An assessment of how Environmental Impact Assessments of new coal mines in South Africa consider climate change.

BY

Rutherford George Mvukwe (1084339)

A research report submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE (INTERDISCIPLINARY GLOBAL CHANGE STUDIES)

Supervisor: Mrs Ingrid Watson

Johannesburg, 3 November 2020

Declaration

I, **Mvukwe Rutherford George,** declare that the work I have submitted as my research report is my own work. I am aware of the University's rules, regulations and consequences regarding plagiarism.

Signature: **Mvukwe RG** Date: **03/11/2020**

Dedication

I am dedicating this research report to my WIFE (Mvukwe Mercy- nee Gunde) and my parents (Mvukwe Second Mnali and Mvukwe Rebecca Paruvete). I gratefully thank my wife for her unwavering love, moral and financial support throughout my studies. I thank my parents for their wonderful love and guidance.

Acknowledgements

I would like to sincerely thank and appreciate my Supervisor (Mrs Ingrid Watson) for a job well done. This work was not going to be a success without her kind supervision. THANK YOU**.** To Dr Schwaibold, I thank you for your assistance and persuading me to take the MSc Interdisciplinary Global Change Studies programme. I would want to greatly appreciate all those who committed themselves and participated in the interviews. Thank you very much.

Abstract

Climate change is a serious global risk that adversely affects the environment and societies across the world. Anthropogenic greenhouse gas emissions mainly from the combustion of fossil fuels are the major cause of climate change. Climate change is closely associated with global air temperature increases, changes in the precipitation patterns and frequencies, changes in wind speeds and directions, melting of glaciers, snow and ice, and rising of sea levels. The Environmental Impact Assessment (EIA) is an important tool used in the management of environmental issues. The incorporation of climate change factors into the EIA process has gained global momentum. Many organisations and governments have developed different principles and guidelines that can be used when considering climate change in the EIA process. This research assessed how climate change is considered in the EIA process for new coal mines in South Africa, and how this compares with global best practice. South African legislative documents and guidelines were reviewed to establish the legal requirements for considering climate change in the application of mining permits and mining rights for new coal mines. A thorough review of Environmental Impact Assessment reports and Environmental Management Programme reports for five new coal mines from the Mpumalanga Province (South Africa) was done to find out how the EIAs for new mines consider climate change. Interviews with an official from the Department of Mineral Resources, a climate change expert, one sustainability officer and 4 mine environmental officers were done. The investigation established that the consideration of climate change in the South African EIA process for new coal mines is in its early stages. Greenhouse gas emissions which are the main contributors to climate change are comprehensively dealt with in the EIA process. Legislation and clear guidelines for incorporating climate change factors into the country's EIA process, especially around developments that contribute to climate change, are needed in order to manage and mitigate the impacts of coal extraction on the climate, as well as developing adaptation strategies for coal mines.

Key words: Climate change, climate change assessments, EIA process, coal mining, mitigation, adaptation strategies.

Table of Contents

List of figures

List of tables

List of abbreviations

CARICOM	-Caribbean Community
CEAA	-Canadian Environmental Assessment Agency
CO_2	-Carbon dioxide
CH_4	-Methane
DEA	-Department of Environmental Affairs
DEFF	-Department of Environment, Fishery and Forestry
DEAT	-Department of Environment and Tourism
DMR	-Department of Mineral Resources
EAP	-Environment Assessment Practitioner
EIA	-Environmental Impact Assessment
EMP	-Environmental Management Programme
EU	-European Union
GHG	-Greenhouse Gas
IAIA	-International Association for Impact Assessment
IEMA	-Institute of Environmental Management and Assessment
IPCC	-Intergovernmental Panel on Climate Change
MPRDA	-Mineral and Petroleum Resources Development Act
NCEI	-National Centres for Environmental Information
NEMA	-National Environmental Management Act
NEM: AQA	-National Environmental Management: Air Quality Act
N_2O	-Nitrous oxide
OECD	-Organisation for Economic Cooperation and Development
SEA	-Strategic Environmental Assessment
UNFCCC	-United Nations Framework Convention on Climate Change

Chapter 1

1.1. Introduction

Climate change is directly and indirectly caused by human activities that alter the atmospheric composition as well as by natural climate variability that are observed over long periods of time (UNFCCC, 2014). According to Shumba *et al*. (2012) climate change refers to a long term change in the conditions of the atmosphere that are different to a great extent from the past averages. Greenhouse gas (GHG) emissions such as carbon dioxide, mainly from fossil fuel combustion, or methane production from agricultural activities have the potential of causing changes in the atmospheric temperatures, thus enhancing the gradual process of climate change (Sala *et al*., 2012). The world is going through a process of climate change phenomenon that has a potential of leading to many problems that will affect human survival and development unless effective steps are taken to change human behaviour (IPCC, 2014). According to Chamaides and Wang (2005), many climate change scientists agree that anthropogenic factors are the primary factors that are responsible for stimulating the gradual process of global warming. Global warming is caused by the accumulation of GHGs in the atmosphere (IPCC, 2014). The climate change phenomenon comes with social, economic and environmental risks (IPCC, 2014) such as drought, floods, spreading of vector borne diseases, heat waves, reduction of ice and snow covers.

The concern for the negative impacts of mining activities on climate issues and the impacts of climate change on mining has been on the rise in the recent years (Glasson *et al*., 2013). According to Glasson *et al.,* (2013), many symposia, conferences, workshops and dialogues have been and are being held to deliberate on the need to incorporate climate change factors in the EIAs of new development projects. New coal mine development proposals are closely monitored and scrutinised for their potential influence on climate change and how these new mines will adapt to possible pressures related to climate change (Fuggle and Rabie, 2009).

1.2. Environmental Impact Assessment (EIA)

The EIA is a comprehensive risk planning and a powerful management tool that can serve the purpose of identifying and implementing appropriate management measures and controls by countries across the world (IAIA, 1996). The EIA system may be used for analysing and reporting on the impacts of certain types of activities to enable decision makers to correctly determine the options that can be taken to mitigate and manage the negative impacts of the activity or project (IAIA, 1996). The EIA system is also used to convert assessments into effective binding plans for preventing, minimising, mitigating and repairing the potential environmental impacts (IAIA, 1996). The assessments of climate change can contribute positively by assisting governments and organisations to meet both their national and international commitments to solve human-induced climate change and assist in the understanding of the potential social and environmental consequences of climate change (Byer *et al*., 2012).

EIAs are tools that are essential for evaluating the potential negative effects of all major projects with possible impacts on the environment (Fuggle and Rabie, 2009). According to Glasson *et al*. (2013), an EIA is used to evaluate the potential environmental consequences of implementing a developmental project. EIAs are essential as they are used as guidance in making informed and effective decisions, preparing development plans and to guide sustainable development in a country (Glasson *et al*., 2013). The EIA process should be accompanied by a comprehensive climate change assessment that shows the ways in which the project will contribute to climate change and also how the project will be potentially affected by climate change (Agrawala *et al.,* 2012). The incorporation of climate change in EIA is gaining momentum in the development of new projects, especially after countries signed the Paris Agreement that called for the reduction of GHG emissions in 2015.

1.3. Importance of coal mining to South Africa

According to Conti *et al.,* (2014), more than 95% of Africa's coal exists in South Africa, making the country a major supplier of coal on the continent. The selling of coal brings a lot of foreign currency into the country. South Africa produced 253 million tonnes of coal worth R146 Billion in 2018 and 258 million tonnes in 2019 worth R139 Billion (Minerals Council of South Africa, 2019). South Africa in 2013 produced close to 33% of the world's coal, making the country the world's seventh largest coal producer (Duus, 2013). According to Eberhard (2011), coal is vital to South Africa's energy sector as it is responsible for fuelling local industry. The Minerals Council of South Africa (2019) statistics show that more than 70% of the electricity demand is generated from coal power and according to Eberhard (2011) the use of coal in South Africa will continue for some time. The mining of coal, particularly in Mpumalanga, is important to the economy of the province as it is a key economic activity (Minerals Council of South Africa, 2019). Mining is associated with development as it plays a vital role in infrastructure development and creation of employment opportunities. The Richards Bay Coal Terminal serves as South Africa's primary export port. Many people, particularly in Mpumalanga are employed in coal mining activities (Eberhard, 2011). According to the Minerals Council of South Africa (2019), the coal mining sector had 89 647 employees in 2018 and 92 230 employees in 2019 which was about 19% of the total employment in the South African mining sector.

1.4. Rationale

As a developing country, South Africa is likely to continue with coal mining due to its reliance on coal-fired power stations for generating electricity. On the other hand the country is fully committed to reducing its GHG emissions. The South African government introduced strategies through climate change policies that enhance the shift to climate resilient and low carbon development, as well as resource efficient pathways that will deliver high impact economic, social and environment benefits (DEA, 2017). In the last ten years environmental issues including climate change are now vital in policy making (IEMA, 2015). Climate change should be an important element in the assessments for new projects and decision making processes. According to IEMA (2015), climate change negatively impacts the environment and hence affects economic development, mainly in developing countries. With this in mind, it is fundamental to assess how new coal mines in South Africa are considering climate change in their EIAs so as to achieve both the development of

the economy and GHG emissions reduction policies. New coal mines must also adopt proactive strategies to mitigate and adapt to a changing climate. This can only be achieved after effective climate impact assessments are done. In order to have an understanding of how new coal mines operating in the country are geared to achieve a balance between sustainable development and GHG emissions, there is a need to have a closer look at how they are considering climate change in their EIAs. This research aims to determine, through the use of case study examples, how climate change is considered in the EIAs for new coal mines in South Africa, and how this compares to global practice.

1.5. Research Aim

The aim of the research is to find out how climate change is considered in the EIAs for five selected new coal mines in the Mpumalanga Province of South Africa.

1.6. Research Questions and Objectives

Questions

i. What are the legal requirements and guidelines for the consideration of climate change in the application of a new coal mining permit?
ii. How is climate change considered in the Environmental Impact Assessments for new coal mines?
iii. How does climate change coal mining legislation and practice in South Africa compare to international best practice?

Objectives

i. To identify the legal requirements and guidelines for the consideration of climate change in the application of new coal mine permits.
ii. To analyse how climate change is considered in the Environmental Impact Assessments for new coal mines.
iii. To compare the climate change coal mining legislation and practise in South Africa with the international best practice.

1.7. Methodological Approach

The research assessed how the EIAs for five selected new coal mines in Mpumalanga address climate change. A review of South African legislation governing the application for environmental authorisation for new coal mine was done to establish what the climate change legislative requirements and guidelines are. Interviews with an official from DMR (competent authority) were done to get the application requirements of the department. The EIA reports and EMP reports of five selected new coal mines that made their applications after 2014 were reviewed to analyse how the EAPs considered climate change factors. Interviews with one sustainability manager and four mine environmental officers were also done to establish how climate change was considered in the EIAs of the mines. Various international documents that detail how climate change is incorporated in the EIA process were reviewed. The data obtained were tabulated for easier comparison.

1.8. Structure of the Report

Chapter 1 introduces the research by contextualising the main issues to be tackled and expressing the research statement. It gives the rationale and aim of the research and ends with a brief description of the methodology that was followed.

Chapter 2 explores the relevant literature review on climate change and the legislation governing coal mining in South Africa. It also covers climate change considerations in EIAs for new coal mines in South Africa. The chapter also reviews global protocols that South Africa is a signatory to.

Chapter 3 describes the research design and methodology used. It also deliberates on the data sources used and how the data were collected. It concludes by giving an explanation of how the data were analysed and managed. This chapter also covers a wide ranch of aspects of the research such as the research limitations, ethical issues binding the research, sampling methods and sample sizes.

Chapter 4 covers the research results and findings to answer the research questions of the investigation. The chapter gives the findings of the document reviews that were done as well as the results and findings of the interviews that were done.

Chapter 5 covers the discussions of research results and other issues that emanated from the research process.

Chapter 6 covers the recommendations based on some of the findings and the ultimate conclusion to the research.

Chapter 2

2. Literature Review

This chapter explores the relevant literature and provides the context to the research. The chapter looks at global and local literature that elaborates on the risky nature of climate change. The literature review then extends to the global and local responses to climate change issues. The South African legislation that is used to govern mining in the context of climate change is part of the literature that was reviewed. The South African legislation reviewed includes the MPRDA (Act No. 28 of 2002), the NEMA (Act No. 107 of 1998), NEMA Air Quality Act (Act No. 39 of 2004), NEMA: EIA Guidelines (GNR. 982) of December 2014, NEMA: EIA Regulations (GG. 41432) of February 2018, the Technical Guidelines for Monitoring, Reporting and Verification of GHG Emissions by Industry that must be read with the National Greenhouse Gas Emission Reporting Regulations, the National Pollution Prevention Plan Regulations (GN 712 of 2017) and the Thabametsi Court Ruling of 2017. The South African Constitution (section 24) was also reviewed as it provides the basis of the Acts that were reviewed. Local and international literature that explains the general EIA process and how climate change assessments can be incorporated into the EIA process was also reviewed.

2.1. Climate change as a global risk

This section explores the critical need of dealing with climate change issues facing South Africa and the greater world at large. According to the IPCC (2007), climate change is a serious global risk that can adversely affect both the environment and society. The atmospheric concentrations of anthropogenic GHGs (such as CO_2, CH_4, and N_2O) have continuously increased since the year 1750, leading to increases in the global average surface temperatures. According to Hansen *et al*. (2006), about 30 years prior to 2006 the world experienced a global temperature increase of about 0.2 ^{O}C. According to the records available, the year 2019 was the warmest year ever and the years 2016, 2015, 2017, were the second, third and fourth warmest years respectively (NCEI, 2019). From the time temperature records were being kept (a period of 140 years), the 10 warmest years are in the last 23 years. According to NCEI (2020), the southern hemisphere (land) had the highest temperatures recorded in the same 23 years. These statistics point towards the need to have a comprehensive and effective mechanism for dealing with the threatening situation. Both mitigation options and adaptive mechanisms are urgently needed. According to the 4th Assessment Report (AR) of the IPCC (2007), climate change mitigation and adaptation are the best ways forward of responding to climate change issues. The process of incorporating climate change assessments in projects that emit GHGs can be an effective alternative solution to the impacts of climate change. According to IPCC Reports (2016), climate change related extreme weather events with devastating consequences are becoming more and more frequent globally, with the increases in extreme weather events such as the El Nino events (2015/16), drought (2015/16/17 in the southern parts of Africa), more intense tropical cyclones such as tropical cyclone Idai of 2018, heat waves and extreme temperatures (such as in 2018 and 2019) being recorded (IPCC, 2019). Many poor societies are vulnerable to these extreme weather events. Devastating consequences associated with these extreme weather events include melting of

glaciers, more frequent intense tropical cyclones, fresh water flowing into oceans where it will be trapped on top of salt water, Iceland and the Greenland areas getting cooler than before (Engelbrecht *et al*., 2019). Extreme temperatures are slowly drifting towards the global warming threshold of 1.5 ^{O}C (Engelbrecht *et al*., 2019). These increased temperature conditions have potential negative effects on biological processes and ecological systems that are the sources of natural resources for societies (Engelbrecht *et al*., 2019).

In general decreases in precipitation are likely to occur over parts of southern Africa as the global climate warms (Engelbrecht *et al.,* 2019). The region is projected to become substantially drier and temperature increases of more than 4 ^{O}C are plausible towards the end of the century under low mitigation scenarios (Engelbrecht *et al*., 2019). Many poor societies depend on crop faming for their livelihoods. With crop farming almost becoming impossible, such societies will come under threat of starvation (Engelbrecht *et al*., 2019). Climate change is also a very serious global food security threat and the extent and magnitude will mainly depend on the socio-economic and regional position of a country (Schmidhuber and Tubielo, 2007). More frequent strong El Nino events may plausibly occur by mid-century (Engelbrecht *et al*., 2019) and these will also have negative impacts on farming activities that are more common in already vulnerable societies.

Temperature anomalies recorded in Africa since 1971 are showing warmer years accompanied by fewer cooler years (Engelbrecht *et al*., 2019). Projections are uncertain but all models are showing more or less the similar projections. With low mitigation projections, there will be no more cool years by 2050 (Engelbrecht *et al*., 2019). With the global projected 6 ^{O}C increase, by 2099 there will be no livestock production and crop production will be impossible (Engelbrecht *et al*., 2019). Southern Africa is likely to be drier as East Africa is likely to become wetter. The southern sections of Africa are warming twice the global rate while increases in fire-danger days, hot days and heat-wave days are also expected across Africa under low mitigation (Engelbrecht *et al*., 2019).

Coming to a local level, the National Climate Change Response Policy (White Paper) of 2011 acknowledges that South Africa's environment and its socio-economic conditions are making the country vulnerable to the adverse climate change impacts (DEA, 2011). The country is highly vulnerable since it is a developing country (with high poverty levels) that mainly depends on coal which is a high source of GHG emissions for the generation of its power (DEA, 2011).

2.2. Global response to climate change

In this section, literature that covers international response to climate change is reviewed. The roles played by the IPCC, the Kyoto Protocol, UNFCCC, ICMM, and the Paris Agreement will be discussed. The Kyoto Protocol came into effect in February 2005 and was established to operationalise the UNFCCC by means of committing all the industrialised nations to limit and also to lower their GHG emissions using their own individually determined targets (IPCC, 2007). The industrialised nations were asked to make commitments that would see these nations adopting policies and measures of mitigating their GHG emissions and submit reports frequently (IPCC, 2007). The Kyoto Protocol emphasised the need to meet the individually set targets through implementing natural measures and establishing effective monitoring strategies that are

supported by employing compliance and reporting systems that would ensure transparency (IPCC, 2007). On 21 December 2015 during COP 21 in Paris, parties to the UNFCCC agreed to tackle climate change by signing an agreement that saw the parties embarking on a pathway to achieve a low carbon future (IPCC, 2015). The Paris Agreement of 2015 brought together all the countries to work for one common cause that would see the success of a low carbon future through strengthening responses to the dangers that may be brought by climate change (IPCC, 2015). According to the IPCC (2015), the Paris Agreement aims at making sure that the global average temperature rise is kept at below 2 ^{O}C above the pre-industrial levels by enforcing member states to design and implement GHG emission strategies.

The IPCC was established in the year 1998 and it is the organisation that is on the fore-front of spearheading climate change assessments (Agrawala, 2011). The major aim of the IPCC is to make sure that the world has clear scientific information on the latest state of knowledge regarding climate change issues (Agrawala, 2011). The IPCC operates with working groups that generate two outputs, firstly the underlying detailed Assessment Reports (AR) and secondly, policymaking summaries (Agrawala, 2011) that are given to governments across the globe for critical analysis and review. In all the Assessment Reports done, the IPCC integrates climate change into sustainability principles of the different countries around the world (IPCC, 2015). The IPCC has been and is playing an important role of encouraging all the stakeholders to embark on effective climate change mitigation through collaboration between the public and private as well as communal and individual efforts (IPCC, 2014). Midgley *et al*. (2002) proposed that, climate change adaptation measures and options go a long way in the development of resilience through addressing the impacts that are threatening systems, projects or livelihoods. The IPCC (2014) describes climate mitigation measures as those activities as well as those innovations that can help in reducing the atmospheric concentrations of GHGs or alternatively developing storage capacities of GHGs.

