive way while sustaining employment and security of supply?

4.1.1 The effect of reducing production or closing the coal-mining sector

The challenging and complicated question that must be considered by the South African government is the contribution of the coal industry to Global Climate Change compared to the country's challenging background (Goosen, 2013). Goosen further discovered that many of the renewable technologies are costly and highly mechanized, thus have small operational workforce.

The mining industry created 74,660 jobs between 2000 and 2009, reaching 504,000 workers in 2010 (Jin, 2021). There is a risk of between 80 to 90 thousand workforce losing their jobs as the coal power plants retire and this is excluding the associated mines and transport infrastructure (Schers, 2021). Schers further indicates that the forecast is that the coal industry will have a reduced output of about 60% considering the change in electricity markets around the world. The just transition in South African energy market will further cripple the unemployment rate.

Coal mining contributes 2.3% to the national GDP, while it contributes 19% of gross value added through goods and services produced in the province of Mpumalanga. The coal mining is concentrated in a few municipalities, one can imagine the impact of mine closures in those municipalities as the mines contributions are greater than the provincial 19% (Hanto et al., 2021).

According to Energy Research Centre of University of Cape Town, Eskom consumed 65% of local coal production in 2014 and Eskom annual report of 2017 indicated that coal accounts for 91%

of electricity production. This is an indication that just transition from coal to renewable energy will have a negative impact on the economy at large (Burtonet al., 2018).

The coal industry employed around 77000 workers in 2015. In 1995, the sector had 70 percent unskilled workforce while the highly skilled was at 5% (Burtonet et al., 2018). By 2015, the sector had 10 percent highly skilled, 35 percent mid-level workforce and 56 percent semi and unskilled workers (Quantec, 2015). The number of unskilled and semi-skilled workforce in the coal industry is around 40000 (Burtonet et al., 2018).

According to coal mining matters, for every direct employment created in the coal mining industry, a further two to three jobs are created down and up-stream and this is through contractors, suppliers of goods and services (coal mining matters, 2022). The mining industry employed 453543 people which is a reduction from 504 000 number of 2010. The coal industry accounted for 19 percent of the total employees, the coal industry trend can be seen on figure 4 below. The mining industry also provide services to the surrounding communities by funding services such as housing, water and sanitation (Strambo et al., 2019).

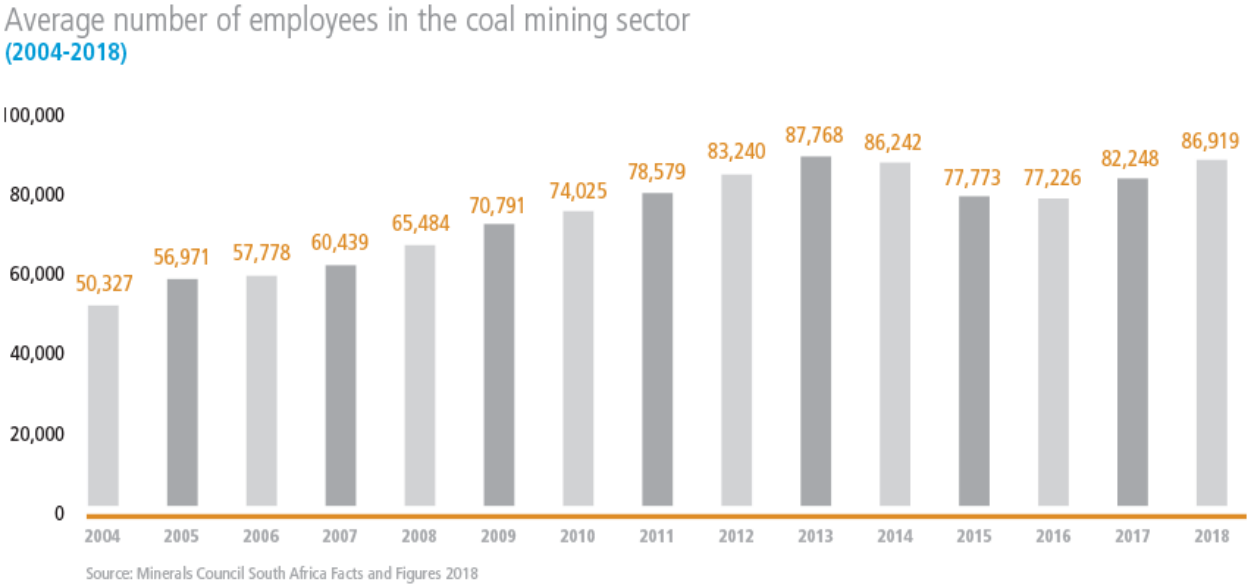


Figure 4.