The International Council on Mining and Metals (ICMM) is an industrial group of companies established in 2001 to represent the leading global companies in advancing their commitment to sustainable development (ICMM, 2020). According to the ICMM (2020), the organisation helps member companies to ensure ethical business practices through its ten principles, best practice guidelines and various work programmes that include buying from clean supply chains. The ICMM has developed its own climate change policies (for its members) that are in line with international policies and agreements (ICMM, 2020), According to ICMM (2020), the organisation has developed policies that are targeted at reducing GHG emissions, supporting international climate change policies and agreements, and pushing for low carbon economies. The organisation has developed GHG reduction strategies, ensuring the efficient use of natural resources, enhancing research and development of low GHG emissions as well as measuring progress and reporting results (ICMM, 2020). ICCM also encourages its members to adapt to the changing climate through building resilience in the mining and metals industry (ICMM, 2020). The ICMM has also developed guidelines for adapting to a changing climate. ICMM members are expected to submit reports on their performance against the GRI Guidelines (ICMM, 2020).

The Initiative for Responsible Mining Assurance (IRMA) is a nongovernmental organisation that was founded in 2006 (IRMA, 2020). According to IRMA (2020), the organisation complies with the ISEAL Code of God Practice for setting environmental standards and is the answer to the global demand for environmentally responsible mining. The mission of IRMA is to protect people and the environment directly affected by mining activities (IRMA, 2020). IRMA (2020) has also developed its own standards that are in line with other international policies and agreements in response to a changing climate. IRMA members have an environmental responsibility of lowering their GHG emissions as well as protecting the air quality (IRMA, 2020).

Across the globe many different climate change mitigation measures and options and adaptation measures have been and are being considered in Impact Assessments (IA) tools that include the EIA (Byer *et al*., 2012). All the measures aim at effectively reducing the GHG emissions through the various options (such as reporting and monitoring tools) in order to enhance the benefits of the proposed projects and also facilitating the protection of these projects from the effects of climate change through adaptation (IAIA, 2013). With this in mind, the IPCC's 4th Assessment Report (2007) identified climate mitigation and adaptation as the best ways of responding to and dealing with the negative effects of climate change. The IPCC's 4th Assessment Report was followed by the 5th Assessment Report in 2014, which presented a broad spectrum of mitigation measures, options and practices that may be used to potentially reduce the GHG emissions of a project (IPCC, 2014). The options that were presented included measures such as replacing fossil fuels with technologies that reduce the GHG emissions (for example using nuclear energy as well as renewable energy) and implementing GHG emission mitigation options in all the stages of the project as well as improving efficiency and GHG capture and storage (IPCC, 2014). From the 5th Assessment Report of the IPCC in 2014, the following difficulties in implementing mitigation measures and adaptation measures were given:

- Increasing the attention of all the stakeholders to mitigation options and adaptation measures of projects;
- The promotion of the change in technology (developing countries still lag behind in this respect);
- Improving the understanding behind uncertainties and risk management of projects;
- Encouraging positive global collective actions (in contrast, the USA is forcing its way out of the Paris Agreement and South Africa is erecting more coal-fired power stations); and
- Difficulties of reconciling or completing different priorities other than climate change (as in the case of South Africa where the priority is to create employment opportunities as the coal mining industry is a vital source of employment) (IPCC, 2014).

Many regional organisations and many nations have embarked on the call by the IPCC to work on the employment of different tools (mainly EIA through incorporating climate change assessments) that enhance climate change mitigation measures and adaptation measures (IPCC, 2014). Some notable organisations that came with tools and guidelines to this effect include IEMA, IAIA, CARICOM and OECD. Nations on the fore-front include; Canada, China, USA, with South Africa picking up with the 2014 NEMA EIA regulations. These are discussed in the next sections.

2.3. South Africa's response to climate change

South Africa became actively involved in issues related to climate change around the late 1990s after the publications of the first and the second IPCC Assessment Reports (Lukey, 2011). The responses by South Africa to climate change are reviewed in the sections below.

2.3.1. The evolution of the Climate Change Policies in South Africa

South Africa ratified the UNFCCC in August of 1997, leading to the identification of the need to have a National Climate Change Policy (DEA, 2017). South Africa then initiated the National Climate Change conferences after the third IPCC Assessment Report included South Africa amongst the developing nations' top polluters (Lukey, 2011). Many more initiatives (including the National Climate Change Response Policy, Climate Change Bill and the Carbon Tax Act) were initiated. The National Climate Change Response Policy (NCCRP) White Paper was published in 2011 (Lukey, 2011). In 2018 the government gazetted the Climate Change Bill and on 1 June 2019 South Africa introduced the Carbon Tax Act No.15 of 2019 to try and reduce the impacts on climate and climate change. Below is table 1 showing the evolution of climate change policies in South Africa.

Table 1: The evolution of the Climate Change Policies in South Africa

Policy Environment	Year	Policy
Increasing awareness of climate change evident by ratification of multinational climate change agreements and establishment a multi-stakeholder National Climate Change Committee (1996-2004).	1996	The Constitution of South Africa
	1997	South Africa ratifies and UNFCCC and establishes the NCCC
	1998	The National Environment Management Act
	2000	Millennium Development Goals
	2002	National Disaster Management Act South Africa hosts World Summit on Sustainable Development South Africa ratifies Kyoto Protocol
	2004	National Climate Change Response Strategy
Recognising the reality of climate change, South Africa develops a national climate change strategy. This was marked by the appearance of some early adopters at sub-national (2005-2009).	2006	Framework for Climate Change Adaptation (Cape Town City).
	2007	Climate Change Strategy (Ekurhuleni).
	2008	Climate Adaptation Plan (eThekwini). Climate Change Response Strategy and Action Plan.
	2009	Climate Change (Johannesburg). Status Quo Vulnerability Study (KwaZulu-Natal). DEA Climate Support Programme established.
South Africa hosts UNFCCC COP17, shifting gears into a focus on implementation. Adaptation gains prominence, balancing mitigation (2010-2015).	2011	South Africa hosts UNFCCC COP17. National Climate Change Response Climate Change Response Strategy (Eastern Cape).
	2012	National Development Plan published. Climate Change Response Strategy (Gauteng).
	2013	Climate Change Adaptation Sector Strategy for Rural Human. National Water Resource Strategy II.
	2014	National Climate Change Response Dialogue. Biodiversity Climate Change Response Strategy. National Climate Change and Health.

Policy Environment	Year	Policy
	2015	DEA CSP develops Climate Adaptation Strategies for Mpumalanga. North-West, Limpopo, Northern Cape and Free State. Climate Change Adaptation Plans for South African Biomes. Draft Climate Change Sector Plan for Agriculture, Forestry and Fisheries.
Recognising the need to strengthen the climate change mandate, South Africa developed a Climate Change Bill	2016	Draft National Adaptation Strategy. Climate Adaptation Strategies renewed and updated for Western Cape, Eastern Cape and KZN
	2018	Draft Climate Change Bill
	2019	The Carbon Tax Act

Source: (Engelbrecht *et al*., 2019).

2.3.2. The Climate Change Response Strategy (2004)

The Climate Change Response Strategy was introduced in 2004 after the ratification of the UNFCCC (DEAT, 2004). The Strategy explored the nature of the expected climatic changes that may happen locally and globally and justified climate change as a major problem for the country (DEAT, 2004). The Strategy reviewed and examined the obligations of the UNFCCC and Kyoto Protocol and also analysed the vulnerabilities of South Africa and all the possible climate change consequences (DEAT, 2004). According to DEAT (2004), the Response Strategy also explored the many different adaptation strategies and potential mitigation measures for South Africa, emphasising the actions that affect sustainable development in South Africa. The Strategy proposed strategic objectives, actions and interventions (DEAT, 2004).

2.3.3. The Climate Change Response White Paper (2011)

The White Paper was published in 2011. South Africa has a vision for an efficient and effective response to climate change issues and has put in place long term transitional strategies to ensure a low-carbon economy and societies that are climate resilient (DEA, 2011). To be effective, the response to climate change needs multi-faceted interventions (social, economic and environmental) that will be able to integrate the mitigation strategies and the adaptation elements within the country's developmental framework (DEA, 2011). The White Paper pressed for an effective response and a long-term transformation of the country to being a climate-resilient and low-carbon economy and also being a low-carbon society (DEA, 2011). The strategy involved managing the measures coming from the actions of the people and also the ability to respond to international responses and measures that have adverse consequences for the country (DEA, 2011). The White Paper also called for a sustainable development pathway that will reflect a climate resilient development (DEA, 2011). In addition, the White Paper clearly outlined the importance of developing mitigation measures that complement the global efforts of reducing the GHG emissions and also supporting the Sustainable Development pathway in the country (DEA, 2011). The set of mitigation measures of the White Paper demonstrated a clear need for the inclusion of climate change issues and assessments at project-level and the need to have legal requirements to regulate the incorporation of climate change assessments in the EIA system (DEA, 2011).

2.3.4. The Climate Change Bill (2018)

The Climate Change Bill of South Africa was gazetted in June 2018. The Bill is aimed at building an effective strategy to respond to climate change and to a long term transition (DEA, 2018a). The Bill also seeks to create a low-carbon economy and societies that are climate change resilient in the context of a developmental framework that is environmentally friendly (DEA, 2018a). The Bill provides for a coordinated response to climate change and all its negative effects by all the government sectors as well as private sectors (DEA, 2018a). The Climate Change Bill also provides for an effective management of the unavoidable negative impacts of a changing climate through the enhancement of adaptive capacity, reduction of vulnerability to climate change, and strengthening resilience in the economy, societies and the environment (DEA, 2018a). Furthermore the Bill aims at stabilising the quantities of GHGs in the atmosphere

at low levels that do not interfere with the climate system thus allowing sustainable development (DEA, 2018a).

2.4. Mining and legislation in South Africa

The national government is responsible for the management of the minerals and petroleum resources and controls the mineral wealth through the DMR. The DMR ensures sustainable development of the country through passing and monitoring regulations that are used to manage the mineral wealth and provides guidelines that are pronounced by the MPDRA (Act No. 28 of 2002) and the NEMA (Act No. 107 of 1998). The DMR is the competent authority that receives EIA reports, EMP reports and Mine Works Programme (MWP) for authorization in conjunction with Environmental Authorisations for listed activities. As the competent authority, DMR has the power to enforce the inclusion of the relevant climate change factors into EIA reports of new mines.

The DMR in conjunction with the DEFF is the custodian of the regulatory that control mining activities in South Africa. The country's environmental regulatory framework boosts the investor confidence and decision making process. A regulatory framework must be stable, predictable and be favorable to the investors. South Africa has well developed environmental regulations that are targeting at spearheading development that is sustainable through the management of the environment (DEA, 2017). The legislation that governs mining activities in South Africa (DEA, 2017) is the MPRDA (Act No. 28 of 2002). The Department of Mineral Resources (DMR) is responsible for the MPRDA, which facilitates sustainable development within the national environment policies while and promoting social and economic development (DEA, 2017). The MPRDA (Act No. 28 of 2002) works in conjunction with the NEMA (Act No. 107 of 1998) to ensure that sustainable development is achieved (DEA, 2017). All mining activities are in listing two of the NEMA: EIA Regulations (GNR.982) of December 2014 (DEA, 2014). According to DEA (2014), all activities in listing two are high risk activities that are likely to cause impacts that are not easily predictable causing significant environmental impacts. Such activities go through full scoping and a full EIA process (DEA, 2014). Climate change is considered as a huge stumbling block in the development plans of the country, which need well-coordinated approaches that involve all the stakeholders (DEA, 2014). The NEMA: AQA (Act No. 39 of 2004) has incorporated the assessment of GHG emissions and published regulations and guidelines for an efficient governance and coordination of the mechanisms used to monitor emissions in the country (DEA, 2014).

2.4.1. The Constitution of South Africa

Mining causes a lot of environmental impacts; as a result the new democratic government of South Africa brought a different approach to sustainable development. The agenda of the Constitution is focused on:

- Placing the people's interests first;
- Including people in the decision making processes;
- Sustainable development using resources with the future generations in mind.

The Constitution's section 24 deals with environmental rights. ***"****Everyone has the right:*

- *To a clean environment that is good to their health or well-being; and*

- *To protect the environment, for the current benefits and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; and promote conservation".*

The Constitution of the country is the supreme law that controls and overrides all other laws. Section 24 of the Constitution directly influences all the other Acts that are used to regulate the mining sector in the country. Both the MPRDA (Act No. 28 of 2002) and the NEMA (Act No. 107 of 1998) are guided by and operate within the Constitution of the country.

2.4.2. MPRDA (Act No. 28 of 2002)

The MPRDA (Act No. 28 of 2002) which was enacted together with other regulations in 2004 is the main legal framework regulating the mineral industry in South Africa. The state through the DMR uses the MPRDA to:

- Promote equal access to the mineral resources of the country and the transformation of the mining sector;
- Advance the economic situation of all citizens;
- Ensure the sustainable development in the communities affected by mining;
- Guarantee security of tenure in terms of prospecting and mining operations;
- Ensure sustainable development through the efficient use of the mineral resources;
- Align the mineral industry of the country to world's modern reforms;
- Subject all mining activities to the same regulatory requirements;
- Provide equitable opportunities to all new entrants; and
- Control and monitor all standards in respect to environmental, health and safety and other working conditions.

As the competent authority, the DMR uses the MPRDA (Act No. 28 of 2002) to regulate the environmental authorisations in the application of coal mining permits (DEA, 2017). The DMR enforces the incorporation of climate change issues in the EIA reports as a requirement for the application of a new coal mine permit (DEA, 2017).

2.4.3. NEMA (Act No. 107 of 1998) and NEMA EIA Regulations (GNR.982) of December 2014

NEMA provides for the Minister of Environmental Affairs to include activities in the list that require environmental authorisations before they commence. This led to the promulgation of Listing Notices 1 (GNR.983), 2 (GNR. 984) and 3(GNR.985) and the EIA Regulations (GNR.982) of December 2014. The EIA regulations were amended in April 2017 by GNR.326, while Listing Notices 1, 2 and 3 were amended by GNR.327, GNR.325, and GNR. 324 respectively as of December 2014 and all mining operations are to be authorised under NEMA with the DMR acting as the Competent Authority.

Table 2: Listing Activities and the type of assessment to be done

Listing Notice	Description of the Activity	Type of Assessment
Listing Notice 1 (GNR. 983)	Smaller scale activities. Impacts are generally known and manageable. Less likely to have significant environmental impacts.	Basic Assessment
Listing Notice 2 (GNR. 984)	Larger scale (larger footprint) and high risk activities. Impacts not easily predictable. Likely to have significant environmental impacts.	Full Scoping and EIA
Listing Notice 3 (GNR. 985)	Listing activities and sensitive areas per province. Approval is needed.	Basic Assessment

Source: DEA (2017)

The NEMA EIA (2014) Regulations place mining activities into Listing Notice 2 (GNR.984) that calls for a full Scoping and EIA to be done. A full EIA process includes conducting a climate change assessment supporting the requirements of the White Paper on climate change. The NEMA EIA (2014) Regulations mention the incorporation of climate change factors into the EIA process under air quality assessments, reporting and monitoring, hence indirectly calling for the incorporation of the climate change factors into the EIA process.

2.4.4. NEMA: Air Quality Act (Act No. 39 0f 2004)

NEMA: AQA (Act No. 39 of 2004) controls and regulates atmospheric emissions and provides for Listed Activities (GN.893 of November 2010) that may cause significant effects on the environment, including economic conditions, social conditions, cultural heritage or ecological conditions. All conditions on this list will require the application of an Atmospheric Emission License (AEL). The NEMA: AQA (Act No. 39 of 2004) will allow coal mines to incorporate climate change into the EIA process by enforcing the EAPs to include the list of GHG emitted, their quantities, mitigation strategies, monitoring and evaluation of the identified GHGs. The National Pollution Plan Regulations (GN 275 of 2017) were introduced in July of 2017. New coal mines submit pollution prevention plans. The purpose of the Regulations is to prescribe the requirements that pollution prevention plans of greenhouse gases declared as priority air pollutants need to comply with in terms of section 29(3) of the NEMA: AQA (Act No. 39 of 2004) (DEA, 2017). In April 2017, DEA introduced The Technical Guidelines for Monitoring, Reporting and Verification of GHG emissions by industries which must be read with the National Greenhouse Gas Emission Reporting Regulations (DEA, 2017). The Technical Guidelines for Monitoring, Reporting and Verification of GHG emissions by industries describes the reporting methodology as specified in the NEMA: AQA (Act No. 39 of 2004): National GHG Emission Reporting Regulations (DEA, 2017). According to DEA (2017), The Technical Guidelines for Monitoring, Reporting and Verification of GHG emissions by industries provide guidance to reporting companies on

methodologies to apply when quantifying GHG emissions from industrial activities listed on table 5.2of the guidelines.

2.4.5. Challenges of mainstreaming climate change issues

With all the regulations and guidelines in place, there are still many challenges that need mainstreaming with regards to climate change issues (DEA, 2011). According to DEA (2011), the challenges include:

- The fragmented environmental policies into which climate change should be blended (as exposed by the Thabametsi court ruling in 2017);
- The belief that climate change mainstreaming can delay the development of projects (also highlighted by one of the mine environmental officers during an interview); and
- Different definitions regarding successful climate change mainstreaming.

According to DEA (2011), to successfully mainstream climate change issues, all the three government levels (local, provincial and national) must coordinate smoothly in the following three ways:

- Stakeholder coordination, engagement and public participation;
- Horizontal coordination within as well as across different departments at national level (mentioned also in the interviews); and
- Effective coordination within all the spheres of the government departments that are related directly to climate change and environmental management.