The South African Renewable Energy Technology Centre director, Naim Rassool recently told the Engineering news that the South African renewable-energy sector will not have an adequate competent employees, unless if it endeavor to re-engineering the skills of coal mining employees. Rassool also suggest that the government should carefully consult and look at the damage that the renewable sector will do to the coal-fired power stations and mining regions in an event that the power station cease to operate (Hancock, 2020).

Discussion

The global increase of coal-fired electricity is proof that coal is a major player in maintaining a baseload electricity supply. Take global electricity production in 2020 was 25657 TWh and 35 percent of the production was coal-power generation, Africa was responsible for 850 TWh while South Africa has 0.0379 TW of coal generation installed (enerdata,2021).

Taking the country's coal-power production facts into consideration and combining them with South Africa's high unemployment rate and the employment that coal mines provide and not forgetting the low-skilled labour, one must make an informed decision on whether it will be to the beneficial of the South African citizen's to close down the country's coal mines.

4.1.2 The introduction of Renewable Energy, Eskom being a single buyer (Map-out the potential short to mid-term road map of introducing renewable energy).

According to Hanto et al., there will be an increase in electricity production due to increasing demand. It can also be seen on figure 5 below that in an event that the country achieves its renewable energy target, higher production will then be achieved. The graphs reflect that coal electricity production in the business as usual (BAU) scenario will be at 268TWh by 2030 and

reduce to 94TWh by 2050. While the on the 2° C scenario indicates that wind and solar will be at 247TWh by 2030 and 123TWh by 2050 as gas and nuclear starts to play a bigger part in the energy mix (Hanto el at., 2021).

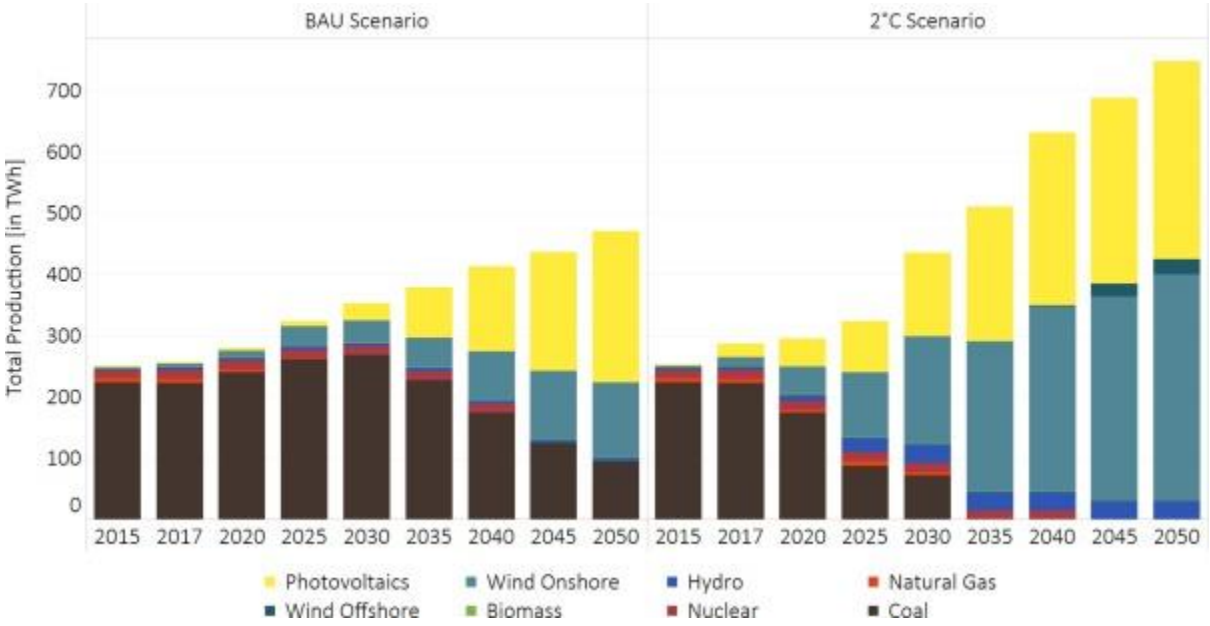


Figure 5. Employment effect in South Africa. Source: Own illustration.

Hanto el at., further demonstrates below on figure 6 and 7 that with the scenario of transitioning into renewable energy, jobs will move from Mpumalanga to other provinces with job creation peacking between 2035 and 2045, while reducing in 2050.

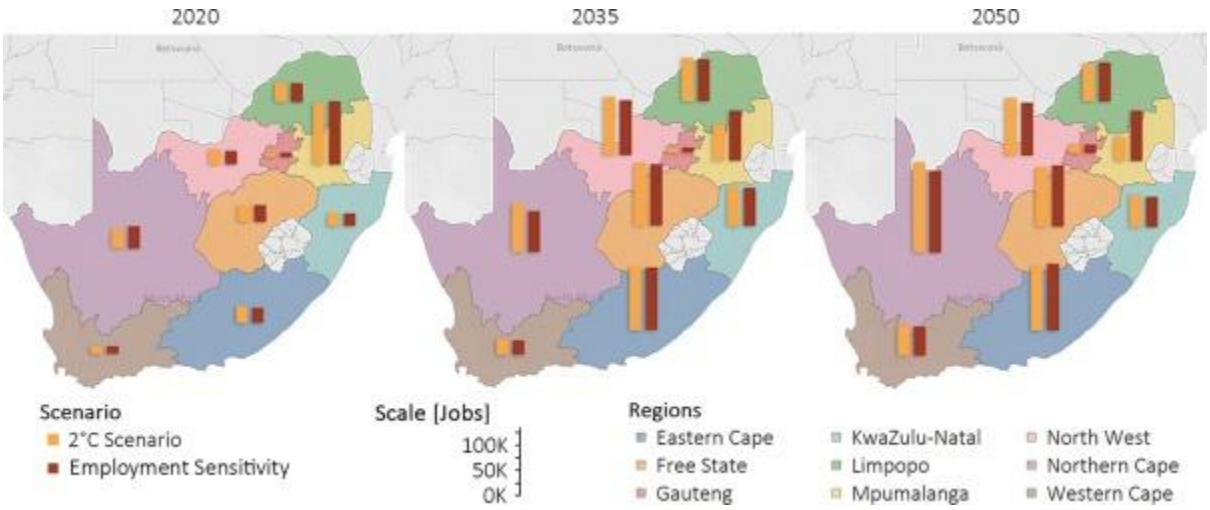


Figure 6. Regional distribution of employment for 2 °C scenario and employment sensitivity in South Africa. Source: Own illustration.

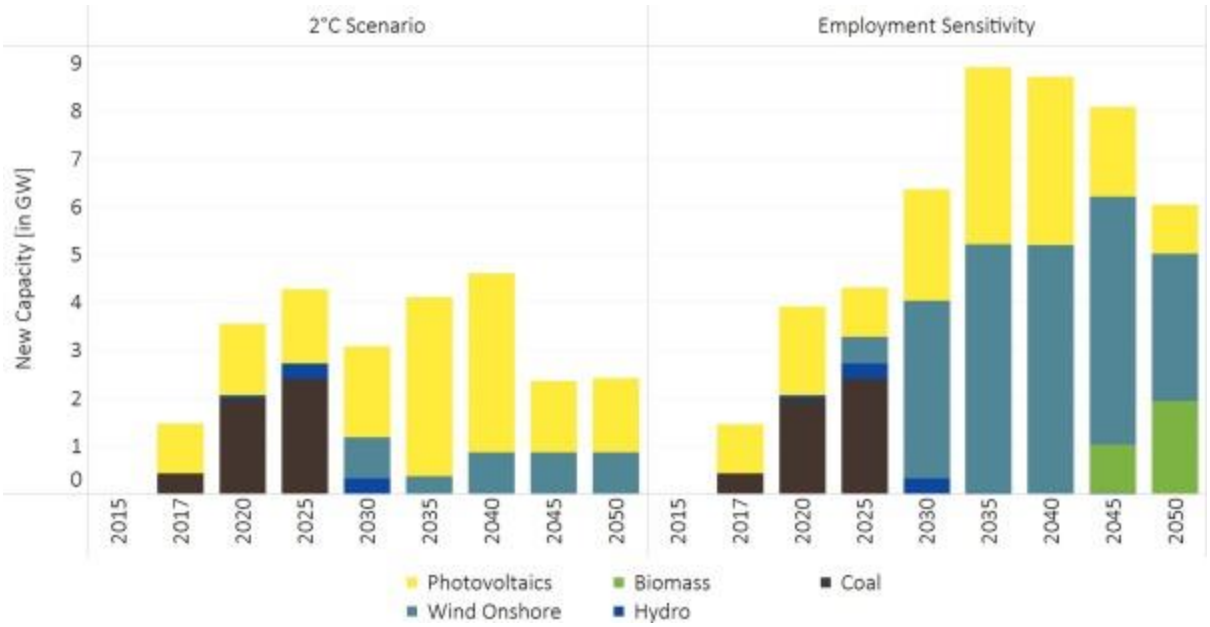


Figure 7. Necessary capacity build-out in Mpumalanga in order to preserve current employment numbers. Source: Own illustration.