2.5. Environmental Impact Assessment (EIA)

There has been an increase in the number of nations developing legislation that regulates environmental issues in the last 30 years (Glasson *et al.,* 2013). According to Weston (2004) the USA and the UK are amongst the first countries to introduce environmental legislations. In order to safeguard and stop the damage to the environment by human activities, the USA in 1969 introduced the National Environmental Policy Act (Weston, 2004). To support the Act, the USA then introduced the Environmental Impact Statement with the term EIA being adopted for all the projects that could have potential damaging environmental impacts (Weston, 2004). The EIA concept was also discussed by European community members, leading to its adoption in the late 1980s (Weston, 2004). Many countries worldwide have so far adopted the EIA process in their major development projects to reach informed decisions (IEMA, 2015). The EIA process is highly distinguished due to its preventative nature of mitigating (He, 2013). Many organisations, countries and regions (such as the OECD, CARICOM, China, Korea and Canada) have developed EIA systems that comprehensively incorporate climate change factors. These are discussed fully in later sections of the report. Below are the step by step stages of a full EIA process according to Wood (1995):

- The EAPs must consider of other available alternatives of achieving the same objectives;
- Drafting and designing of the selected development proposal;
- Checking the necessity of the EIA process (screening);
- Selection of the concepts to be dealt with in the EIA (scoping);
- Preparation of a full EIA report (description of the proposal and the environmental aspects to be affected by the project and reviewing the extent and significance of impacts);

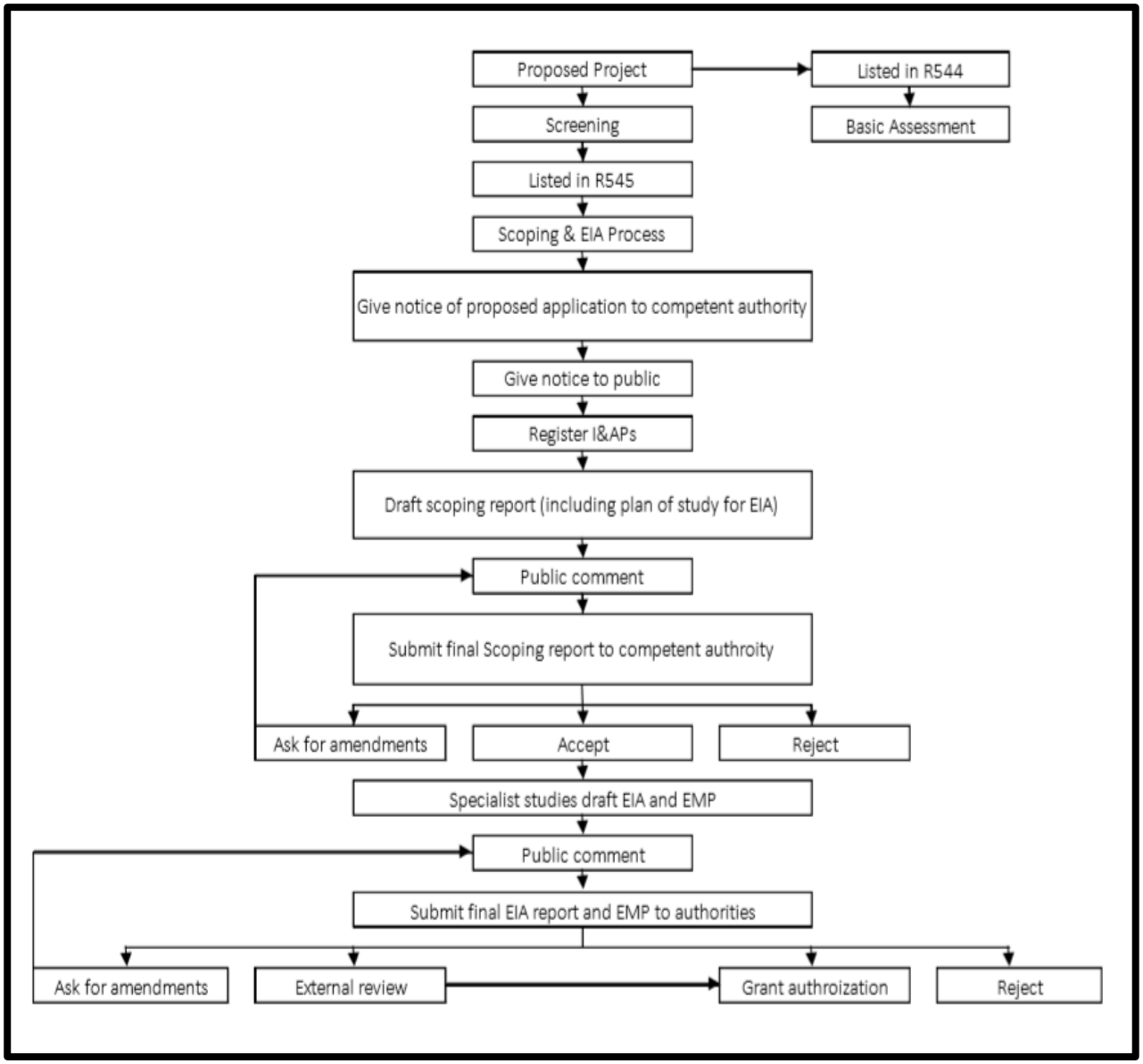
- Evaluating of the EIA report checking for its adequacy;
- Settling on an informed decision on the project, after careful consideration of the EIA reports and submissions made; and
- Monitoring and follow-ups of the impacts and mitigation strategies on the proposal.

2.5.1. The general EIA process in South Africa

The EIA process is outlined in the EIA regulations and Listing Notices of the NEMA (Act No. 107 of 1998). The NEMA: EIA regulations of 2014 provide for listing activities that should not start without getting an environmental authorisation and submitting the relevant reports to the Competent Authority for the purpose of making important decisions (DEA, 2017). According to DEA (2017), the process gives the developer a chance to assess the possible environmental impacts of a proposed development and also provides for identification of mitigation measures to be used to ensure that environmental impacts are avoided, minimised or mitigated. Of importance is the public participation process that is also legislated and forms the core part of the EIA process (DEA, 2017). During the process of public participation, the contributions of the interested and affected parties are vital and are considered by the Competent Authority in order to make informed decisions (DEA, 2017). The EIA process has its weaknesses but it is useful in South Africa's environmental impact management regime.

In South Africa, the EIA is an important regulatory instrument that is used to manage and also to mitigate the negative impacts of new projects that have the potential of affecting the wellbeing of people (DEA, 2017). According to DEA (2017), the EIA system is taken as a process that actively facilitates sustainable development. The EIA process is well explained in the EIA Regulations and Listing Notices (DEA, 2017) that are used to implement Chapter 5 of the National Environmental Management Act (NEMA). The EIA regulations describe the listing activities that cannot start before getting an environmental authorisation and identifying processes and the reports that should be given to the Competent Authority for making decisions (DEA, 2017). According to DEA (2017), the process of EIA allows the developer of a project to assess the possible environmental impacts of the intended development and also provides for identification of all the options that can be implemented to make sure that environmental impacts are avoided, minimised or mitigated. NEMA EIA Regulations (GNR.982) of December 2014 requires comprehensive air quality assessments and climate baseline information to be done for all projects that require environmental authorisations. Air quality assessments allow the air quality specialists to look at GHG emissions (produce a list of the GHG emitted, their quantities, mitigation strategies, monitoring and evaluation of the identified GHGs). In the NEMA AQA (Act No. 39 of 2004), GHG emissions are comprehensively dealt with.

Figure 1: Flow diagram showing the South African EIA process



Source: (DEA, 2017)

There are many potential entry points for climate change factors in the South African EIA process. To start with, the current EIA process already includes the reporting of the baseline climate information as well as identification of GHG emission (DEA, 2017). The screening process allows for the consideration of all regulations and policies on climate change (DEA, 2017). According to DEA (2017), the regulations enforce the inclusion of the regulatory frameworks used by the EAPs in the EIA reports.

2.6. Climate change risk assessment

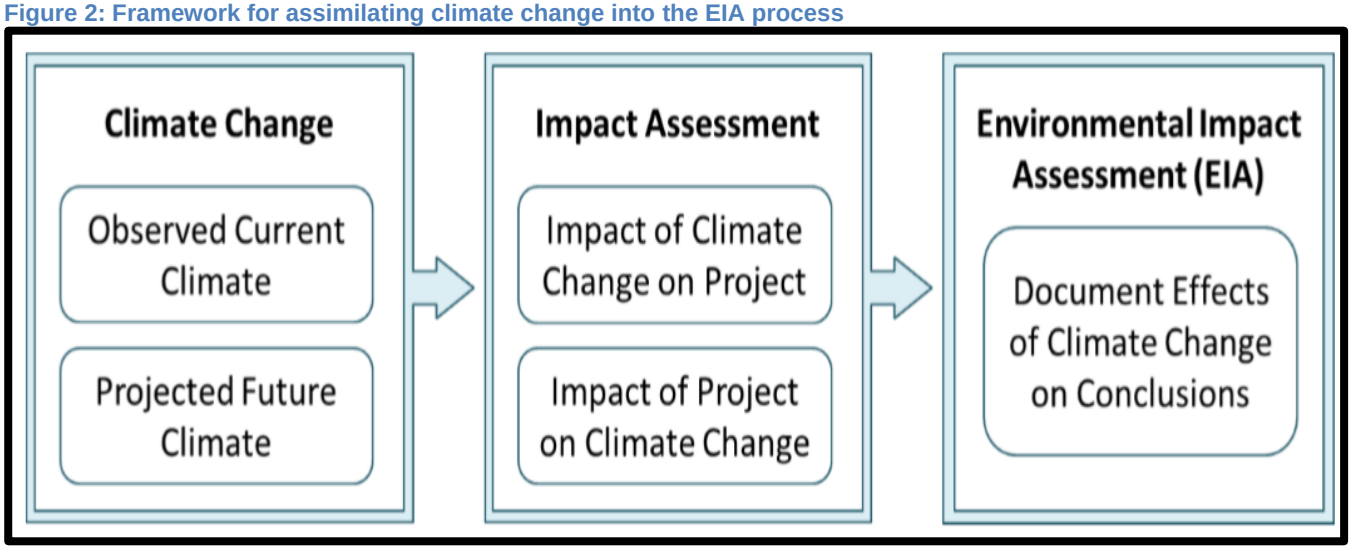
Risk management involves risk assessment amongst many other things. Risk assessment is a very broad term that involves many aspects such as risk analysis, risk identification, risk description and risk estimation (Schaltegger *et al*., 2016). Like any other business, when planning to operate a new coal mine, a business

risk assessment should be done. In the business risk assessment, a comprehensive climate change risk assessment is one of the many key assessments that should be done (Agrawala *et al*., 2012). According to Agrawala *et al*. (2012) the climate risk and vulnerability scoping process and screening process should include comprehensive information on how the project will be climate depended, how the project will be climate vulnerable and how the project impacts will exacerbate vulnerabilities. The climate baseline information must be projected across the complete life cycle of the project, looking at the climate change effects (climate change scenarios) for the project area over the life cycle of the project (Agrawala *et al*., 2012.) Both climate change and mining have direct and indirect impacts on the communities around and ecosystem services in the area. The risk assessment should include all the direct and indirect risks to the project, direct and indirect project risks to the communities, ecosystem services and the natural habitats (Agrawala *et al.,* 2012). According to Agrawala *et al*. (2012), the EIA report must include a comprehensive stand-alone section on climate change risk mitigation, adaptation, monitoring and adaptive management. The EIA report must show how various climate change factors are included in the project design, show the offset measures, show the behavioural change initiatives, as well as all the disaster risk management strategies that are associated with climate change factors (Agrawala *et al*., 2012).

2.7. Incorporating climate change assessments into the EIA process

The use of EIA has been an important development in the management of environmental issues since the year 1973 (Yi and Hacking, 2011). Many national authorities and some development banks have made significant steps in spearheading the incorporation of climate change impacts and adaptation measures within EIA process (Agrawala *et al*., 2012). According to Yi and Hacking (2012), the Organisation for Economic Co-operation and Development (OECD) endorsed the process of incorporating climate change factors into the EIA process, encouraging all its members to formulate effective guidelines that incorporate climate change factors in their EIAs. Capstic *et al*. (2014) developed a framework that can be followed to support the assimilation of climate change into an EIA process using provided guidance and best practice principles. The framework is described in a stepwise format as shown in figure 2 below.

Figure 2: Framework for assimilating climate change into the EIA process



Source (Capstic *et al*., 2014)

According to Capstic *et al.* (2014), in the first step, both the current climate and the projected future climate are fully described. In step two, all the strategies that will be used to support effective decision-making are developed. The third and last step will see the documentation of the decision making process.

2.7.1. International Context

Although voluntary, international organisations such as IAIA, IEMA, OECD and CARICOM are calling for companies to push beyond compliance by means of using guidelines, standards and codes of practice within the climate change context (Yi and Hacking, 2011). According to Yi and Hacking (2011), there are acceptable guidelines that sufficiently suggest how the EIA process can be used to account for climate change at a project level. There are 10 principles derived from international organisations that are recommended for implementation to produce a climate-aware EIA (CEAA, 2003; IEMA, 2010). Table 3 below shows a summary of the ten principles.

Table 3: The recommended implementation principles for the EIA Best Practice Principles

	Incorporation of climate change into EIA Best Practice Principles
1	The EIA process must review all the GHG emission policies and regulations (national and international) and polices on the mitigation and adaptation of climate change.
2	The EAPs must develop comprehensive climate change related objectives.
3	The EIA process must take into account the current climatic conditions and the projected climate change scenarios during the development of the climate change baseline.
4	The EIA must identify all the current GHG emissions baseline and projected changes in the GHG emissions.
5	The EIA must assess all the effects of the project, including emissions and embodied during construction and operation.
6	The EIA must assess all the direct and indirect GHG emissions as well as their effects on emission sinks.
7	The EAPs must identify all the potential impacts of climate change on the project and the risks to ecological systems and societies in the area.

8	The EAPs must identify all the cumulative effects that are associated with climate change.
9	The EAPs must find and include all the opportunities that can be used to facilitate the inclusion of effective mitigation and adaptation options into the design of the project.
10	The EIA process must include effective monitoring and strict follow-up strategies in the context of climate change.

Source: CEAA (2003); IEMA (2010)

Over the years various countries, organisations and authors have made progress in examining climate change factors and have proposed approaches of incorporating these climate change factors into the EIA process. Although there are some differences, all the approaches seem to agree on basics of how climate change factors can be incorporated in the EIA process (Yi and Hacking, 2011). Based on their presumed strengths, seven approaches were selected and are reviewed below.

2.7.2. Approach outlined by He (2013)

As with Capstic *et al*. (2014) who developed a framework that can be used to support the incorporation of climate change into the EIA process, He (2013) outlined six main ways that can be used by EAPs to incorporate climate change into the EIA process. The six ways are described in detail below.

2.7.2.1. Connecting with sustainable development principle and the precautionary principle

The EIA process has come out as an internationally recognised powerful tool that can be used to help those who make decisions to achieve the sustainable development goals (He, 2013). Sustainable development was defined by the World Commission on Environment and Development (WECD) as a way of availing the current needs without affecting the potential of the coming generations to meet their own needs (United Nations, 1987). According to He (2013), the adoption of the Sustainable Development Principle and the Precautionary Principle provides the vital rationale that is used to consider climate change impacts in developmental activities. In order to promote sustainable development, the decision makers should acknowledge the obvious risks that come with a changing climate, hence they should take the correct measures to deal with the climate change risks (He, 2013). He (2013) states that, climate change impacts are a threat to both environmental and socio-economic development, as a result the sustainable development concepts can be used to work as a perfect guide to respond to climate change issues. In his conclusion, He (2013) suggests that, sustainable development could be the most appropriate conceptual and practical framework for dealing with climate change mitigation and adaptation.

2.7.2.2. Managing uncertainties

There are various circumstances that are linked to climate change uncertainties that have not yet been well addressed (He, 2013). Ways of accommodating the inherent climate change uncertainties are the most significant and are also the most challenging when it comes to the incorporation of climate change considerations in EIAs (He, 2013). There is need to increase the accuracy of climate change predictions as this will help in the incorporation of climate change impacts assessments into the EIA process (He, 2013). He

(2013) gives three approaches that can be followed in order to manage these uncertainties. The approaches that can be followed are:

- Embarking on advanced scientific research that will lead to an improvement in the accuracy of climate models;
- The use of effective adaptive management as a tool to address the climate change uncertainties; and
- The preparation of all possible alternatives is crucial as they make many optional choices to be available, hence reducing the risks that are associated with uncertainties.

2.7.2.3. Placing EIA in climate change policy context

Integration of climate change factors can also be achieved by carefully measuring and assessing the climate change impacts of a proposed project by placing them in the context of the policy objectives or in the regulations of the country (He, 2013).

2.7.2.4. Assessing climate change impacts on proposed projects and their environment

He (2013) called for the assessment of climate change impacts on new projects and identified three types of Climate change impacts that must be assessed in EIA. The three types identified by He (2013) are:

- Climate change impacts on the project;
- Impacts on the environment and the social conditions that the project operates in due to impacts on the project, and
- Direct impacts on the environment and the social conditions which may affect the project.

In the climate change context, He (2013) concludes by saying that the three listed above can be translated to be the assessment of vulnerability and adaptive capacity of that particular project. In support of the possibilities of projects being vulnerable, Odell *et al*. (2018) emphasise the need to have laws that allow the development of strategies that reduce the vulnerabilities of projects and increase the adaptive capacities of these projects. Through the introduction of Acts like the NEMA Act (Act No. 39 of 2004) that regulates the GHG emissions, the South African government is geared to reduce the impacts of projects such as coal mining on the climate (Aljareo, 2014).

2.7.2.5. Improving monitoring and follow-up mechanisms to provide new inputs

The practice of monitoring and carrying strict follow-ups on climate change mitigation strategies and adaptation measures is a significant process as it enables the new information gathered and the lessons learnt to be integrated into EIA procedures in order to improve the process of incorporating the climate change factors (He, 2013). As suggested by the OECD (2009), monitoring and follow-ups of the mitigation strategies are necessary steps as they allow the implementation of appropriate remedial actions. In the studies done by Chang and Wu (2013), lack of proper monitoring was cited as one of the possible barriers that exist when trying to effectively implement EIAs.

2.7.2.6. Inputting climate change factors within EIA steps

According to He (2013), the final response to climate change encompasses reduction of GHG emissions and adaptation. As a result, the incorporation of climate change in to the EIA process can be handled in the following two ways:

- Consideration of GHGs: where a new project has the potential to contribute to GHG emissions leading to climate change; and
- Consideration of impacts: where change in the climate may have negative effects on the proposed project or on other related aspects of the project.

Many international environmental institutions have developed frameworks that can be followed when incorporating climate change into the EIA process. According to He (2013), climate change can successfully be incorporated within the EIA steps as shown in the table below.

Table 4: Steps in the EIA process where climate change factors can be inserted (He, 2013)

EIA step	How climate change factors are incorporated
Screening	All climate change sensitive projects must undergo a rigorous screening process.
Scoping	All the impacts of climate change and climate change vulnerabilities should be singled out and be investigated during the scoping stage. Effective mitigation options and adaptation measures are put in place.
Analysis of Alternatives	All the different alternatives of pursuing the same goal in different climate change scenarios should be explicitly explored.
Preparation of EIA	Detailed assessments of the climate change impacts and impacts on climate change are carried out. Effective measures of mitigating the possible climate risks and the adaptations to potential climate change impacts must be put in place.
Decision making	The variables of climate change should be treated equally with all other important environmental factors.
Implementation	All the climate change mitigation strategies and adaptation options must be implemented.
Follow-up, monitoring and evaluation	All the impacts of climate change, their mitigation measures and the adaptation measures being implemented must be subjected to strict monitoring, thorough frequent assessments and evaluations.
Learning by doing	New information gained must be used to make decisions in the future by incorporating into the EIA process.

Source: He (2013)

2.7.3. Institute of Environmental Management and Assessment (IEMA) approach

The Institute of Environmental Management and Assessment (IEMA) is an independent international organisation of environmental and sustainability professionals (IEMA, 2020). According to IEMA (2020), the organisation's mission is to support individuals and organisations to set, recognise and achieve global sustainability standard practices. In 2015, the IEMA developed a climate change resilience and adaptation guide that can be used internationally in the development of new projects. The IEMA EIA Guide to climate change resilience and adaptation outlined an EIA process that was influenced by the 2014 European Union Directive for environmental management (IEMA, 2015). According to IEMA (2015), the European Union Directive of 2014 stated that an EIA must:

- Always make reference to all the aspects of climate change;
- Provide a detailed description of how the project's resilience to the possible effects of climate change was considered; and
- Explain explicitly how the climate change effects have been assessed.

According to IEMA (2015), during the screening process of the EIA, all regulations and policies on climate change must be considered and during the scoping stage all the climate change concerns must be identified. The climate change concerns to be considered should include the climate change projections that should be adopted for the project and the identification of all environmental receptors that are vulnerable to climate change (IEMA, 2015).

According to IEMA (2015), when undertaking the EIA, it is significant to define the baseline with changing climate. This should be achieved by considering how the climate change factors are likely to change in the future, looking at the time scale over which changes are projected to occur (IEMA, 2015). It can also be achieved by considering how the projected climate change effects can alter the present baseline conditions as well as identifying the thresholds beyond which the scale of change will likely alter the baseline (IEMA, 2015). When carrying out the EIA, all the possible alternatives must be considered by looking at how these may affect the climate and how the project will be resilient to climate change (IEMA, 2015). According to IEMA (2015), when carrying out the EIA, a complete analysis of the project's impacts without the influence of climate change, the cumulative impacts to climate change of an affected baseline, the climate change uncertainties, and whether the impacts of the project are worse, the same, less than without climate change must be done. In a study carried out by Woolsey (2012) in the USA, the document review showed that climate change considerations vary greatly from project to project. The document review by Woolsey (2012) showed that the emissions by projects are frequently considered but the impacts of climate change on the projects are considered far less. The review established that the resilience of the projects to the possible effects of climate change was not being considered.