A question was possed to Gabriel Kgabo who is general manager in the office of the Eskom distribution group executive. Prior to the current position, he was the first head of grid access unit for renewables at eskom. He was asked of his opinion of the renewable contracts that Eskom

has signed in bid window 1 -3 of the REIPPP and his answer was that they will be very expensive legacy contracts because it is invertible that South Africa should deregulate the electricity industry for it to be sustainable and competitive.

According to the International Energy Agency (IEA), global production from coal-fired generation grew by 9%, gas by 2%, nuclear by 3.5% while renewable sources grew by 6% in 2021 (IEA, 2022). On the 10th June 2021, the South African president announced an increase of embedded generation cap from 1MW to 100 MW in an effort for private companies to assist government in mitigating the loadshedding effects (Merten, 2021) .This without mentioning anything about the country's electricity transmission business.

South African Renewable Energy Council (SAREC) reports that Eskom can only sign new renewable contracts if the grid connection quotes are increased compared to the original quotes (Smith, 2017). Eskom indicated to the South African parliament that it would need to strengthen the network and a need for a back-up plan, in order to introduce new renewable energy plants (Creamer, 2014).

4.1.3 Discussion

Eskom CFO, Calib Cassim requested an additional amount of R18,36 billion for renewable Independent Power Producers (IPP) in Eskom's Multi-Year Price Determination (MYPD5) for financial year 2022/2023 and 2024/2025. A further R2,5billion was requested in the same application for short-term IPPs project. This an indication that the current format were Eskom is a single buyer of electricity from IPPs is very disadvantaging to all electricity consumers in the country as they have no choice any alternative as Eskom pass through risk cost and all the other costs.

Frank Hinda agrees with Hanto el at.,that jobs will move from Mpumalanga to the Northern Cape or to other regions where renewable plants will be constructed. However, their common biggest concern is the upskilling and willingness of the current unskilled coal employees to migrate after working and leaving in Mpumalanga for decades.

Eskom is the sole transmission license holder in South Africa. Therefore, no any other company has the authority to wheel electricity from generation to distribution. Companies must first connect to the Eskom controlled grid prior to the electricity reaching end-users. However, the first liberalization of transmission had already been taken, Eskom's transmission license had an "open access" condition. This means non-discrimination open access to uncommitted capacity, transparency of tariffs, disclosure of cost and pricing information to the National Energy Regulator of South Africa.

This makes it difficult for private investors to even consider investing in generation, as they will still be under Eskom's control to supply their customers through the transmission lines. Hence privatization will be more beneficial than deregulation on its own.

4.2 The effect of carbon tax when introduced at this current form.

Globally countries are transitioning to low-carbon economies; South Africa is the leading country among African countries. South Africa has committed to reduce its greenhouse gas emission with 34% and 42% by 2020 and 2025 respectively (Okonkwo, 2021). The South African government introduced a carbon tax policy to help achieve these numbers. South Africa will already commenced with the implementation, with the first phase being from 1 June 2019 to 31 December 2022 with the second one from 2023 to 2030 (Okonkwo, 2021).

South Africa already has four environmental taxes; they are tax on greenhouse gas emission, fuel tax, tax on electricity use and energy tax. According to Heerden at al. (2006) model found that if either of the taxes is recycled through a reduction in food prices, it could decrease emission, increase GDP and decrease poverty (Heerden et al., 2006).

John Ward and Gaia de Battista, from Vivid Economics suggest that by 2035, exports will be higher by 3.5 percent and this will be a competitive disadvantage for South African companies (Ward & Battista, 2016).

The question of how will the introduction of carbon tax affect employment in their electricity sector was asked to the following experts

Lonwabo Magida with more than 20 years'experience in the electricity sector and is the acting Group Executive for Engineering Service at Johannesburg City Power answered, "City Power needs to do a proper assessment in order to get a proper understanding on what are the drivers or what activities within the course of executing its mandate result in carbon tax being incurred. For instance, if it is due to buying power from Eskom's fossil fuelled electricity, City Power would need to explore ways to minimise such exposure. This could directly or indirectly result in City Power introducing new skills and competencies within the workforce".

While Frank Hinda who is an acting General Manager at City Power and has more than 20 years' experience in the energy sector including working in different countries answered, "Introduction of carbon tax currently has very little impact as the effective carbon tax rate in the case of Eskom is still zero, in other words it appears that the carbon tax is still lower than the environmental levy. As a result, net carbon tax liability is still zero. This however is likely to change as the effective tax rate is increased making the cost of coal based electricity generation to be less competitive. Resulting in job losses in the particular sector.

To the extent that coal based electricity is replaced with clean energy sources it may well not be able to absorb those from the coal based generation sector due to difference in skill set requirement. The fact

that coal based generation is primary based in the Mpumalanga and Limpopo provinces while clean energy is primarily generated in the Northern Cape makes relocated employment opportunities less attractive".

Oupa Seopa, General Manager for Kelvin Power with more than 20 years'experience in the coal and electricity generation sector replied, "Kelvin Power Station is a coal fire power station that is close to its end of life. Carbon Tax increase operating cost which reduce profitability. This has a potential of reducing employment within the business".

Paul Collier, General Manager for Kelvin Power station with over 20 years'of experience in the electricity generation sector and has worked in different countries across the globe answered, " It has no effect on the level of employment as we still need the same number of employees to produce the MWs and the financial impact is generally passed to the consumer".

The second question asked was "The question of how will the introduction of carbon tax affect operational costs in their electricity sector"

Lonwabo Magida answered, "At face value carbon tax becomes another cost (or disincentive) that City Power must carry in its operations. One of the ways to prevent this could be to look for more efficient ways of incurring such a cost, be it diversifying to carbon neutral solutions or reducing the City Power exposure towards this tax. An example would be a newer and more efficient network as opposed to the old infrastructure that we currently operate".
Frank Hinda answered, "Clean energy is becoming cheaper and therefore more attractive compared to new coal generation and is to make the cost of generation of electricity to reduce which is favourable.

As carbon tax rate is increased it will certainly increase the cost of coal based electricity generation to even go up further. As the country may not be able to completely get rite of coal as renewables are still able to provide base load electricity and also because the uptake of renewable capacity may not necessarily grow at a rate faster than the rate at which carbon tax may be increased operating cost of electricity generation may increase before it may start to come down".

Paul Collier answered, “There is a minor impact on the operations costs due to the consultants needed to calculate and verify the amount to be paid. All other aspects of the operation remain the same therefore no change”.

Oupa Seopa answered,” Carbon Tax is a cost to the business, the operational costs are significantly increased. This cost is not easily included into the tariff (price of the product). This means that the organisation needs to internalise some of these costs”.

The third and last question to the experts was, “Any other positive or negative effects that might transpire from the introduction of Carbon Tax”.

Oupa Seopa answered, “The positive is that Carbon Tax Act provide for allowances that are aimed at reducing the liability. However some of these are not feasible for an old plant like Kelvin. Other allowances might result or necessitate reduction in electricity generation, meaning reduction in revenue and profitability which would result in reduction in employment. This is because Carbon Capture and Storage (CCS) is the only in abatement method for Carbon. Currently there is no CCS site in South Africa”.

Paul Collier answered, “There is no real positive effect to Kelvin but there is to the environment as a whole. As part of the tax offsets, Kevin purchases carbon credits that come from investments in green and carbon reduction projects. The negative is to the consumer as the tariff has increased”.

Lonwabo Magida answered, “Carbon Trading is an old phenomenon where parties who cannot reduce their carbon footprint could indirectly contribute to the required reductions by enabling others players in the market by investing in them. This in the long run, while having a potential to help reduce the global carbon footprint it would enhance development of the underdeveloped communities”.

Frank Hinda answered, “There will certainly be job losses as the cost of retraining and reskilling affected communities may well be left to the state which already is struggle with general socio economic objectives.

Socio economic impact may well be under estimated and it becomes real it may lead to slower transition in the interest of socio political stability.

Coal based electricity generation may be forced to become more competitive and cleaner in order to remain relevant. Air pollution reduction in location of coal generation plant".

4.2.1 Discussions

Eskom CFO, Calib Cassim requested an additional amount of R2,36 billion for carbon tax in Eskom's Multi-Year Price Determination (MYPD5) for financial year 2022/2023 and 2024/2025. Carbon Tax penalty was designed with an aim of encouraging polluters to minimize greenhouse gas emission; however, this has not been the case as the polluters are just passing it through to the customers. Paul Collier above also confirmed this by saying that the power station treats carbon tax penalty as a pass through cost.

The request from Eskom concurs with Theresa Alton on his research paper that the introduction of carbon tax will increase electricity tariffs and create a financial constraints on the poor household (Altonet al., 2014). It will also result in companies reducing their production output in order to be within the non-texable band as indicated by Oupa Seapa, thus resulting in retrenchments and contributing to the high unemployment rate that the country is facing.