As part of the EIA process, the development of effective mitigation and adaptation strategies should be done (IEMA, 2015). The EIA process should determine if the project requires adaptive environmental management or not, explicitly outline the mitigation and adaptation strategies that are required to make the project resilient to climate change, as well as clearly defining the monitoring that is required under the adaptive management regime (IEMA, 2015). During the decision making stage where the permission to develop will be granted or refused, the competent authority has to check if the EIA report has defined the implementation procedures of the mitigation strategies under adaptive management as well as checking how the resources for adaptive management are guaranteed (IEMA, 2015).

The EIA should include a clear climate change adaptation plan to be implemented when the project is operating (IEMA, 2015). According to IEMA (2015), the climate change adaptation plan should clearly spell out all the critical issues related to:

- Who will be monitoring and checking if the project owners are complying with the adaptive management strategies that were put in place;
- How the climate change effects on the project and environment will be monitored; and
- Who will be implementing the adaptive management process and how the effects are monitored.

2.7.4. International Association for Impact Assessment (IAIA) approach

The International Association for Impact Assessment (IAIA) is an organisation of professionals (researchers, practitioners and users of impact assessments) with diverse interests and organisations who are concerned with environmental stewardship and sustainability (IAIA, 2020). IAIA was established in 1980 and aims at protecting, not harming, the Earth, the environment and people (IAIA, 2020). The IAIA vision is to ensure best practice in the use of impact assessment and the organisation has a mission to provide best practice in all the forms of impact assessments (IAIA, 2020). IAIA developed their Best Practice Principles of considering climate change into the EIA system (Bayer *et al*., 2018).

The IAIA Best Practice Principles were first developed in 2010, then updated in 2018 (Byer *et al.,* 2018*).* Climate change is expressed by Byer *et al.* (2018) as a multifaceted development issue that brings about a lot of key challenges to global sustainability of ecosystems as well as human prosperity. The climate change impacts are often known to potentially worsen other environmental challenges and also cause a lot of threats and risks to humanity (Byer *et al.,* 2018*).* To address climate change, IAIA proposed Best Practice Principles that are supposed to be implemented by EIA practitioners (Byer *et al.,* 2018*).*
According to Byer *et al*. (2018), during the scoping stage of the EIA process, the EIPs should apply measures to determine the project's GHG emissions, how the project will be affected by climate change factors, identify the measures to mitigate climate change impacts and identify the adaptation options to climate change.

According to Byer *et al., (*2018*),* where the project will contribute to the GHG emissions, the EAPs should:

- Clearly identify and define all the country's relevant mitigation policies and objectives;
- Estimate the composition , the magnitude as well as the intensity of the expected net GHG emissions of the project, including its effects on the carbon sinks;
- Identify all the mitigation measures (designs and technologies), all the alternative measures to lower GHG emissions at all the phases for all elements; and
- Fully address all the cumulative impacts of the project.

Almost all projects are climate change sensitive and as a result they will be affected by and are vulnerable to the changing climate (Byer *et al.,* 2018*).* According to Byer *et al.* (2018), the IAIA best practice principles call for the inclusion of the following into the EIA process:

- The identification and the use of the adaptation objectives of the country's climate change policies into the EIA process (if they are not available, then the EAPs must define the adaptation objectives of the project);
- The EIA must clearly identify the baseline conditions that can potentially be affected by the project and how climate change can affect the baseline conditions as well as assessing the impacts against the changed baseline;
- A minimum of three climate change scenarios must be addressed and be evaluated as well;
- The extent to which the economic, social and natural systems related to the project are vulnerable to climate change must also be assessed; and
- The EIA must select and evaluate the possible ways that the project can be modified to lower the impacts of the expected changes in the climate.

It also essential for the EIA to consider the different vulnerabilities and adaptive capabilities that exist in the different societal groups where the project will be based (Byer *et al.,* 2018). According to Byer *et al.* (2018), the EIA report must be accompanied by a clear assessment of the interactions between mitigation and adaptation consequences and measures as well as their relationships with other social and environmental issues that should be addressed. Jain *et al.* (2017) reviewed electronic files to establish how the Federal Environmental Impact Statements address climate change in fossil fuel projects. The review clearly identified and defined the country's relevant fossil fuel mitigation policies and objectives. The review also identified the

mitigation measures and the alternative measures to lower GHG emissions at all the phases of the projects. The review established that 78% of the projects considered the impacts of climate change on their environment, while only 11% considered their impact climate change. The impacts of climate change were considered by 22%, 11% considered climate change on alternatives while the majority of the projects did not consider their adaptations to climate change (Jain *et al*., 2017).

The climate change EIA must make use of the latest comprehensive scientific information on the changing climate such as recent climate change projections (Byer *et al.,* 2018*)*. The EIA should address all the uncertainties by considering reasonable and possible future climate change information and scenarios. The precautionary principles of sustainable development should be the bases for making the decisions about whether the project should be accepted or rejected*.* The EIA should also identify the impacts of the management measures that will be put in place, including the adaptive management plan (Byer *et al.,* 2018*).*

2.7.5. Canadian Environmental Assessment Agency (CEAA) Approach

The Canadian Environmental Assessment Agency (CEAA) is responsible for implementing all Environmental Acts on behalf of the Canadian government (CEAA, 2020). The CEAA developed general guidelines for incorporating climate change considerations in EIA to be used by environmental practitioners (Agrawala *et al.,* 2012). The CEAA in 2009 pronounced that all EIAs should be carried out in the initial stages of the project plan and a climate change risk assessment should be included during scoping (Agrawala *et al*., 2012). According to Agrawala *et al*. (2012), the project proponents must do full assessments of all the climate factors and the relevant climate impacts of the proposed project. The CEAA (2009) identified four points in the EIA process that could be used to consider climate change impacts and adaptation (Agrawala *et al*., 2012). According to Agrawala *et al*. (2012), entry point number one of the CEAA comes in during climate change screening of the strategic phase. In this phase, the EAPs identify and justify the consideration of climate change risks of the project, identify how the proposed project can be sensitive to the change in climate, as well as identify impacts of the sensitivity of the project and their implications (Agrawala *et al*., 2012). Entry point number two is the scoping of climate change risk and adaptation options assessment during the concept phase of the project (Agrawala *et al*., 2012). According to Agrawala *et al*. (2012), during this stage EAPs must identify all the project elements and the climate variables that should be assessed; and also identify a relevant responsible authority to do the assessment.
According to Agrawala *et al*. (2012), entry point number three involves **c**onducting the climate risk (identification and assessment of relevant climate variables and elements) and defining the adaptation options and making decisions. When making the decisions about whether the project should be accepted or not, the competent authority must check if the risks and adaptation options were identified and assessed (Agrawala *et al*., 2012). According to Agrawala *et al*. (2012), entry point number four will be implementing the climate change adaptation measures. These measures must be implemented through EMP, CMP and OMP; and these must be closely monitored over time (Agrawala *et al.,* 2012).

The Canadian Government provides the guidelines on incorporation of climate change consideration through the Canadian Environmental Assessment Agency (CEAA, 2009). Table 5 below gives the CEAA (2009) guidance on incorporating climate change considerations.

Table 5: The CEAA Guidance on incorporating climate change factors into the EIA process

	Step	Guidance on incorporation climate change considerations into the EIA process
1	Preliminary scope for impact considerations	Attention must be given to general considerations and the data that are easily available. Attention must also be put on identification of climate impacts that will be addressed in greater detail.
2	Identification of impacts for considerations	Identification of the project's possible sensitivity to a changing climate. All the changing climate parameters must be clarified.
3	Assessment of impacts for consideration	A thorough assessment of a wide range of all the climate parameters that are likely to change must be done. A full determination of the extent of the climate change impacts on the project. All potential environmental and public risks caused by the effects of climate change on the project must be assessed. The EAPs must find out if there is need for impact management.
4	Management of impacts	The mitigation options to be used to minimise the vulnerability of the project must be fully clarified. The adaptive management plans to lower the risks that are associated with climate change must be fully clarified. The process must allow the incorporation of on-going information and risk assessments.
5	Follow-up, monitoring and adaptive management	Continuous monitoring of both the project and the effectiveness of the mitigation options being used must be implemented. If it is necessary, implementation of remedial actions must be exercised. The relevant authorities must incorporate all "lessons learnt" into normal EIA procedures.

Source: CEAA (2009)

During the scoping stage, the CEAA (2009) guidelines prioritise general considerations of climate change factors using readily accessible information as well as the identification of the climate impacts and the sensitivity of the project to possible changing climate parameters. The CEAA (2009) guidelines also put emphasis on determining the extent of possible climatic impacts on the project as well as assessment of the potential risks on the environment and on the public as a result of the effects caused by climate change on the project. Under the management of impacts, the CEAA (2009) guidelines call for the clarification of the mitigation plans that help to reduce the project's vulnerability as well as the clarification of the adaptive management measures to lower the risks that are linked to climate change. According to the CEAA (2009) guidelines, there is need to incorporate the on-going information and risk assessment and also monitoring the efficiency of the mitigation plans and implementing remedial actions where necessary.

Wentz *et al*. (2016) carried out a survey (from 2012-2014) of climate change considerations in the Federal Environmental Impact Statements in the mining sector. Most of the mines identified the climate impacts that were addressed in greater detail and also identified the projects' possible sensitivity to a changing climate (Wentz *et al.,* 2016). The survey established that 77% of the statements considered the impacts of GHGs on the climate while the same percentage considered the impact of climate change on the mining activities (Wentz *et al.,* 2016). According to Wentz et al. (2016), 77% of the mines considered the impacts of climate

change on the alternatives as well as the impacts of their activities on the climate. Only 31% of the mines considered their impacts on climate change during the construction phase (Wentz *et al.,* 2016).

2.7.6. The Caribbean Community (CARICOM) Approach

The Caribbean Community (CARICOM) was established in 1973 by the Caribbean countries to form a unified community through the promotion and sharing of cultural, social and economic prosperity (Agrawala *et al*., 2012). In 2004 the CARICOM region developed a comprehensive operational Guidance to be used by EAPs to incorporate climate change mitigation and adaptation options into the EIA process (Agrawala *et al*., 2012). The CARICOM Guidance that was developed identified important points on the EIA process for considering climate change factors (Agrawala *et al*., 2012). A preliminary vulnerability assessment should be done to identify all the significant climate change hazards to inform the EIA screening and scoping process (Agrawala *et al.,* 2012). The EAPs must use the already available data and knowledge from relevant experts to estimate the frequency and the probability of the hazardous meteorological events in the area. The EAPs should also include the severity of these impacts on the different components of the project itself as well as on its zone of influence. According to Agrawala *et al. (*2012), using the existing information, the initial screening stage must consider how the proposed project is likely to affect the environment and also how climate change impacts will affect the project. During the scoping stage, the EAPs should identify, analyse and include critical climate issues into the EIA report (Agrawala *et al*., 2012). The baseline climate information of the project site, climate change scenarios, important hazards, the potential adverse impacts on the project and the boundaries of the project must be identified by the EAPs. The CARICOM Guidance (2004) also enforces the use of relevant legislation and institutions of the country to guide the process of carrying out a climate change assessment that is comprehensive. A comprehensive climate change adaptation programme to address the climate change impacts should be put in place (Agrawala *et al.,* 2012).

2.7.7. The European Union (EU) Approach

The European Union Directive (2014/52/EU) focuses on improving the consistency and quality of EIA content (Hands and Hudson, 2016).) According to Hands and Hudson (2016), the EU Directive states the need to explore the impact of the project on the climate and vulnerability of the project to climate change, confirming the need to consider climate change at greater detail and specificity.

2.7.8. The Organisation for Economic Co-operation and Development (OECD) Approach

The OECD is an international organisation that works to build better policies for better lives (OECD, 2009). The OECD works with governments and policy makers to establish international best practise standards and finding solutions to social, economic and environmental challenges (OECD, 2009). According to Yi and Hacking (2012), the OECD endorsed the incorporation of climate change into the EIA process and encourages all its member states to formulate effective guidelines that blend climate change to their EIAs. The requirements that are put forward by different stakeholders for consolidating climate change into EIA processes in all kinds of projects, particularly coal mining, have the potential of bringing significant benefits to the whole world in a longer term (Agrawala *et al*., 2012).

2.7.9. Challenges for incorporating climate change into the EIA process

There are several theoretical difficulties that can arise in trying to integrate climate change within the EIA process. According to He (2013), scientific uncertainties of climate change, the difficulty in distinguishing climate change from climate variability, and the legal and institutional difficulties that are caused by the interactions between climate change and economic development are some of the core difficulties that arise in trying to incorporate climate change factors into the EIA process. In the South African context, even with the NEMA EIA Regulations (GNR.982) of December 2014 in place, the comprehensive incorporation of climate change factors into the EIA process is hindered by the lack of regulatory laws (Aljareo, 2014). When China rolled out its guidelines to incorporate climate change into their EIA process, He (2013) found met many challenges discussed below. According to He (2013), there were barriers that were caused by the EIA Design (the design lacked effective public institutional public participation and also missed the targets of the country's policies on climate change and also barriers in the implementation of the EIA process (implementation lacked strong leadership, lacked the political will, lacked sound judicial system, the powers of the environmental authorities were limited, the institutional frameworks were inefficient, and there was poor environmental management capacity. In addition to the findings by He in 2013, an assessment of the challenges faced when implementing the incorporation of climate change factors in the Chinese EIA process done by Chang and Wu (2013), also identified the following challenges:

- There were no exclusive laws and regulations on climate change;
- There were no applicable assessment standards and criteria;
- The implementers had no practical experience; and
- There was no common understanding by different the authorities who were involved in the process.

2.8. South African approaches

There is need to guide where and how mining takes place within a climate change context. Although best practices are generally not legal requirements, in the South African context, best practices to achieve sustainable development are framed in terms of the MPRDA and NEMA authorisations and management processes (DEA, 2017). As reviewed in sections 2.3, 2.4 and 2.5, South Africa has responded to climate change issues by introducing different policies, regulations and guidelines. The key climate change issues that must be considered by applicants for new coal mines are summarised below. According to the DEA (2017), the DMR regulations are:

- The new coal mine authorities must submit relevant environmental reports (scoping report, EIA report, specialist reports and EMP);
- The new coal mine authorities must do an Air Quality assessment that includes a comprehensive assessment of the broader GHG emissions and the mitigation strategies;
- Must include climate baseline information of the area where the new coal mine will be located;
- Must submit a pollution prevention plan;
- Must submit a monitoring, evaluation and reporting mechanisms for GHGs; and
- Must submit detailed information on ambient pollutants according to the National Framework for Air Quality Management.

As reviewed in section 2.4, the South African approaches are based on the Constitution of South Africa, the MPRDA (Act No. 28 of 2002), NEM: AQA (Act No. 39 of 2004), NEMA (Act No. 107 of 1998) and the NEMA EIA Regulations (GNR. 982) of December 2014. In a study carried out by Aljareo (2014) that reviewed the role of EIA at project-level in addressing climate change, it was outlined that the 2010 EIA regulations did not explicitly state climate change but climate change incorporation into the EIA process was implied in the NEMA, List Notice 2 of the 2010 regulations as well as in the NEM: AQA. Since 2014, DEA has introduced the Technical Guidelines for Monitoring, Reporting and Verification of GHG Emissions by Industry in 2017 that must be read with the National Greenhouse Gas Emission Reporting Regulations of 2017, the National Pollution Prevention Plan Regulations (GN 275 of 2017) and NEMA: EIA Guidelines (GG No. 41432) of February 2018. How these regulations and guidelines work as South African approaches to the incorporation of climate change issues into the EIA process has been discussed in section 2.4 of the report. According to the DMR official, DMR also recognises the outcome of the Thabametsi Court Ruling of 2017 which clearly stipulates how the climate change issues should be incorporated into the EIA.

2.9. Coal mining activities and their impacts on the climate

Coal mining has both positive and negative impacts on the environment and society. This section focuses on the negative impacts on the climate. Coal mining has many devastating direct, indirect, induced, and cumulative impacts on the climate. Although large amounts of GHG are emitted during the combustion of coal, the mining of coal also contributes significantly to climate change (Day *et al.,* 2010). According to Day *et al*. (2010), most of the GHG emissions from coal mining activities are as a result of fugitive methane. Fugitive emissions are as a result of methane leakages at various stages of the mining activities such as exploration and drilling (Cohen and Winkler, 2014). Methane and carbon dioxide are also released through the production of carbonaceous waste material that is subjected to low-temperature oxidation (Day *et al*., 2010). Coal mines operate heavy machines such as bulldozers and haul trucks which add emissions as they are powered by diesel (Day *et al*., 2010). Fuel oil mixtures and ammonium nitrate based explosives that add emissions into the atmosphere are often used in the mining sector (Day *et al*., 2010). According to Day *et al*. (2010), coal mines send waste material to landfills where it adds to the methane emissions. Mines increase their GHG foot print as a result of land clearing that is done mainly during the construction phase (Day *et al*., 2010). According to Cook and Lloyd (2012), GHGs intensify the enhanced greenhouse effect, leading to global warming which is responsible for triggering a wide range of changes in the atmosphere. The changes in the atmosphere include:

- Gradual increase in the global temperatures;
- Changes in long term precipitation patterns; and
- Increase in extreme weather events such as floods, droughts, hurricanes, heat-waves.

2.10. Impact of climate change on coal mining

Mining in general and in this case coal mining activities, can be affected by climate change in many different ways. Below is table 6 showing the potential negative on-site and off-site climate change impacts of climate change on mining activities according to Odell *et al*. (2018).

Table 6: Potential climate change impacts

Potential Climate Change Impacts on-site.	**Potential climate change impacts off-site.**
There will be some risks to the structural integrity of surface impoundments and site conditions from the effects of extreme weather conditions such as flooding, landslides, soil erosion and thawing permafrost in some locations.	Increase in water scarcity will reduce availability of critical climate–sensitive mine inputs such as water and energy, particularly in water-stressed regions.
There will be an overall increase in the health risks, economic impacts on local communities and environments.	The mines will be affected by absenteeism of the workers due to illness and reduced labour availability due to increased risk of heat stress, chronic diseases, health and social impacts from drought. A
Mines will experience a lot of on-site health and safety risks from the increased risk of extreme weather conditions such as floods and wildfires.	Climate change can lead to changes in the markets such as changes in the demand for metals and minerals.
In terms of operations there will be reduced efficiency, higher operation costs from higher temperatures, and reduced water quality and availability, particularly in areas where water resources are already under stress leading to complications in the production lines and processing activities. This can lead to redesigning of the mine and change in the technology in use.	The mines can face energy supply problems due to unreliable generation and transmission of power that may be caused by disruption by extreme climate events.
The mines will face reduced performance on water and waste impoundments due to changes in the hydrological conditions.	The supply chains for the mines can be affected due to the damage to transport infrastructure (road, rail, marine, air) from extreme events (such as flooding, tropical cyclones, droughts, landslides, sea level rise).
There will be need for EIAs that take future climate into account; long-term closure and reclamation plans should reflect the expected climate over the site lifetime.	The supply chains can also be affected as a result of disruptions or delays to transport routes from seasonal changes and extreme weather events. Mines will face potential damage to stockpiled ore/metals due to supply chain disruptions.
There will be an increase in the possibilities of creating new pollution pathways that will lead to the exacerbation of material management risks.	The supply chains for mines can be affected by changes in the periods over which remote locations are accessible by land or marine transportation modes.
The mine operations, closure and post-closure plans will be affected by increased weathering and potentially acid-generating rock due to the increases in temperature and precipitation.	

Source: Odell *et al*. (2018)

Chapter 3

3. Research Methodology

A research methodology is concerned with the steps used by a researcher to investigate the research question, including the logic behind the steps (Kumar, 2008). A research methodology is an organised way of solving problems being studied in the research (Kumar, 2008). According to Kumar (2008) the four types of methodologies of doing a research are quantitative research, qualitative research, mixed methods (pragmatic approach) and participatory approaches.

This research used the qualitative research method. The qualitative method (Ashley and Boyd, 2006) allows for the collection of non-numerical descriptive data. Three qualitative research methodologies (open-ended interviews, multiple-case study approach and a document review approach) were used to collect non-numerical descriptive data. A wide range of non-numerical descriptive data was collected. The descriptive data collected ranged from the legislative requirements and guidelines for the application of new coal mines in South Africa, the EIA process locally and internationally, incorporation of climate change into the EIA process locally and internationally, to international Best Practice Principles. The qualitative approach assisted in the interpretation of phenomena transpiring in the natural environment (Roudgarmi, 2011). The qualitative methodology that was used allowed inferences to be drawn easily (Kumar, 2008). According to Kumar (2008), open-ended interviews provide opportunities to obtain meaningful data as follow-up questions during the interviews allowed the collection of more information. Open-ended interviews are adaptable and also allow for flexibility, leading to an in-depth understanding (Kumar, 2008). Although a qualitative methodology brought the best results for this research, there were always possibilities of influencing the data collected by the researcher during the interviews (Ashley and Boyd, 2006). Findings from qualitative approaches cannot always be generalised (Kumar, 2008); as a result the outcome of this research cannot be a general representation of the status quo in the country.

3.1. Research Framework

The aim of the research was to find out how EAPs considered climate change factors in the EIAs for new coal mines. A qualitative approach was used in the reviewing of various documents. A multiple case study approach was used in this study as it allows the collection of unique data from the selected new coal mine (Ashley and Boyd, 2006). Five coal mines from the Mpumalanga province of South Africa were selected and used as case studies for this research. The multiple case studies allow an in depth description of each of the selected new coal mines (Ashley and Boyd, 2006). The choice of five new coal mines allowed the possibility of having an in-depth study as compared to selection of a large number of new mines. A nonprobability sampling (reliance on the available subjects/convenience sampling) method was used to select the five mines used in the study. The researcher approached more than 15 new coal mines in Mpumalanga and the first five to agree were selected for the research. Although this method was convenient to the researcher, convenience sampling does not allow control over the representatives of the sample (Babbie, 2011). According to Babbie (2011), convenience sampling has problems with generalisation of the data collected. In

this case the data collected from the five mines cannot be used as a general trend for all new coal mines in Mpumalanga and in South Africa at large.

The five selected coal mines ranged in size from 412 ha for the smallest to 35 000 ha for the largest, the mines have been operating between 1 year and 5 years. Two of the mines are underground mines, two mines operate open pits (open cast mining) and one has both underground and open pits. Three of the mines are locally owned (two owned by the same company) and one is co-owned (owned by a multinational company in conjunction with a local company) and one is owned by a multinational company. All the five mines produce thermal coal that is consumed at local power stations.

To answer research question one, a review of South African mining legislative documents was done. The documents reviewed included the MPRDA (Act No. 28 of 2002), NEMA (Act No. 107 of 1998), NEMA: AQA (Act No. 39 of 2004), NEMA EIA Regulations (GNR. 982) of December 2014, Technical Guidelines for Monitoring and Verification of GHG Emissions by Industries of 2017 that must be read with the National GHG Emission Reporting Regulations, the National Pollution Prevention Plans Regulations (GN 275 of 2017), the Thabametsi court ruling of 2017 and NEMA: EIA Guidelines (GG No. 41432) of February 2018. A thorough search of the climate change requirements needed to apply for a coal mining licence was done and a list of these climate change requirements was drafted.

In addition to this a search for keywords was done across all the sections of the above named regulations and guidelines. The keywords used were climate, climate change, climate vulnerability, climate change assessments, air pollution, GHG emissions, climate change regulations and climate change guidelines. The keywords that were selected provided enough to cover the research context as all the necessary regulations, guidelines and international best practice principles needed for the research were obtained. The sections with these words were listed and the full legal environmental requirements (the climate change requirements that the mines should comply with) containing these words were also given. Sections of the above named Acts with statements that could imply that climate change should be considered (such as GHG emissions, air pollution, specialist reports, natural extreme events, relevant environmental reports, country's environmental policies and plans) but not openly stating so, were also identified and listed. A comment of whether climate change was stated in the legislation as a requirement, not stated or implied was given for each legal environmental requirement that the mines are expected to comply with.

To answer research question two, a review of the documents for five selected new coal mines was done. The documents that were reviewed are listed below and also indicated in section 3.6 on table 7 and section 4.2 on table 9. Only coal mines in the Mpumalanga Province that submitted their applications after 2014 were considered. The applications done after 2014 were selected as they had to follow the new EIA regulations (EIA Regulations (GNR.982) of December 2014). The documents that were reviewed included EIA reports of the mines, climate change specialist assessment reports, Environmental Authorisations and Environmental Management Programme reports. Seven interviews were carried out, with one climate change expert, one DMR official, one sustainability manager of a mine and four Environmental Managers of

the respective mines were done. The interviewees were selected primarily on their experience of EIA, mining and climate change and their availability to be interviewed.

The document review and interviews were used to obtain information that describes the direct and indirect climate change considerations taken in the EIAs of the five mines. The IEMA (2015) and CEAA (2009) recommended principles of incorporating climate change factors into the EIA process (as given on table 3) were used as a bench mark to evaluate the climate change considerations by the EAPs. The CEAA principles were selected for use as they are generally accepted as sufficient for incorporating climate change factors into the EIA process at project level (Byer *et al*., 2012; YI and Hacking, 2011). From the descriptions, the similarities and differences were identified and tabulated for easier comparisons.

To answer question three, the results of question one and question two were compared with the international (China, IEMA, IAIA, IRMA, ICMM, EU, OECD, CEAA and CARICOM) best practice principles and guidelines. These were selected as they demonstrate the need for organisations to push beyond the usual legal compliance which is a common practice. They also have clear guidelines, standards and well pronounced codes of practice. A discussion on how and where the South African legislation and practice meet the international best practice and where there are differences was also done. Tables and colour codes (green, amber and red) were used to make the comparisons. The green colour code indicates where South African principles and guidelines are matching or doing better than the international best practice principles. The red colour code is used to indicate where the South African principles and guidelines are lagging behind, hence in need of improvement. The amber colour code is used where there is considerable progress towards meeting the international best practice principles within the South African EIA system. Table 7 shows a tabulated overview of the research process.

3.2. Data Collection Methods

The research used primary data sources and secondary data sources. Literature describing the incorporation of climate change into the EIA process was extensively reviewed and suitable relevant questions were developed. Open-ended questions were developed and were used in interviews to collect primary data from the climate change and mining expert, one DMR official; four mine environmental officers and one mine sustainability manager. A purposive sampling method was used to select the interviewees. The use of open-ended questions allowed the extraction of specific relevant information (Babbie, 2011). The in-depth qualitative interviews allowed the collection of primary data on how coal mines are incorporating climate change into the EIA process. Mine environmental officers were selected to be respondents as they are directly responsible for and oversee all environmental issues (mainly applications for all environmental authorisations and implementation of the EMPs) of the mines. Each interviewee was given the opportunity to answer the drafted questions as well as expanding on them. The interviews allowed the collection of valuable primary data and were also instrumental in collecting vital information through spontaneous conversations that occurred. Legislative documents were used to collect secondary data on the requirements for the application of new coal mining rights after 2014 when the new NEMA EIA Regulations (GNR.982) of December 2014 were introduced. The EIA reports and the EMP reports of the five selected new coal mines were also used to collect secondary data on how the EAPs incorporated climate change issues in the EIA

process. Some of the information was also collected on the internet. The information collected on the internet included how other nations, regions and organisations are incorporating climate change issues into their EIA process. Best Practice Principles from different organisations and regions were collected from the internet.

3.3. Data Analysis

As the interview questions contain open-ended questions, this generated different types of data which required different data analysis approaches (Babbie, 2011). Open ended questions (Babbie, 2011) provide mostly qualitative data and thematic analysis and coding were used to analyse this type of data. According to Babbie (2011), thematic analysis is used to analyse and report data patterns. For this particular research, the researcher arranged the data collected from the document review into themes according to the research questions and objectives. The data were grouped into three themes as per research questions; climate change legislative requirements for the application of a new mining right, ways of incorporating climate change factors into the EIA process and international Best Practice Principles. The researcher transcribed the interviews and reviewed them putting the data into the same three themes that answered the research questions. The qualitative data were collected and analysed simultaneously. Tables were mainly used to present data, making it easier to compare.

3.4. Ethical Considerations

The researcher applied for ethics approval from the University of Witwatersrand Human Research Ethics Committee (non-medical). After obtaining the ethical approval (Protocol No. HA1915, refer to Appendix 1), the researcher made sure that he obtained informed consent (Appendix 2) from the participants in a culturally appropriate way. This was done by explaining the purpose of the research (academic purposes) and what it intended to uncover (Appendix 3). The researcher also made it clear that participation was voluntary and participants were also allowed to withdraw at any point when they felt so. The results of the collected data were made available to the respective mines. Confidential information was kept in a laptop with a password and coded files that were securely locked up and it was not disclosed to anyone.

3.5. Limitations of the Study

The research used the non-probability sampling techniques. Non probabilistic sampling suffers from limited generalisability and there are a limited number of statistical analysis methods which can be used to analyse the data (Asthana and Braj, 2016). The study was focused on coal mining in Mpumalanga and as such conclusions can only be drawn for this sector and not for different commodities in different provinces. However, some of the findings maybe applicable.

The research relied on reports from the interviews. Spector (1994) states that answers to sensitive questions provided in reports are influenced greatly by social desirability. The data supplied depended on what the environmental officers were willing to share for various reasons. It is accepted that this bias cannot entirely be eliminated from a research (Spector, 1994). From the data obtained it is clear that some of the answers given by the interviewees do not correspond with the data on the EIA reports and the EMPs of the mines.

There is significant evidence arising, which shows that people's self-reports are also affected by issues such as attitude, cognitive processes, mood and personality (Spector, 1994). In one case the interview was done just after the mine had been closed by DMR due to non-compliance issues and also issues related to safety of workers. This may have compromised the quality of the answers that were obtained from the interview process. To reduce the limitation of over relying on self-reports, the research also used objective information that was obtained through the review of EIA reports of the selected new coal mines.

3.6. Tabulated Research Process

The research approach is summarised in table 7.

Table 7: Tabulated and overview of the research process

	Research question	Data	Analysis	Outcome
1	What are the legal requirements for the consideration of climate change in the application of new coal mines?	Reviewed legislations. MPRDA (Act No. 28 of 2002) NEMA (Act No. 107 of 1998) NEMA-EIA regulations (GNR. 982) of December 2014. NEMA-AQA (Act No. 39 of 2004). NEMA: EIA Guidelines (GG No. 41432) of February 2018. The Technical Guidelines for monitoring, reporting and verification of GHG emissions by industry. The National Greenhouse Gas Emission Reporting Regulations The National Pollution Prevention Plan Regulations (GN 712 of 2017) The Thabametsi Court Ruling of 2017	Search through the legislation to establish the requirements for mining applications that are directly and indirectly related to climate change.	Produce a list of the legal environmental requirements that a new coal mine must address in its application for a mining permit.
2	How is climate change considered in the EIAs for new coal mines?	Reviewed EIA reports of the selected new coal mines that were submitted after 2014 in Mpumalanga. (EIA reports, climate change specialist studies, EMP reports, Environmental Authorisations). Seven interviews were done, one DMR officials and four mine environmental officers, one sustainability manager and one with a climate change expert.	**Direct and indirect considerations** Identified whether climate change has been directly identified as an impact. Identified whether climate change has been identified as a risk to the mine or an impact from the mine. Finding out if climate change specialist studies/assessments were done. Identified the climate change mitigation measures included in the EMPs.	Descriptions of how climate change has been considered by the five mines. Identification of similarities and differences on the selected new coal mines.

	Research question	Data	Analysis	Outcome
3	How does coal mining climate change legislation and practice in South Africa compare to international best practice?	The results of research question 1 and 2. A review of International best practice principles and guidelines on coal mining and climate change (IRMA,IAIA, IEMA, EU, ICMM, OECD, CEAA, CARICOM, China)	Comparison of the results of research question 1 and 2 with the selected international best practice principles.	A discussion of how and where South African legislation and practice meet the international best practice principles and where there are differences.

Chapter 4

4. Research Findings

4.1. Legislative requirements for new mining applications

In order to mine in South Africa, a company needs to apply for a mining right in terms of the MPRDA (Act No. 28 of 2002) sections 22 and 23 (DEA, 2017). In addition to this, an application for environmental authorisation should be submitted. The environmental issues in the South African mining industry are controlled by regulatory/legal frameworks. The legislation and the sections that list the specific climate change requirements for the application for new mines are listed in table 8 below. For each of these, the specific legal requirements related to climate change that the mines should comply with are listed. The last column comments on whether climate change considerations were stated in the legislation, not stated or just implied as a requirement.

Table 8: List of the legislative documents reviewed and associated climate change legislative requirements

Legislation	Responsible Authority	Section of the Act	Legal environmental requirements that mines should comply with.	Comments on Climate Change Consideration
MPRDA (Act No. 28 of 2002)	DMR	Section (22)(4)(a)	Submission of relevant environmental reports as required by NEMA (Act No. 107 0f 1998) and NEMA: EIA Regulations (GNR.982) of December 2014.	Climate change is not stated the legislation
NEMA (Act No. 107 of 1998)	DEA	Section (24)(1)(b) Section (24)(1)(d) Section (24)(1)(e) Section (24)(1)(f) Section (26)(d)(4) Section (26)(11)(4)	Submission of a prescribed report (EIA). Submission of the EMP. Submission of an application for an environmental authorisation. Submission of a Specialist Report. Submit information on avoidance, management, mitigation, monitoring and reporting the impacts of the project. Submit the environmental impacts and their cumulative impacts.	Climate change is not stated in the legislation
NEMA: EIA Regulations (GNR.982) of December 2014	DEA	(23)(2)(a)	Submit a relevant environmental report (For mining activities in Listing Notices 1; the applicant submits 3 different reports, a Basic Assessment report, EMP and specialist reports.	**Climate change is implied in the legislation**

Legislation	Responsible Authority	Section of the Act	Legal environmental requirements that mines should comply with.	Comments on Climate Change Consideration
Implementation Guidelines for EIA Regulations (GNR.982) of 2014.		(23)(3)	For mining activities in Listing Notices 2, the applicant submits 4 different reports, a scoping report, EIA report, specialist reports and EMP). Specialist report on GHG emissions, mitigation strategies and monitoring strategies. An EIA report must include the information on appendix 3, 4, and 6. Appendix 3: 2(a). The EIA process must determine the county's policies and legislative context. (3)(h)(7). The EIA process must describe the negative of the project on the environment focusing on geographical aspects. Appendix 4: (1)(m)(2). The EIA process must deal with pollution (emission) risks. Appendix 6: Specialist reports (Climate change specialist report not mentioned).	
NEMA: EIA Guidelines (GG No. 41432, February 2018), National guideline on minimum information requirements for preparing EIAs for mining activities that require environmental authorisation.	DEA	(2)(2) (3)(3)(2) (4)(1)	The EIA process must take into account government policies and plans. The extraction methods must consider the physical environment (including climate). The EIA process should show environmental baselines investigations, must include predicted changes to the environment as a result of climate change. The EIA process must indicate where the baseline conditions may change due to extreme events caused by climate change. Appendix B: baseline climate information requirements. Appendix B provides the assessment criteria for determining the baseline environment and includes – climate and meteorology.	**Climate change is stated in the legislation**

Legislation	Responsible Authority	Section of the Act	Legal environmental requirements that mines should comply with.	Comments on Climate Change Consideration
		(5)(3)	The EIA process must include climate and meteorology information that include: Wind speeds and wind direction, rainfall, temperature (average, minimum, and maximum), and evaporation. The EIA process must include monitoring of GHG emissions.	
NEMA: Air Quality Act (Act No. 39 of 2004) National GHG emissions reporting regulations of 2015.	DEA	Section (7) (1).	Submission of GHG emissions and activity data to the competent authority.	**Climate change is implied in the legislation**
NEMA: Air Quality Act (Act No. 39 of 2004) Declaration of GHGs as priority air pollutants of 2014.	DEA	Section (29) (1) (3).	Submission of a pollution prevention plan, monitoring, and reporting.	**Climate change is implied in the legislation**
The Technical Guidelines for monitoring, reporting and verification of GHG emissions by industry of 2017.	DEA		Provides guidance to reporting companies on the methodologies to apply when quantifying GHG emissions from industrial activities listed on table 5.2 of the guidelines.	**Climate change is implied in the legislation**
The National Greenhouse Gas Emission Reporting Regulations of 2017	DEA	7(1)	Submit the GHG emissions and activity data as set out in the Technical Guidelines for monitoring, reporting and verification of GHG emissions by industry of 2017.	**Climate change is implied in the legislation**
The National Pollution Prevention Plan Regulations (GN 275 of 2017)	DEA	3(1)(b) 3(1)(c) 3(1)(d)	The description of the production processes as cited in Annexure A of the Regulations. GHGs generated from the production process listed in Annexure A of the Regulations. The total GHG emissions from the production process.	**Climate change is implied in the legislation**

Legislation	Responsible Authority	Section of the Act	Legal environmental requirements that mines should comply with.	Comments on Climate Change Consideration
		3(1)(e) 3(1)(f)	Details of the methodology to monitor annual GHG emissions. Description of the mitigation measures.	
Case Laws (Thabametsi Court Ruling, 2017)	High Court of South Africa		All new projects must submit a relevant environmental report that includes a climate change assessment report. All new projects must do an individual climate change assessment that includes a comprehensive assessment of the broader climate change impacts and how the project will make them worse. A climate change assessment of a new project must consider the extent to which the viability of the new project will be affected by the climate change impacts (climate-related risks). A new project must do a climate change assessment report that includes comprehensive descriptions of the broader climate change mitigation measures and adaptation plans.	Climate change is stated in the Case Law

As summarised on table 8, climate change issues in the South African legislation are not clearly stated but are implied in some of the regulations. Climate change issues are clearly stipulated in Case Laws with specific reference to the Thabametsi Court Ruling of 2017. Although the Legislative documents (MPRDA (Act No. 28 of 2002), NEMA (Act No. 107 of 1998), NEMA EIA Regulations (GNR.982) of December 2014, NEMA EIA Regulations (GG No. 41432) of February 2018 and the NEMA: AQA (Act No. 39 of 2004) clearly indicate that new projects should submit relevant environmental reports, they do not specifically mention climate change assessment reports as part of the assessments to be submitted. However, where climate change is identified as a significant impact, which should be the case in all coal mining projects, the EIA must include a climate change specialist study.