South Africa is a developing economy with its unemployment rate at 32.6% in the first quarter of 2021 from 32.5% in the fourth quarter of 2020. As the production reduces, there might be a need to cut employees.

The South African government has increased VAT from 14% to 15% from 1st April 2018 which already puts a burden for most families. Most companies have indicated that this will be a pass through cost to consumers, like it is with the environmental levy. This will result in price increases

which might result in consumers reducing their spending habits. The reduction in spending habit will result in companies making a loss in profit and having to cut costs which can be employees.

Another challenge since the tax will be charged on production is that low usage consumers might end up subsidizing high usage consumers, depending on the mechanism that the producers use to calculate the pass through cost. Eskom which produces more than 90% of electricity in South Africa has been applying for double digit tariff increases since 2008 to fund their new built programme and renewable procurement projects. The public has opposed all the applications, complaining that they cannot afford higher electricity increment. Carbon tax has the unintended consequence of Eskom being put in a position to increase its tariff even further.

Recommendations

The results have uncovered that South African industries that are affected by carbon tax do not necessarily deploy mechanism to cap carbon emissions but impose a pass through method. The pass through method affect end users economically, thus not address the main purpose that the carbon tax was meant for. It would then protect the end users if the government was to amend the legislation to prevent pass through cost.

The chapter also discovered that there are advantages and disadvantages of deregulating the electricity industry in South Africa which both affect the socio economic standing of ordinaring citizens. It is therefore suggested that the topic be research further on the best practice of introducing renewable energy while allowing private investors.

Summary

The South African government began exploring feed-in tariffs which were later rejected in favour of competitive bidding, this was in 2009 (Eberhard et al., 2014). In 2011 the South African government requested proposals from private investors of renewable energy, under the programme called Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).

The REIPPPP was a step in the right direction in achieving a deregulated electricity generation industry. However, the independent power producers would bid to the Department of Energy and the Department of Energy appointed Eskom as the preferred buyer of the electricity (Fitzsimons, 2014). This would not have much of an impact on the end-users, as Eskom would still be the sole supplier in the electricity generation industry.

Eskom is the owner of all the Transmission and some of the distribution network with the rest belonging to municipalities. The deregulation of the electricity generation industry without privatization of the generation, transmission, distribution networks will result in a conflict of interest for Eskom and municipalities.

In 2016 Eskom requested a tariff increment of 16%, this was to recover R12 billion loss of revenue in the previous financial year and an additional R11.1 billion in that current year (Engerati, 2016). Considering the inflated coal contract that the utility signed, it was unfair for end-users to be penalized by the company's revenue mismanagement.

Nigeria privatized Eko Distribution. Prior to the privatization, the company struggled to overcome funding, technology, customer engagement and management challenges (Engerati, 2016). However, in 2015 Eko Distribution was ranked among the most improved companies in the world

with approved funding from the US Trade and Development Agency to sponsor some of their technology studies (Pieterse, 2015).

Electricity is a commody, that is impossible to store electricity on large scale (Agbenyo, 2017). This might lead to suppliers drastically increasing the prices to discourage end-users when realizing that the supply cannot meet the demand. In addition, the demand and supply has to be balanced in real-time for the stability of the power grid.

References

Administrator, N. C. (2015, April 17). *404* [Text]. NASA. http://www.nasa.gov/404

Alton, T., Arndt, C., Davies, R., Hartley, F., Makrelov, K., Thurlow, J., & Ubogu, D. (2014a). Introducing carbon taxes in South Africa. *Applied Energy*, *116*, 344–354. https://doi.org/10.1016/j.apenergy.2013.11.034

Alton, T., Arndt, C., Davies, R., Hartley, F., Makrelov, K., Thurlow, J., & Ubogu, D. (2014b). Introducing carbon taxes in South Africa. *Applied Energy*, *116*, 344–354. https://doi.org/10.1016/j.apenergy.2013.11.034

Annual percentage change in CO2 emissions. (n.d.). Our World in Data. Retrieved 28 March 2022, from https://ourworldindata.org/grapher/change-co2-annual-pct

Bungane, & Babalwa. (2017, May 3). *Electricity Deregulation*. www.esi-africa.com/magazine_articles/electricity-deregulationwhere-are-we

Burton, J. (n.d.). *Coal transitions in South Africa. Understanding the implications of a 2oC-compatible coal phase-out plan for South Africa*. 36.