The requirements for climate change assessment reports are clearly cited in the Thabametsi Court Ruling of 2017. It compels all new projects to do a stand-alone climate change assessment that includes a comprehensive assessment of the broader climate change impacts and how the project may make them worse (Humby, 2018). The Thabametsi Court Ruling of 2017 also calls for the consideration of the extent to which the viability of the new project may be affected by the climate change impacts (climate-related risks) (Humby, 2018). Climate change factors are implied (indirectly considered) in the NEMA: AQA (Act No. 39 of 2004) through the Declaration of GHGs as priority air pollutants of 2014 and in the National GHG emissions reporting regulations of 2015. The requirements of these legislations are reflected in EIAs under the Air Quality section of the EIAs. According to Agrawala *et al*. (2012), there is need for the EIA process to consider climate change (impacts on the climate and project vulnerability) in detail. In summary, applications for new coal mines should include comprehensive stand-alone climate change assessments that are guided by legal legislation that enforce the South African climate change policies and plans.

4.2. Considerations of climate change by mines: document review

In order to establish how the five new coal mines incorporated climate change into their processes, a document review was done. The research looked at the EIA reports, climate change specialist reports, environmental authorisations and EMP reports of the mines. The review was mainly based on the regulations and guidelines that the EAPs of the mines followed, climate change related data, climate change specialist reports, climate change mitigation measures, climate change adaptation options and checking the entry points of climate change issue into the EIAs. The findings of the document review are presented on table 9 below to enable easier analysis and comparisons. An analysis of the climate change factors included was done using the recommended climate change incorporation principles for EIA (IEMA, 2015 and CEAA, 2009) as a bench mark as explained in the methodology section.

Table 9: Findings of the document review

	Mine A	Mine B	Mine C	Mine D	Mine E	Comments
	Owner 1. Locally owned. Large in size. Both open cast and underground mining	Owner 2. Locally owned. Large in size. Underground mining	Owner 2. Locally owned. Small in size. Open cast mining.	Owner 3 and 4. Local and multinational owners. Medium in size. Open cast mining.	Owner 5. Internationally owned. Large in size. Underground mining.	All the five mines produce thermal coal that is consumed at local power stations.
Year of application for mining right	2017	2015	2019	2016	2019	Three applications (A, B and D) were done after the NEMA EIA Regulations (GNR.982) of December 2014 and two (C and E) were done after the NEMA EIA Regulations
Mine documents reviewed	EIA and EMP reports Environmental authorisations	EIA and EMP reports Environmental authorisations	EIA and EMP reports Environmental authorisations	EIA and EMP reports Environmental authorisations	EIA and EMP reports Environmental authorisations	
Climate change specialist report	None	None	Present (not comprehensive)	None	Present (not comprehensive)	
Climate change terms used	Climate. GHG emissions	Climate. GHG emissions	Climate, climate change, GHG emissions, global warming.	Climate, climate change, GHG emissions, global warming.	Climate, climate change, GHG emissions, global warming.	All mines included the term GHG emissions
Recommended climate change incorporation principles for EIA (IEMA, 2015 and CEAA, 2003).						
Relevant policies and regulations cited. The EIA process must review all the GHG emission policies and regulations (national and international) and polices	MPRDA (Act. No. 28 of 2002) NEMA (Act No. 107 of 1998). NEMA Air Quality Act (Act No. 39 of 2004).	MPRDA (Act. No. 28 of 2002). NEMA (Act No. 107 of 1998). NEMA Air Quality Act (Act No. 39 of 2004).	MPRDA (Act. No. 28 of 2002). NEMA (Act No. 107 of 1998). NEMA: Air Quality Act (Act No. 39 of 2004).	MPRDA (Act. No. 28 of 2002). NEMA (Act No. 107) of 1998. NEMA Air Quality Act (Act No. 39 of 2004).	MPRDA (Act. No. 28 of 2002). NEMA (Act No. 107) of 1998. NEMA Air Quality Act (Act No. 39 of 2004).	All the five mines used all the relevant national policies, regulations and guidelines that were available by the time of application.

	Mine A	Mine B	Mine C	Mine D	Mine E	Comments
on the mitigation and adaptation of climate change.	NEMA EIA Regulations (GNR. 982) of December 2014.	NEMA EIA Regulations (GNR. 982) of December 2014.	NEMA EIA Regulations (GG. 41432) of February 2018. The Technical Guidelines for monitoring, reporting and verification of GHG emissions by industry of 2017. The National Greenhouse Gas Emission Reporting Regulations of 2017 The National Pollution Prevention Plan Regulations (GN 712 of 2017)	NEMA EIA Regulations (GNR. 982) of December 2014.	NEMA EIA Regulations (GG. 41432) of December 2014. The Technical Guidelines for monitoring, reporting and verification of GHG emissions by industry of 2017. The National Greenhouse Gas Emission Reporting Regulations of 2017 The National Pollution Prevention Plan Regulations (GN 275 of 2017)	No mine mentioned any international commitment protocol. The two mines (C and E) established after 2017 did not cite the recommendations by the Thabametsi Court Ruling of 2017
Stand- alone climate change section. The EAPs must develop comprehensive climate change specific objectives.	None	None	Present (not comprehensive)	None	Present (not comprehensive)	Two EIA report s (mine C and mine E) had stand-alone climate change sections. Although present, the sections had no comprehensive climate change objectives. The climate change specific objectives are not a requirement for NEMA EIA Regulations.
Climate baseline data (Which ones? To what extent?)	Given Rainfall statistics.	Given Rainfall statistics.	Given Rainfall statistics.	Given Rainfall statistics.	Given Rainfall statistics.	All the EIA reports included full baseline information on climate.

	Mine A	Mine B	Mine C	Mine D	Mine E	Comments
The EIA process must take into account the current climatic conditions and the projected climate change scenarios during the development of the climate change baseline.	Temperature statistics. Regional wind systems. Wind speed Wind direction.	Temperature statistics. Regional wind systems. Wind speed. Wind direction.	Temperature statistics. Regional wind systems. Wind speed. Wind direction. Extreme weather conditions.	Temperature statistics. Regional wind systems. Wind speed. Wind direction. Humidity. Pressure.	Temperature statistics. Regional wind systems. Wind speed. Wind direction. Extreme weather conditions given.	Projected climate change scenarios during the development of the climate change baseline were not given.
The relationship between the main project (features and their sizes) and the incorporation of climate change in the EIA process.	Not included	Not included	Not included	Not included	Not included	Not a requirement for NEMA EIA Regulations (GNR.982) of December 2014
Climate change impacts of the project (identified?) The EIA must identify all the current GHG emissions baseline and projected changes in the GHG emissions.	GHG emissions were identified	GHG emissions were identified	GHG emissions were identified	GHG emissions were identified	GHG emissions were identified	The EIA reports identified GHG emissions. Projected changes in the GHG emissions were not identified.
Climate change impacts on the project (identified or not identified?) The EAPs must identify all the potential impacts of climate change on the project and the risks to ecological systems and societies in the area.	Not identified	Not identified	Not identified	Not identified	General climate change impacts for mining activities were given	The EIA report for mine E identified general climate change impacts. Not a requirement for NEMA EIA Regulations (GNR.982) of December 2014

	Mine A	Mine B	Mine C	Mine D	Mine E	Comments
Were climate change impacts and local vulnerability issues analysed? The EIA must assess all the effects of the project, including emissions and embodied during construction and operation.	Not identified	Not identified	Not identified	Not identified	Not identified	Not a requirement of the two sets of the NEMA EIA Regulations of 2014.
Were climate change impact cumulative effects addressed? The EAPs must identify all the cumulative effects that are associated with climate change.	Not addressed	Not addressed	Not addressed	Not addressed	Not addressed	Only cumulative impacts of GHG emissions were addressed in the reports.
Statistical analysis of climate related data (Was it given? To what extent?)	Not given	Not given	Not given	Not given	Given for baseline information.	Not a requirement for NEMA EIA Regulations of 2014.
Greenhouse gas emissions. (Were direct and indirect GHG emissions included?	Direct GHG emissions were included	Direct GHG emissions were included	Direct GHG emissions were included	Direct GHG emissions were included	Direct GHG emissions were included	All EIAs identified the GHG gasses that are emitted under the Air Quality section.
Uncertainties of measuring GHGs	Not included	Not included	Not included	Not included	Not included	None of the 5 mines included the uncertainties of measuring GHGs. Regulations.

	Mine A	**Mine B**	**Mine C**	**Mine D**	**Mine E**	**Comments**
Emission sinks The EIA must assess all the direct and indirect GHG emissions as well as their effects on emission sinks.	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned	None of the EIAs mentioned the positive role played by emission sinks or the impacts on emission sinks.
Positive effects of green-space of climate change mitigation	Not included	Not included	Not included	Not included	Not included	None of the five EIAs included the positive role the green-space of climate change.
Positive contribution by the mines to the base GHG emissions.	None	None	None	None	None	None of the EIAs included any positive contribution they can do to the base emissions.
Information on air quality assessment. (Included? Which one? To what extend?)	Included. Specialist report on air quality present. Comprehensive information given. Cumulative impacts given. Negative impacts identified. Mitigation strategies were given. Monitoring explained fully. Cumulative impacts were included.	Included. Specialist report on air quality present. Comprehensive information given. Cumulative impacts given. Negative impacts identified. Mitigation strategies were given. Monitoring explained fully. Cumulative impacts were included.	Included. Specialist report on air quality present. Comprehensive information given. Cumulative impacts given. Negative impacts identified. Mitigation strategies were given. Monitoring explained fully. Cumulative impacts were included.	Included. Specialist report on air quality present. Comprehensive information given. Cumulative impacts given. Negative impacts identified. Mitigation strategies were given. Monitoring explained fully. Cumulative impacts were included.	Included. Specialist report on air quality present. Comprehensive information given. Cumulative impacts given. Negative impacts identified. Mitigation strategies were given. Monitoring explained fully. Cumulative impacts were included.	All the EIAs fully covered baseline information on air quality. It is a requirement for NEMA EIA Regulations 2014. Requirements for the NEMA Air Quality Act (Act No. 39 of 2004).

	Mine A	Mine B	Mine C	Mine D	Mine E	Comments
The EAPs must find and include all the opportunities that can be used to facilitate the inclusion of effective mitigation and adaptation options into the design of the project.	No specific climate change mitigation and adaptation options into the design were included	No specific climate change mitigation and adaptation options into the design were included	No specific climate change mitigation and adaptation options into the design were included	No specific climate change mitigation and adaptation options into the design were included	No specific climate change mitigation and adaptation options into the design were included	Only specific GHG emissions mitigation options were included by the EAPs.
Follow-up plans for monitoring and evaluation of GHG emissions. Included? Which ones? The EIA process must include effective monitoring and strict follow-up strategies in the context of climate change.	Included.	Included	Included	Included	Included	All the five EIAs included monitoring plans and evaluation of GHG emissions under air quality using the IPCC Guidelines for National GHG Inventories of 2006 to meet the UNFCC policies.

Table 10: Summary of key findings of the document review

Mine	Was climate change comprehensively considered?	Was the baseline climate considered?	Were the impacts of the mines on the climate directly considered?	Were the impacts of climate change on the mines considered?	Were adaptations of the mines to climate change given?	Were the GHG emissions of the mines given?
A	No	Yes	No	No	No	Yes
B	No	Yes	No	No	No	Yes
C	No	Yes	No	No	No	Yes
D	No	Yes	No	No	No	Yes
E	No	Yes	No	No	No	Yes

Three of the applications that were reviewed were made after the introduction of the NEMA EIA Regulations (GNR. 982) of December 2014 and two were made after the NEMA EIA Regulations (GG No. 41432) of February 2018. The five applications used all the relevant policies and regulations (MPRDA (Act. No. 28 of 2002), NEMA (Act No. 107 of 1998), NEMA: Air Quality Act (Act No. 39 of 2004). The NEMA: EIA Regulations (GNR. 982) of December 2014 were vital to the research as they indirectly imply the incorporation of climate change factors into the EIA process. The NEMA EIA Guidelines (GG No. 41432) of February 2018 used by the applications done in 2019 to some extent mentioned climate change. None of the five EIA reports included the climate change specific objectives. Although not comprehensively covered, two EIA reports had stand-alone sections for climate change. The climate change sections mainly covered the baseline climate conditions in areas where the mines are situated such as rainfall and temperature statistics, regional wind systems, wind speed and direction, extreme weather conditions. All the five mines had comprehensive climate baseline information under the air quality section. The review showed that all the mines included the issue of GHG emissions in their reports, identifying all the GHGs emitted during the construction and operational stages of the mine life cycle. The five EIA reports did not acknowledge the uncertainties in measuring the GHGs emitted. Two EIA reports had stand-alone sections for climate change and one of the two had a climate change specialist report which only dealt with climate baseline data comprehensively. This was as a result of the use of the NEMA EIA Guidelines (GG No. 41432) of February 2018 which state this requirement clearly.

None of the five mines stipulated the impacts of their activities on the climate. According to one interviewee, mining does not contribute much to climate change which is contrary to the literature. According to Day *et al*. (2009) and Cohen and Winkler (2013), mining activities contribute a lot of GHGs into the atmosphere. None of the five mines included climate change adaptation strategies and none of the five reports included the relationship between the main coal mining project (features and size) and the incorporation of climate change in the EIA process. Only one EIA report identified the general climate change impacts on coal mining. None of the EIA reports addressed climate change cumulative effects. Most of the climate change issues were not addressed during the EIA process mainly because they are not included in the NEMA EIA Regulations as echoed by all the mine environmental officers.

All five reports mentioned the issue of GHG emissions and comprehensively gave the mitigation strategies but did not link the GHG emissions to climate change. The five EIA reports did not give any statistical analysis of climate change related data and they did not consider the role played by emission sinks as well as the positive effects of green-space mitigation mentioned any positive contribution to the baseline GHG emissions. All the follow-up plans (monitoring and evaluation) on GHG emissions in the five EIA reports were comprehensively covered under the Air Quality section, hence indirectly covering climate change.

As expressed by one of the interviewees, the South African EIA system comprehensively deals with GHG emissions, mitigation options and monitoring under the Air Quality section, hence sections of climate change issues, especially GHG emissions, are somehow covered. This is mainly as a result of South Africa keeping abreast with Global agreements such as the Paris Agreement. Mine E, seems to be marginally better than the other four mines. Though not comprehensive, the EIA report for mine E had a climate change specialist report. This could be attributed by the fact that it is owned by a multinational company that is likely to be reporting their activities internationally. It can also be attributed to the use of the NEMA EIA Regulations (GG No. 41432) of February 2018 that have sections that clearly spell out certain aspects of climate change to be included, such as using extraction methods that consider climate change and baseline investigations that indicate and emphasise where the baseline conditions may change due to extreme natural events (DEA, 2018b). On table 10 for mine E, it is indicated that climate change was not comprehensively covered as the report had limited information on climate change consideration. Mine C seem to lag behind although the application was done after the 2018 NEMA EIA Regulations.

4.3. Interviews

Literature describing the incorporation of climate change into the EIA process was extensively reviewed and suitable relevant questions were developed. To obtain primary data, interviews were carried out with one DMR official, one climate change expert, one sustainability manager and four environmental officers of the mines. The interviews proved to be resourceful as the interviewees expressed their thoughts broadly covering the subject matter at hand including collecting more relevant information through spontaneous conversations that occurred.

4.3.1. Interview findings with the DMR official

Two interviews were carried out with one of the senior officials at DMR who is in charge of mines and the environment with many years of experience with the department. Two interview sessions had to be done as the first interview session was ended prematurely due to work commitments. The DMR official interviewed acknowledged that the department has legislations that govern climate change issues for coal mines. The official clarified that as much as most of the legislation used does not state the term climate change; they do cover possible impacts of coal mining on the climate. The DMR uses the following pieces of legislation to govern applications of new coal mines:

- The Constitution of South Africa;
- The MPRDA (Act No. 28 of 2002);
- NEMA (Act No. 107 of 1998);
- NEMA EIA Regulations (GNR. 982) of December 2014;
- NEMA EIA Guidelines (GG No. 41432) of February 2018;
- NEMA: AQA (Act No. 39 of 2004);
- The Technical Guidelines for monitoring, reporting and verification of GHG emissions by industry;
- The National Greenhouse Gas Emission Reporting Regulations;
- The National Pollution Prevention Plan Regulations (GN 275 of 2017) and
- Case/Common Law (Thabametsi Court Ruling of 2017).

Case laws or common laws are determined by the courts of South Africa after the judges consider and interpret the country's legislation. They set precedents to similar future cases until they are challenged in the courts of law. According to the DMR official, case laws are binding and are recognised by the country's Constitution as they have the same strength with legislation that is passed in the parliament until they are challenged. This is so with the Thabametsi Court Ruling of 2017. Although the Thabametsi Court Ruling was not related to coal mining, any such case in the mining sector is treated in the same way. According to the DMR official, the Thabametsi Court Ruling is being enforced on project based climate change assessments. The official emphasised that the DMR is empowered to use Case Law in its operations. To that effect, since 2017 climate change factors should be considered for the applications of all new coal mines, although there is no mandate to do so within the NEMA Regulations (not yet incorporated into law).

According to the DMR official, the new coal mine developers must submit a relevant environmental report that includes a climate change assessment report. They must do an individual climate change assessment that includes assessing broader climate change impacts and how the mine will make them worse. The climate change assessment report must contain the climate variables, the climate baseline and information on future climate scenarios of the area where the new coal mine will be located. The assessment should also consider how the new coal mine will be affected by the climate change impacts (climate-related risks). Although this is not on NEMA: EIA Regulations (GNR.982) of December 2014 and the NEMA EIA Regulations (GG No. 41432) of February 2018, DMR uses the Thabametsi Court Ruling to enforce it. The climate change assessment report must include comprehensive descriptions of the broader climate change

mitigation measures and adaptation plans. The DMR official also mentioned that the consideration of climate change issues is still a big ask as it is not yet put into law and some issues like pollution prevention are not under their jurisdiction but under DMR.

4.3.2. Interview findings with the climate change expert

The interview with the climate change expert established that coal mines are not major contributors to climate change as the process of coal mining does not generate a lot of pollutants and the production machines that use fossil fuels have a very low carbon footprint. The interview also established that the current legislation and guidelines on coal mining in South Africa do cover climate change issues although they are not explicitly stated. According to the interviewee, the South African EIA process does not quantify climate change but the EIA process already covers enough aspects on GHG emissions that are the contributing factors to climate change.

4.3.3. Interview findings with mine environmental officers

Interviews to find out how the EAPs of the selected mines incorporated climate change into the EIA process were done with four environmental officers of the respective mines and one sustainability manager. Environmental officers were selected as respondents as they are the ones who deal with environmental issues on at mines. Table 11 bellow shows the results of the interviews.

Table 11: Interview findings for mine environmental workers

Question	Mine A	Mine B	Mine C	Mine D	Mine E	COMMENTS
7. Was climate change considered in the application?	Climate change was not considered.	Climate change was not considered.	Climate change was not considered.	Climate change was not considered.	Climate change was partially considered.	Only one mine partially considered climate change.
8. Was a climate change assessment done?	Climate change assessment was not done.	Climate change assessment was not done.	Climate change assessment was not done.	Climate change assessment was not done.	Climate change assessment was partially done.	Only one mine did a partial climate change assessment.
9. Were the impacts of the mine activities on the climate directly considered and were the impacts of climate change on the mine considered?	The impacts of the mine on the climate were not directly considered. The impacts of climate change on the mine were not considered.	The impacts of the mine on the climate were not directly considered. The impacts of climate change on the mine were not considered.	The impacts of the mine on the climate were not directly considered. The impacts of climate change on the mine were not considered.	The impacts of the mine on the climate were not directly considered. The impacts of mining on the mine were not considered.	The impacts of the mine on the climate were not directly considered. Some general impacts of climate change on mining were given.	The impacts of the mine on the mine activities were indirectly considered in form of GHG emission mitigation strategies.
10. Did climate change projections and scenarios influenced the design of the mine? How? Can you give examples?	Climate change projections and scenarios did not influence the design of the mine.	Climate change projections and scenarios did not influence the design of the mine.	Climate change and scenarios did not influence the design of the mine.	The climatic projections the structuring and placing of the mine infrastructures. Wind direction determined the dust sampling positions. Surface structures were built	Climate change projections and scenarios did not influence the design of the mine.	Only one mine included climate change projections and scenarios in the mine design.