Carbon Tax | What is carbon tax? | Carbon Footprint Measurement and Management. (n.d.). Retrieved 28 March 2022, from http://www.thecarbonreport.co.za/carbon-tax/

Causes of climate change. (n.d.). Retrieved 28 March 2022, from https://ec.europa.eu/clima/climate-change/causes-climate-change_en

Climate Change—United Nations Sustainable Development. (n.d.). Retrieved 28 March 2022, from https://www.un.org/sustainabledevelopment/climate-change/

Climate To. (n.d.). Climate To. Retrieved 28 March 2022, from https://climate.to/

COBENEFITS. (n.d.). Retrieved 28 March 2022, from https://www.cobenefits.info/

Contact us via LiveChat! (n.d.). Retrieved 28 March 2022, from https://secure.livechatinc.com/

DA raises concern on job loss in Mpumalanga. (2021, June 22). *Lowvelder*. https://lowvelder.co.za/734488/da-raises-concern-on-job-loss-in-mpumalanga/

Department of Energy Strategic Plan 2010 to 2013 and budget 2010/11 | PMG. (n.d.). Retrieved 28 March 2022, from https://pmg.org.za/committee-meeting/11344/

Electricity deregulation: Where are we? (2017, May 3). *ESI-Africa.Com*. https://www.esi-africa.com/magazine-article/electricity-deregulationwhere-are-we/

Electricity distribution on the verge of crisis. (n.d.). BusinessLIVE. Retrieved 28 March 2022, from https://www.businesslive.co.za/bd/opinion/2017-01-12-electricity-distribution-on-the-verge-of-crisis/

Electricity Production Data | World Electricity Statistics | Enerdata. (n.d.). Retrieved 28 March 2022, from https://yearbook.enerdata.net/electricity/world-electricity-production-statistics.html

Engerati. (2017). Retrieved 28 March 2022, from https://www.engerati.com/article/energy-deregulation-transforming-asia%e2%80%99s-energy-sector.Date

Eskom's coal-fired power struggle. (n.d.). BusinessLIVE. Retrieved 28 March 2022, from https://www.businesslive.co.za/fm/features/2017-03-23-eskoms-coal-fired-power-struggle2/

GILBERT, R. J. E. (1996). *International Comparisons of Electricity Regulation*. Cambridge University Press.

Hanto, J., Krawielicki, L., Krumm, A., Moskalenko, N., Löffler, K., Hauenstein, C., & Oei, P.-Y. (2021). Effects of decarbonization on the energy system and related employment effects in South

Africa. *Environmental Science & Policy*, *124*, 73–84. https://doi.org/10.1016/j.envsci.2021.06.001

Home—Coal Mining Matters. (n.d.). Retrieved 28 March 2022, from http://www.coalminingmatters.co.za/

Lukey, P. (n.d.-a). *The South African National Climate Change Response Policy – an evidence-based policy-making case study*. 23.

Lukey, P. (n.d.-b). *The South African National Climate Change Response Policy – an evidence-based policy-making case study*. 23.

Mining Review Africa Edition 9, 2009. (2009, September 28). *Miningreview.Com*. https://www.miningreview.com/top-stories/mining-review-africa-edition-9-2009/

MJ. (2010, October 21). Non-condensing greenhouse gases are why we are not a frozen wasteland. *A Man With A Ph.D.* https://amanwithaphd.wordpress.com/2010/10/21/non-condensing-greenhouse-gases-are-why-we-are-not-a-frozen-wasteland/

Morden, C., & Hemraj, S. (n.d.). *Reducing Greenhouse Gas Emissions Pricing Carbon – The Carbon Tax Option*. 68.

More competitive electricity market required in South Africa. (n.d.). Retrieved 28 March 2022, from https://www.engineeringnews.co.za/article/more-competitive-electricity-market-required-in-south-africa-2014-04-15/rep_id:4136.

Musara Beta—Zimbabwe Mining Indaba. (n.d.). Studylib.Net. Retrieved 28 March 2022, from https://studylib.net/doc/5320620/musara-beta---zimbabwe-mining-indaba

National Inventory Submissions 2021 | UNFCCC. (n.d.). Retrieved 28 March 2022, from https://unfccc.int/ghg-inventories-annex-i-parties/2021?msclkid=33aec576ae6711ec9cba31add3667258

Okonkwo, J. U. (2021). Welfare effects of carbon taxation on South African households. *Energy Economics*, *96*, 104903. https://doi.org/10.1016/j.eneco.2020.104903

Page Not Found | NOAA Climate.gov. (n.d.). Retrieved 28 March 2022, from https://www.climate.gov/news-features/climate-qa/how-much-will-earth-warm-if-carbon-dioxide-doubles-pre-industrial-levels.