Question	Mine A	Mine B	Mine C	Mine D	Mine E	COMMENTS
				facing directions less prone to wind. Containment dams in positions whereby in case of adverse weather conditions, pollutants will flow into pollution control dams		
11. Does the mine have climate change mitigation strategies in place?	The mine does not have climate change mitigation strategies.	The mine does not have climate change mitigation strategies	The mine does not have climate change mitigation strategies	The mine does not have climate change mitigation strategies.	The mine does not have climate change mitigation strategies.	None of the mines has climate change mitigation strategies in place.
12. Do you think a climate assessment is/would be useful for a new coal mine? What should this cover? Should this be a requirement of legislation?	Yes Climate change assessments will be useful and they should be a legislative requirement. All climate change factors must be covered.	Yes Climate change assessments will be useful and they should be a legislative requirement. Weather predictions should be considered in the modelling and environmental specialist reports.	Yes Climate change assessments will be useful and they should be a legislative requirement. They must cover all weather elements, how they can be impacted and also how mines can be affected.	NO Climate change assessments will not be useful must not be included in the regulations. Climate change projections are not accurate as they are just predictions. Climate change assessments waste money and resources delaying the development of projects. To be useful they should be a pre-requisite for all applications	Yes Climate change assessments will be useful and they should be a legislative requirement. The assessment must cover both the coal mining impacts on the climate and the climate change impacts on coal mining.	All interviewees except one noted the importance of climate change assessments and their regularisation into law.

Question	Mine A	Mine B	Mine C	Mine D	Mine E	COMMENTS
				meaning a complete change of the EIA process. National standards have to be revised to suit all topographical differences. All government departments and all stakeholders have to be co-ordinated making it more complicated.		

All the interviewees displayed diverse valuable information about climate change issues. All the interviewees described the cause of climate change as anthropogenic emission of GHGs with four giving the impacts of coal mining on climate. Only one interviewee explained how climate change can impact the mining sector. From the review of NEMA: EIA Regulations (GNR.982) of December 2014, there is evidence that more emphasis is on GHG emissions and the associated possible mitigation options with less or nothing on the climate change impacts on the mines. All the interviewees acknowledged that climate change assessments were not directly considered during the application process. Nevertheless, baseline information on the climate was comprehensively covered as per the NEMA: EIA Regulations (GNR. 982) of December 2014 combined with the NEMA: AQA (Act No. 39 of 2004). This was also echoed by the climate change and mining expert who reiterated that in the South African EIA process, climate change was not quantified but the EIA process already covers enough aspects (GHG emissions) to do with climate change contributing factors. The five interviewees confirmed that the EIAs of the mines did not consider how climate change can affect the mining activities. They all pointed out that this was not a regulatory environmental requirement when the applications were made. The international best practice principles of incorporating climate change into the EIA process emphasise the need to include climate change projections and scenarios into the design of the mine (Agrawala *et al*., 2012). Only one interviewee cited that climate change projections and scenarios were included in the design of the mine, although a stand-alone climate change assessment was not done. The issues cited included infrastructural designs to suit the need to mitigate monitor and evaluate GHG emissions during the operation phase of the mine life cycle. Four interviewees acknowledged that climate change projections and scenarios were not included in the designing of the mines with one citing that ventilation systems would remain the same even if climate change is to be considered. The mitigation options being implemented in the mines are based on the NEMA: AQA (Act No. 39 of 2004) guidelines that are also guided by the IPCC Guidelines for national GHG inventories. The NEMA: AQA (Act No. 39 of 2004) enforces the submission of a pollution prevention plan for approval as well as monitoring, evaluating and reporting. One interviewee expressed that the mine has started implementing climate change mitigation strategies during the operational phase, citing the need for the mine to reduce costs, mainly those related to mine closure.

4.4. International guidelines, standards and recommendations on consideration of climate change in coal mining EIAs

According to Byer *et al. (*2018), best practice principles are developed by industrial bodies, government agencies, financial institutions and organisations in the business themselves. Below is table 12 giving a list of some of the organisations that developed Best Practice Principles that can be used in the incorporation of climate impacts into the EIA process.

Table 12: List of international best practice principles

Year of the document	Title of the document	Institution
2003	Incorporating climate change considerations in EIA: General Guidance for Practitioners.	CEAA
2004	Guide to the integration of climate change adaptation into the EIA process.	CARICOM
2009	Policy Guidance on integrating adaptation in development co-operation.	OECD
2013	Integrating Climate Change Factors within China's EIA Legislation: New Challenges and Developments	China He (2013)
2014	The European Union Directive (2014/52/EU).	EU
2015	IEMA EIA Guide to climate resilience and adaptation.	IEMA
2018	Climate change impact assessment	IAIA

Key Findings

After reviewing all the best practice principles by the above stated organisations (table 12), a summary of the key best practice principles is given below. A climate change orientated EIA process must:

- Review all the relevant policies (local and international) as well as relevant regulations for GHG emissions, mitigation of climate change and adaptation;
- Develop comprehensive and clear climate change objectives;
- Consider the current climate of the area and the projected climate change scenarios when developing climate change baseline;
- Identify all the current baseline and the future possible changes in GHG emissions;
- Do a comprehensive assessment of the cumulative effects of the project;
- Do a comprehensive assessment of direct and indirect GHG emissions and the effects on emission sinks;
- Indicate all the possible impacts of climate change on the project as well as all the risks to the society;
- Establish all the possible cumulative effects that are associated with climate change;
- Make use of all the opportunities to make sure that there is blending of mitigation options and adaptation measures in the designing of the project; and
- Include effective follow-up plans and monitoring initiatives in the context of a changing climate.

All the best practice principles reviewed had most of the summarised points above included although the IAIA and IEMA gave more comprehensive information that can be applied globally. They also included step by step ways of entering climate change factors into the EIA process.

4.5. Comparison of International Best Practice Principles and the South African Practice

As illustrated on table 13 below, coded green are some of South Africa's legislation and practice that align with some of the international best practice. In amber are the areas that are implied in the policies, regulations and guidelines. In red are the areas that are not covered by the policies, regulations and guidelines that were reviewed.

Table 13: Comparison between international best practice reviewed and local practice as obtained from the legislation and guidelines, a review of EIAs and EMPs for mine applications and interviews.

	International Best Practice Principles, with reference to the source document	**Local practice (South African context)**	Colour code
1	All the climate change regulations on climate change are considered (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	The DMR (competent authority) ensures that all the applications meet all the requirements with regard to the regulations governing climate change through various authorisations.	GREEN
2	The country's policies on climate change in conjunction with International policies must be used to govern the EIA process (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	The DMR and the DEA make use of the country's policies that blend with international policies on climate change to govern the process of conducting EIAs.	GREEN
3	Identification of climate change concerns. Submission of a comprehensive Air Quality assessment on GHG emissions using the IPCC Guidelines for National GHG Inventory and the UNFCCC legislations and policies (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	Identification of climate change concerns. Submission of a comprehensive Air Quality assessment on GHG emissions using the IPCC Guidelines for National GHG Inventory and the UNFCCC legislations and policies;	GREEN
4	The baseline climate information must be given (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	Defining the baseline climate information. The NEMA EIA Regulations (GNR.982) of December 2014 and the NEMA EIA Regulations (GG No. 41432) of February 2018 enforce the provision of the description of climate baseline information in the EIA report	GREEN
5	The inclusion of monitoring and follow-up plans for GHG emissions (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	The EIA process includes monitoring and follow-up plans of GHG emissions. Project developers submit a comprehensive pollution prevention plan for GHG emissions that is closely monitored during regular submissions done through NAEIS.	GREEN
6	Climate change assessments have stand-alone assessments in the EIA process. Air quality and climate change treated separately (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	No stand-alone section on the assessment of climate change in the EIA process. Climate change issues dealt with under air quality section.	AMBER

	International Best Practice Principles, with reference to the source document	**Local practice (South African context)**	Colour code
7	All local and international climate change policies are considered (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	Although the South African system considers most polices, there are still gaps in the consideration of other policies such as some section of the White Paper of 2011 (no comprehensive guidelines of incorporating climate change into the EIA process).	AMBER
8	Climate change issues are directly given in climate change assessment regulations (IAIA, CEEA, IEMA, CARICOM and OECD).	Climate change issues are implied in various environmental regulations such as the atmospheric pollution regulations and air quality regulations.	AMBER
9	All climate change issues are comprehensively covered (IAIA, CEEA, IEMA, CARICOM and OECD).	The implied climate change issues are less comprehensive. Baseline climate change information is the only section that is comprehensively covered.	AMBER
10	Emphasis is on both mitigation options and adaptation options as concentration is on both impacts of coal mining on the climate as well as the effects of climate change on the mining sector (He, IAIA, CEEA, IEMA, CARICOM and OECD).	More emphasis is on mitigation strategies as concentration is on how mining can affect the climate and nothing or less on how changes in the climate can affect mining	AMBER
11	All possible entry points are explicitly stated (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	Entry points for climate change not explicitly stated	RED
12	Climate change incorporation into EIA processes is enforced by law (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	Climate change incorporation has not yet been put into law.	RED
13	All environmental receptors vulnerable to climate change are identified (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	No identification of all the environmental receptors that are susceptible to climate change.	RED
14	Climate change projections that should be adopted by the project are considered. (IAIA, CEEA, IEMA, CARICOM, OECD and EU)	No considerations of climate change projections are done.	RED
15	Inclusion of the possible changes in the climate. (IAIA, CEEA, IEMA, CARICOM, OECD)	No considerations of how climate change factors are likely to change.	RED
16	Considerations of the project's resilience to climate change are done (IAIA, CEEA, IEMA, CARICOM, and OECD).	No considerations of how projects will be resilient to climate change are done.	RED
17	The EIA gives a description of the monitoring and evaluation process for climate change impacts (He, IAIA, CEEA, IEMA, CARICOM, OECD and EU).	An outline of the monitoring and evaluation process for the impacts of climate change is not given in the EIA process.	RED

Chapter 5

5. Discussion

This research reviewed the current approaches of assimilating climate change issues into the South African EIA process in the mining sector with specific reference to coal mines in the Mpumalanga Province.

5.1. Climate change policies in South Africa

The South African government has strong plans for an efficient and effective response to climate change and a long term transformation to an economy that releases less carbon and a society that is resilient to the changing climate (DEA, 2011). The government introduced policies that called for an effective response requiring practical interventions that blend mitigation and adaptation elements within a sustainable developmental framework (DEA, 2011). One such policy was the White Paper that called for sustainable development that reflects climate change resilience (DEA, 2011). The White Paper clearly outlined the importance of mitigation measures that complement the global efforts of reducing the GHG emissions and supporting the Sustainable Development pathway in the country. The set of mitigation measures of the White Paper demonstrated the need to consolidate factors of climate change and assessment at project-level as well as the need to have legal requirements that will regulate the fusion of climate change assessments in the EIA system (DEA, 2011). Many countries have developed climate change policies and plans that are more often linked to international protocols and agreements such as the Kyoto Protocol and the Paris Agreement. South Africa as a signatory of such agreements has developed climate change policies (as indicated in table 1) that have clear objectives and what is needed is to transform these objectives into binding regulations through the DMR and DEFF.

5.2. The EIA process

The EIA is an important regulatory tool that can be used to manage all new developmental projects that are deemed to have negative impacts on the environment (DEA, 2017). According to DEA (2017), the EIA process is considered to be actively promoting and ensuring sustainable development in the country. The EIA process that is stipulated in the NEMA: EIA Regulations of 2014 and 2018 is intended to enforce Chapter 5 of the National Environmental Management Act (DEA, 2017). The regulations provide and clarify all the activities that cannot be carried out without getting an environmental authorisation and also stipulate the processes and the reports that should be submitted to the relevant Competent Authority that will assess the reports to make decisions about the project (DEA, 2017). According to DEA (2017), the process gives the developer a chance to evaluate the potential environmental impacts of the development being proposed and also provide for identification of mitigation measures to be put in place. Even though the EIA process plays an important role in South Africa's EIA regime, it also has its weaknesses and challenges. The EIA process in South Africa does not include the identification of all climate change concerns that should be adopted by the project and the identification of all the environmental receptors that are most likely to be vulnerable to climate change. Although the South African EIA process allows for a comprehensive inclusion of the baseline climate information of the area where the project is based, it does not consider how climate

change factors will probably change in the future, also does not consider the changing time scales and the thresholds beyond which baseline conditions are altered. Considerations of how the project itself will be affected and also be resilient to climate change factors are not included.

5.3. Interview with the climate change expert

The interview with the climate change expert established that coal mines are not major contributors to climate change as the process of coal mining does not generate a lot of pollutants and the production machines that use fossil fuels have a very low carbon footprint. According to Cohen and Winkler (2014), gases such as carbon dioxide and methane contribute to climate change. Mining is a significant source of GHGs as its activities release both methane and carbon dioxide (Day *et al*., 2010). Day *et al*. (2010), state that there are fugitive emissions of methane during the mining process and also mining activities such as drilling, transportation by haul trucks, use ammonium based explosives and use of bulldozers contribute a lot of GHG emissions into the atmosphere. Exposure of the coal to air subjects it to low-temperature oxidation, thus more emissions into the atmosphere (Day *et al*., 2010).

The climate changes expect said that, key sectors in terms of climate change are energy generation and agriculture. The interviewee mentioned that, in the current set up coal mines are required to work on carbon emissions. Most emissions occur during the use of coal and some mines extract anthracite which is not used for power generation but rather used as an input in metallurgical processes. Although there are knowledge gaps in climate change, there is enough information on how climate change can be incorporated into the EIA process. The main climate change contributing factor is the release of GHGs (Cohen and Winkler, 2014). Although climate change was not quantified in the EIA process, through regulations and guidelines under the NEMA: AQA (Act No. 39 of 2004) which control GHG emissions, the main climate change contributing factors are dealt with. Processing of coal has been made smarter through technological advancement thus reducing the GHG emissions and what is left is to make the mining sector less labour intensive through technology thus cutting on the workforce that will be affected by the impacts of climate change. With less people working it will mean fewer people will be affected.

5.4. Approaches of incorporating climate change into the EIA process

All the approaches discussed in the literature review section generally accept the importance of incorporating climate change factors into the EIA process. The principles all agree on the need to develop climate change related objectives and also making use of the relevant local and international policies and regulations (like the Kyoto Protocol and the Paris Agreement) that guide for GHG emissions. They also emphasise the need to include both the present and the predicted climate change scenarios when developing the climate change baseline. All the approaches explicitly identify the possible entry points for climate change factors giving specific guidelines on the incorporation of climate change factors into the EIA process. The approaches also agree in the importance of assessing the direct, indirect and cumulative GHG emissions of a project across the project's life cycle. They also emphasise the significance of assessing impacts of climate change on the project itself as well as including climate change factors in the project design. Lastly, all the approaches point

out the importance of developing plans to monitor and engaging follow-up strategies in relation to the climate change context.

In my view, both the IAIA and the IEMA approaches are more relevant to the South African set up as they include more specific vital issues, such as the identification of all environmental receptors that are climate change vulnerable and considering the impacts on emission sinks. The IEMA guidelines are international and more flexible and hence can be used globally. The IAIA approach is more suitable for the mining sector especially in the South African context. South Africa's power generation sector largely depends on coal (Cohen and Winkler, 2014) and coal mining releases a lot of GHGs (Cook and Lloyd, 2012). The IAIA approach will be more suitable for South Africa as it gives specific guidelines for dealing with GHG emissions. The CEAA and CARICOM approaches include effective monitoring and follow-up principles that allow the incorporation of lessons learnt and engaging remediation where it is necessary (Agrawala *et al*., 2012)

5.5. Climate change incorporation into the EIA process

Since 1973 the EIA has been used as an important development tool in environmental management (Yi and Hacking, 2011). In the last two decades climate change has surfaced as a major talking point. Many national authorities, international organisations and multinational development banks have made significant steps in spearheading the incorporation of the effects of climate change and adaptation options within the EIA process (Agrawala *et al*., 2012). According to Yi and Hacking (2012), the OECD endorsed the incorporation of climate change into the EIA process and encourages all its member states to formulate effective guidelines that blend climate change to their EIAs. The requirements that are put forward by different stakeholders for consolidating climate change into EIA processes in all kinds of projects, particularly coal mining, have the potential of bringing significant benefits to the whole world in a longer term (Agrawala *et al.,* 2012). However the current EIA system in South Africa is not fully delivering because the integration of climate change into the EIA process is not yet a regulatory law in the country, although DMR tries to enforce it through Case Laws. That strategy by DMR will always face problems as mines always find exemptions in one way or the other through their lawyers as cited by one mine environmental officer during an interview. The latest piece of legislation (the NEMA: EIA Regulations GG No. 41432 of February 2018) provides for the inclusion of climate and metrological data of the area, the inclusion of the possible changes to the baseline conditions due to natural extreme events, extraction methods considering climate issues and the monitoring of GHG emissions. The South African system has effective and well-structured regulations (NEMA AQA: Act No. 39 of 2004) that govern GHG emissions in all the projects including coal mining (DEA, 2017).

Although the South African approaches have done a lot on the GHG emissions as described above, there is still a lot to be done to meet the basic international standards. The South African system does not give the entry points for climate change consideration into the EIA process and does not provide for the inclusion of information explaining how the project can be vulnerable to climate change. The system does not provide detailed descriptions of how climate change is considered in the EIA process. The system does not consider

the climate change uncertainties and neither does it give provision for climate change in-combination impacts. The South African system also lacks when it comes to defining the roles and responsibilities for implementing future climate change mitigation strategies and adaptation plans for new projects. This could be attributed to the lack of regulatory laws to that effect (Aljareo, 2014).

5.6. Challenges and obstacles of incorporating climate change into the EIA process

As much as the incorporation of climate change into the EIA process can bring positive results, the main challenge in South Africa is the lack of regulatory law and guidelines that govern the process. According to the DMR official during the interview, DMR enforces the incorporation using case laws and best practice principles to achieve these desired results. According to the DMR official, the NEMA polluter pays principle has yielded positive results simply because it is within the regulations. It has reached the same stage where the incorporation of climate change should be part of the environmental regulations in South Africa. The DMR official said that, lack of a regulatory instrument to this regard has seen mines doing business as usual paying fines where possible at the expense of the climate. Evidence from Korea, Canada and the CARICOM group has shown that making the incorporation of climate change into the EIA process compulsory by means of law and strict regulations yield the desired fruits. Although South Africa's climate change policies call for the inclusion of climate change at project level, the current NEMA EIA Regulations (GNR.982) of December 2014 as amended in 2017, do not give guidelines on how to incorporate the climate change factors into the EIA process giving the entry points. Climate change is only implied in the NEMA: Air Quality Act (Act No. 39 of 2004) Pollution Prevention plan regulations.

Even though laws and regulations can be passed, there are also other challenges that can affect the climate change assimilation into the EIA process. According to IAIA (2013) the following challenges can also affect the consolidation of climate change factors into the EIA process:

- There are various uncertainties that are linked to climate change predictions, also commented by one of the interviewees;
- The lack of effective incentives by governments to motivate the integration of climate change into the EIA process;
- No political will and agency interests in addressing the incorporation of climate change into the EIA process;
- No proper planning and coordination by the relevant government institutions;
- Most governments do prioritise economic development ahead of environmental issues;
- Government institutions and agencies are just doing it for the sake of compliance;
- More focus is put on the mitigation of GHGs only (as in the South African situation where focus is on air quality only);
- Lack of the necessary tools and high costs involved in doing the climate change assessments;
- Absence of information and expertise to deal with climate change issues effectively; and

- No proper scientific knowhow and correct apparatus to predict as well as to evaluate GHG emissions.