Page Not Found—EnergySanity. (n.d.). Retrieved 28 March 2022, from https://energysanity.com/2010/06/06/discussion-on-the-deregulation-of-electricity-markets

Perold, V., Ralston-Paton, S., & Ryan, P. (2020). On a collision course? The large diversity of birds killed by wind turbines in South Africa. *Ostrich*, *91*(3), 228–239. https://doi.org/10.2989/00306525.2020.1770889

Renewables accounted for 16.1% of South Africa's power mix in 2020. (2021, March 16). https://www.enerdata.net/publications/daily-energy-news/renewables-accounted-161-south-africas-power-mix-2020.html

Reporter, C. M. (n.d.). *A brief look at SA's coal mining industry*. Mining Weekly. Retrieved 28 March 2022, from https://www.miningweekly.com/article/a-brief-look-at-sas-coal-mining-industry-2010-09-03/rep_id:3650

Ritchie, H., & Roser, M. (2020). CO_2 and Greenhouse Gas Emissions. *Our World in Data*. https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

Salga cites municipal debt talks as a success despite unpaid power bills. (n.d.). BusinessLIVE. Retrieved 28 March 2022, from https://www.businesslive.co.za/bd/national/2017-09-27-salga-cites-municipal-debt-talks-as-a-success-despite-unpaid-power-bills/

Sheila Barradas. (n.d.). Retrieved 28 March 2022, from https://www.engineeringnews.co.za/author.php?page=612&navbar_row=12&u_id=121&offset=0&

South Africa the 12th biggest source of greenhouse gases? Yes, but that's not the only measure that matters. (n.d.). Retrieved 28 March 2022, from https://www.polity.org.za/article/south-africa-the-12th-biggest-source-of-greenhouse-gases-yes-but-thats-not-the-only-measure-that-matters-2021-04-19

South Africa Unemployment Rate Jumps to 10-Year High. (n.d.). Retrieved 28 March 2022, from https://tradingeconomics.com/articles/05262015123112.htm

South Africa's Second National Climate Change Report | Department of Environmental Affairs. (n.d.). Retrieved 28 March 2022, from https://www.dffe.gov.za/otherdocuments/reports/southafricas_secondnational_climatechange

Sterner, T., & Köhlin, G. (n.d.). 18 Pricing carbon: The challenges. *Pricing Carbon*, 16.

Strambo, C., Burton, J., & Atteridge, A. (n.d.-a). *The end of coal? Planning a 'just transition' in South Africa*. 16.

Strambo, C., Burton, J., & Atteridge, A. (n.d.-b). *The end of coal? Planning a 'just transition' in South Africa*. 16.

Surging electricity demand is putting power systems under strain around the world—News. (n.d.). IEA. Retrieved 28 March 2022, from https://www.iea.org/news/surging-electricity-demand-is-putting-power-systems-under-strain-around-the-world

The coal industry as an employer—Coal Mining Matters. (n.d.). Retrieved 28 March 2022, from http://www.coalminingmatters.co.za/what-matters/employment

Time to Privatise South Africa's Power Sector | Engerati. (n.d.). Https://Www.Engerati.Com/. Retrieved 28 March 2022, from https://www.engerati.com/transmission-distribution/time-to-privatise-south-africas-power-sector/

UN Sustainable Development Goals Report 2017. (n.d.). UNDP. Retrieved 28 March 2022, from https://www1.undp.org/content/oslo-governance-centre/en/home/library/un-sustainable-development-goals-report-2017.html?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP_PaidSearch_Brand_English&utm_campaign=CENTRAL&c_src=CENTRAL&c_src2=GSR&gclid=CjwKCAjw8sCRBhA6EiwA6_IF4auVad2jz8MU-XETcy_A57OKeo1XhFS4S2BKn3j0JaZXfFNK3DgIPBoCog4QAvD_BwE

US EPA, O. (2016, June 27). *Climate Change Indicators: Weather and Climate* [Reports and Assessments]. https://www.epa.gov/climate-indicators/weather-climate

Visser, E. (2016). *The impact of South Africa's largest photovoltaic solar energy facility on birds in the Northern Cape, South Africa*. https://open.uct.ac.za/handle/11427/20843

What is the Kyoto Protocol? | UNFCCC. (n.d.). Retrieved 28 March 2022, from https://unfccc.int/kyoto_protocol?msclkid=461e922bae6711ec8b5045a2cc277d12

Yelland, C. (2010, November 23). *SA electricity distribution industry: Government goes back to the drawing board*. Daily Maverick. https://www.dailymaverick.co.za/article/2010-11-23-sa-electricity-distribution-industry-government-goes-back-to-the-drawing-board/

(N.d.-a).

(N.d.-b). Retrieved 28 March 2022, from https://www.giss.nasa.gov/research/briefs/lacis_01/