5.7. Main findings

The main findings of the research are discussed below.

5.7.1. Climate change has not been adequately acknowledged in these coal mines

The consolidation of climate change into the South African EIA process is still in its early stages. The results of the interviews and the review of the EMP reports and EIA reports for the five mines depict that climate change was not adequately acknowledged in the EIA reports of these coal mines. In three of the EIA reports, there are no stand-alone sections for climate change. The White Paper's set of mitigation measures calls for the inclusion of climate change assessments at project-level as well as developing legal requirements that should be enforced to regulate the integration of climate change assessments into the EIA system (DEA, 2011). The Thabametsi Court Ruling of 2017 ordered new projects to do comprehensive climate change assessments as stand-alone assessments, producing a full specialist report by a relevant specialist (Humby, 2018). In the EIA report where there was a stand-alone section on climate change, only climate change baseline information was covered, leaving all the other issues uncovered.

The EIA reports of the five mines failed to clearly show how they can incorporate climate change into the EIA process. However, according to Agrawala *et al*. (2012), in 2009 CEAA managed to identify four potential entry points that are used to effectively fuse climate change impacts and adaptation into the EIA process. The CARICOM Guidance identified key entry points on the EIA process that are used to include climate change factors into the EIA process by member states to effectively consider climate change factors (Agrawala *et al*., 2012).

All the five mines had comprehensive climate baseline data that were given under the Air Quality section of the EIA reports and only one report had clear calculations of GHG emissions. According to He (2013) the effective blending climate change factors into the EIA process can be achieved by putting them in the policy objectives or in the regulations of the relevant authorities. The findings of this research show that there are inconsistencies, as the five EIAs examined clearly show the absence of linkage between the local policies and the development of the new projects such as coal mines. The White Paper in 2011 called for the inclusion of climate change assessments at project-level as well as developing legal requirements that must be used to regulate the blending of climate change assessments in the EIA system (DEA, 2011). This could explain the high incidences where by the researcher found out that a number of mines were closed by DMR during the period of the research due to non-compliance and safety issues.

Four interviewees emphasised the importance of incorporating climate assessments into the EIA process of South Africa as well as making it compulsory within the NEMA: EIA Regulations, identifying the possible entry points for climate change factors into the EIA process. The interviewees said that, giving entry points will help the EAPs to know exactly what climate change aspect to consider at which stage of the EIA process. One interviewee cited the incorporation of climate change assessments in to the EIA process as a

waste of time, describing it as one of the many great initiatives that end up yielding no positive results at the same time slowing down operations hence slowing down development. The interviewee cited the following:

- Climate change projections are not accurate (they are just predictions);
- DMR has to revise all the standards to accommodate all the different conditions in different regions of the country;
- There will be need to change the regulations in all the departments such as the water department and the sanitation department to accommodate the climate change assessment requirements; and
- It will be wasting time, money and resources to undertake the climate change assessments.

Though mine E had a stand-alone section for climate change and a climate change specialist report, the information that was contained in this section and in the specialist report can only be considered as partial consideration of climate change in this research. This decision to regard it as partially considered was reached after comparing the climate change specialist report with the international best practice principles of incorporating climate change into the EIA process (as indicated on table 3). The environmental officer of mine E confirmed that the report was done following the NEMA; EIA Guidelines (GG No. 41432) of February 2018 and it met all the climate change requirements of this Act.

5.7.2. None of the five mines cited the impacts of climate change on the respective mines.

According to IEMA (2015), the EIA process should always make reference to all the relevant aspects of climate change, providing a detailed description of the processes used to consider the resilience of the project to climate change was considered and also explain explicitly how the different climate change effects have been assessed. Although the five reports reviewed have comprehensive information under the Air Quality section covering GHG emissions comprehensively, the review of the EIA reports and EMP reports indicate that the negative effects of climate change on the mines are not mentioned anywhere. As a result nothing is covered under how the mines can improve their resilience to climate change impacts. Although lack of data, knowledge and resources can affect the consolidation of climate change factors into the EIA process (Chang and Wu, 2013) that is not the case in the South African situation. The environmental officers attributed this to lack of regulatory laws enforcing the blending of climate change into the South African EIA process. The study by He (2013) in China, among other things identified the missing of targets of the country's climate change policies by the relevant environmental management institutions due to an inefficient legal system. Lack of regulatory laws is discussed in the next section.

5.7.3. Lack of a regulatory law and regulations that enforces the incorporation of comprehensive climate change issues into the South African EIA process

From the interviews, it can be deduced that the main setback is the lack of a regulatory law that enforces the inclusion of comprehensive climate change factors into the South African EIA process. All the five interviewees emphasised that climate change assessments are not a requirement of the MPRDA (Act No. 28 of 2002), the NEMA EIA Regulations (GNR.982) of December 2014 and the NEMA EIA Guidelines (GG. 41432) of February 2018. To ensure that there is always consistency and context validity of EIAs, there is

need to always make sure that regulatory laws, guidance and protocols are provided to all the practitioners who are responsible for implementing the assimilation of climate change into EIAs (Yi and Hacking, 2011). As much as the DMR and DEFF try to enforce the incorporation of the climate change factors into the EIA process through Case Laws, the mine authorities always find ways out through their legal structures as echoed by one environmental officer. In an assessment of the challenges faced when implementing the incorporation of climate change factors in the EIA process, Chang and Wu (2013), in China identified the absence of exclusive regulatory laws on climate change and the absence of applicable assessment standards and criteria amongst other issues that derail the effective incorporation of climate change factors into the EIA process. Best Practice Principles are not legal requirements but are different methods and techniques that have proved to lead to successful outcomes through their application (Byer *et al.,* 2018). There is need to legally enforce some of the best practice principles in order to achieve the best results. In South Africa Case Laws are legally binding and can be enforced. The coal-fired Thabametsi power station was given an environmental authorisation although there was no adequate consideration of the power station's climate change impacts (Humby, 2018). The decision was challenged by Earth-life Africa Johannesburg in court in March 2017. The Court ordered the company to do a comprehensive climate change assessment (Humby, 2018). According to Humby (2018), this judgement has been a great game-changer with far reaching implications in the way in which environmental authorisations should be done in South Africa. A project's climate change assessment has to be done as a stand-alone assessment, including a full assessment of the broader climate change impacts and how the project may make them worse (Humby, 2018). The court also ordered that the climate change assessment must also consider the viability of any new project that may be affected by the impacts of climate change (Humby, 2018). Nevertheless, this as a Case Law, it can be challenged any time as cited by the interview with the DMR official.

5.7.4. South African versus the international best practice

South Africa has strong climate change policies that are in line with international policies such as the Paris Agreement, the Kyoto Protocol and some of the International best practice guidelines. South Africa also works with the IPCC and the UNFCCC in order to keep in touch with the current climate change issues. The DMR and the DEFF work hand in hand to enforce the country's climate change policies through the NEMA (Act No. 28 of 2002), the MPRDA (Act. No 28 of 2002), the NEMA EIA Regulations (GNR.982) of December 2014, NEMA: AQA (Act No. 39 of 2004) and Case/Common Laws (such as the Thabametsi Court Ruling of 2017). These regulations provide clear cut guidelines on GHG emissions of new development projects. The NEMA: EIA Regulations currently in use spell out clearly on the submissions to be made regarding GHG emissions. The EIA report must include a comprehensive report on the air quality assessment and a pollution prevention plan (DEA, 2014). The air quality assessment must develop the relevant strategies of mitigating GHG emissions. The pollution prevention plan must describe the GHG emission reporting systems, monitoring and evaluation processes to be done. The NEMA: EIA Regulations (GG No. 41432) of February 2018 requires the submission of a description of how the baseline conditions may change due to natural extreme events and also mention the need for the extraction methods to consider climate issues. Although South Africa has gone a long way in trying to address climate change issues in fulfilling the international policies like the Kyoto Protocol and the Paris Agreement, there is still a gap in meeting the

international best practice principles of assimilating climate change factors into the EIA process as depicted on table 13. Best practice principles are meant to ensure effective blending of climate change in decision making and achieve sustainable development (Byer *et al.,* 2018). According to Byer *et al.* (2018), best practice principles are supposed to help EAPs to consolidate climate change considerations into all the strategic-level impact assessments and all the project-levels. By following best practice principles it also helps in ensuring and addressing the climate change concerns of decision-makers and those of stakeholders (Byer *et al.*, 2018). Among other issues, the South African EIA process does not have a stand-alone climate change assessment section which gives clear climate change objectives and does not clarify the entry points for climate change factors into the process of EIA. The process also does not include how climate change factors may change in the future and also does not consider how projects will be resilient to climate change. The EIA process of South Africa covers climate change issues under the Air Quality section. The climate change and mining expert feels that the current EIA process covers the aspects to do with contributors to climate change (GHG emissions) but climate change is not quantified in the South African EIA process.

There are still gaps between the country's climate change policies and the environmental management regulations, especially those that are used to regulate the EIA process. The White Paper of 2011 calls for the formulation of guidelines that will comprehensively consider climate change factors into the EIA process. The latest regulations, the NEMA EIA Regulations (GG No. 41432) of February 2018 fall far short from addressing that issue. According to the interview outcomes, the lack of a regulatory law governing the incorporation of climate change factors into the South African EIA process seems to be the main hindrance factor. The NEMA: EIA Regulations (GG No. 41432 of February 2018) that are currently in use do not:

- State the possible entry points of climate change factors into the EIA process;
- Enforce the identification of the environmental receptors that are vulnerable to climate change;
- Enforce the consideration of climate change projections into the project designs;
- Consider how projects will be resilient to climate change;
- Consider how climate change factors are likely to change; and
- Give an outline of the monitoring and evaluation of climate change in the EIA process.

Chapter 6

6. Conclusion and Recommendations

Based on the review of documents, interviews and the discussions that were done, conclusions and some recommendations have been made to point out strength, weaknesses as well as suggesting possible improvements that can be made to the incorporation of climate change into the South African EIA process. The climate change policies for South Africa (like the White Paper of 2011) are calling for the inclusion of climate change assessments at project-level as well as the need to have legal requirements that regulate the integration of climate change assessments in the EIA system (DEA, 2011). This research aimed at assessing how EAPs for new coal mines (applications done using the NEMA EIA Regulations (GNR.982) of December 2014) considered climate change in the EIA process. A document review to identify the legislation that governs the climate change requirements was done. The MPRDA (Act. No. 28 of 2002), NEMA (Act No. 107 of 1998) as amended, NEMA: Air Quality (Act No. 39 0f 2004) as amended, the NEMA EIA Regulations (GNR. 982) of December 2014 and the NEMA EIA Regulations (GG. 41432) of February 2018 were all reviewed and a list of the climate change requirements was drafted. Interviews with one DMR official, one climate change and mining expert, four coal mine environmental officers and one mine sustainability manger were done. A review of international best practice principles in the incorporation of climate change issues into the EIA process was also done. A comparison with the South African EIA process was also done.

Acknowledging that the research was based on only five case studies, it clearly shows that the consideration of climate change into the EIA process is in the initial stages, but is necessary in South Africa. This research report is in line with other studies that were done previously in the same field of study in South Africa (Aljareo, 2014) and also internationally (Jain *et al.,* 2017). The findings of this report are similar to other studies that were done in South Africa. The first notable example is the lack of mandatory requirements (regulatory laws) as well as lack of proper guidelines and necessary experience needed to incorporate climate change issues into the EIA process. Secondly, the reports show that the South African EIA system does not give specific points in the EIA process that can be used as entry points for climate change factors; neither does it enforce the inclusion of how the mines can be affected by the changing climate. Globally, findings of other similar studies are also showing that most projects consider GHG emissions and how the projects impact the climate with less focus on how climate change can impact the projects. For local reports, minor differences emanated from the regulations and guidelines that were used in the reports as these are constantly reviewed by the responsible authorities. The major challenge was coming up with relevant literature review for similar studies as the incorporation of climate change into the EIA process is still an evolving concept. In conclusion, for the South African EIA process to be a success there must be a very strong relationship between the South African EIA process and climate change assessment as suggested by the Thabametsi Court Ruling of 2017. Proper guidelines and systematic methods on how to blend climate change into the EIA process developed within a South African context are mandatory. This should be supported by enhancing the competence of both the practitioners and authorities who will be spearheading the fusion of climate change into the county's EIA process. Climate change awareness campaigns by all stakeholders can also play a pivotal role in reducing the negative effects of climate change on the

developmental projects, on societies and on the biological ecosystems. During the interviews two environmental officers cited how their mines are using awareness campaigns to try and lower the potential negative effects of climate change. Further scientific studies are also needed to facilitate the production of accurate detailed climate change predictions. He (2013) argues that, by increasing the accuracy of climate change predictions, it can help in the assimilation of climate change impact assessments in to the EIA process. Lastly, when all requirements needed to effectively consolidate climate change assessments into the South African EIA system are in place, evaluations of lessons learnt from the process must be fed back positively into process.

7. Appendices

APPENDIX 1: Ethical Approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF ANIMAL, PLANT AND ENVIRONMENTAL SCIENCES ETHICS COMMITTEE CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

FINAL CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: HA1915**
PROJECT TITLE	An assessment of how Environmental Impact Assessments of new coal mines in South Africa consider climate change
INVESTIGATOR	MVUKWE RUTHERFORD GEORGE
SCHOOL/DEPARTMENT OF INVESTIGATOR	Animal, Plant and Environmental Sciences
DATE CONSIDERED	15 November 2019
DECISION OF THE COMMITTEE	Approved unconditionally.
EXPIRY DATE	Date of submission of the project report
ISSUE DATE OF CERTIFICATE	**CHAIRPERSON** _____ (Dr Shalini Dukhan)

29 January 2020

cc: Supervisor/s : Dr Ingrid Watson

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

MVUKWE
Signature

29/01/2020
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix 2: Participant consent form

CONSENT FORM FOR PARTICIPANTS

I have been given full details about the research on "**An assessment of how Environmental Impact Assessments of new coal mines in South Africa consider climate change**" by Mr Mvukwe Rutherford George who is doing a Master's degree at the University of the Witwatersrand under the supervision of Mrs Ingrid Watson

I have been informed that:

- Participation is voluntary.
- I can withdraw from the research at any time without any repercussions.
- I will remain anonymous in the research report, as my name and the name of my organisation will be coded.
- The information I will provide will be treated with utmost confidentiality.
- I will not receive any benefit or reward for participating in the research.
- The information will be used for academic purposes only.

I **agree/do not agree** to have the interview recorded

By signing below I am indicating that I agree to participate in the research.

Signature Date

……. ……../……/…….

APPENDIX 3: Participant information sheet

School of Animal, Plant and Environmental Sciences
Private bag 3
Wits
2050

PARTICIPANT INFORMATION SHEET

Dear Sir/Madam

By way of introduction, my name is Mvukwe Rutherford George and I am an Interdisciplinary Global Change Studies, MSc student at the University of the Witwatersrand. The reason I am writing to you is to solicit your participation in an interview for my research entitled "**An assessment of how Environmental Impact Assessments of new coal mines in South Africa consider climate change".** The purpose of the study is to make a contribution towards the research component of a Master's degree in Interdisciplinary Global Change Studies. The research aims to find out how climate change is considered in selected new coal mines in South Africa. I am inviting you to be part of this study.

Your participation is completely voluntary, and there is no remuneration for participating in this research process. If you agree, I would like to interview you at a time and location suitable to yourself. The interview will take approximately 30 minutes of your time. You have the right to withdraw from the interview at any time and you may elect not to respond to particular questions.

I would like to assure you of your anonymity in participating in this research should you agree to partake in this survey. The information you provide will be treated with utmost confidentiality, as none of your personal details or any features that may contribute in identifying you will be disclosed in the research report. To ensure anonymity and confidentiality, details will be coded with codes such as mine X, mine official number 1 and Department official number 3. The results of the research will be used strictly for academic purposes. Should you require any additional information about the research please contact me on 1084339@students.wits.ac.za or on telephone number (071) 955-1478 or my supervisor Mrs Ingrid Watson on Ingrid.Watson@wits.ac.za or on telephone number (011) 717-7054

Many thanks in advance.

Yours sincerely

Mvukwe Rutherford George

APPENDIX 4: Interview questions for Department of Mineral Resources officials

Interview questions for Department of Mineral Resources (DMR) Officials

Section A: details of respondent

1. Name of official (to be coded)
2. Position in the department (to be coded
3. How long have you been working for DMR?
4. What is your role in the department?

Section B: Climate Change legislation and regulations for coal mines

5. What is your understanding of climate change? and its impact on mining?
6. Does the department have legislations that govern climate change issues for coal mines?
7. What are the regulations that govern climate change assessments of new coal mines?
8. To get an environmental authorisation, which climate change issues should be considered by new coal mine applicants?
9. In your experience, are all these issues considered? Why/why not? How well are they addressed?
10. Are there any requirements that should be implemented during the operation life of a mine to address climate change? What are these?

APPENDIX 5: Interview questions for mine environmental officers

Interview questions for Mine Environmental Officers

Section A: Details of respondent

1. Name of mine (to be coded)
2. Name of respondent (to be coded)
3. How long have you been working for the mine?
4. What is your role in the company?

Section B: How climate change is considered in the EIA process

5. What is your understanding of climate change? And its impact on mining?
6. In which year did the mine apply for its mining rights?
7. Was climate change considered in the application for this mine? In terms of which regulations?
8. Was a climate change assessment done? What aspects were considered? Are you required to report on these?
9. Were the impacts of the mine activities on the climate directly considered and were the impacts of climate change on the mine considered?
10. Did climate change projections and scenarios influence the design of the mine? How? Could you give me an example?
11. Does the mine have climate change mitigation strategies in place? Were these developed as part of the EIA, or later (during the operational phase)? Could you please explain what these are?
12. Do you think a climate change assessment is/would be useful for a new coal mine? What could this cover? Should this be a requirement of legislation?

APPENDIX 6: Interview questions for climate change and coal mining expert

Interview questions for climate change and coal mining expert

Section A: Details of respondent

1. Name of mine (to be coded)
2. Name of respondent (to be coded)
3. How long have you been working in the coal mining and climate change field?

4. What is your role?

Section B: How climate change is considered in the EIA process

5. What is your understanding of climate change? And its impact on mining?
6. Are climate change assessments useful for the application of new coal mines in South Africa? How? Should climate change assessments be a legislative requirement?
7. What aspects should be considered when carrying out a climate change assessment?
8. Has South Africa done enough in incorporating climate change into the EIA process? If YES, how? If NO, what should be done?

8. References

Agrawala, S., Kramer, A.M., Prudent-Richard, G. and Sainsbury, M., 2011. Incorporating climate change impacts and adaptation in environmental impact assessments.

Agrawala, S., Matus Kramer, A., Prudent-Richard, G., Sainsbury, M. and Schreitter, V., 2012. Incorporating climate change impacts and adaptation in environmental impact assessments: Opportunities and challenges. *Climate and Development*, *4*(1), pp.26-39.

Aljareo, A., 2014. *How is climate change incorporated into Environmental Impact Assessments (EIAs) in South Africa?* (Doctoral dissertation, Masters Thesis, University of the Witwatersrand).

Arts, A., Caldwell, P. and Morrison-Saunders, A., 2001.*Environmental impact assessment follow-up: good practice and future directions* - findings from a workshop at the IAIA 2000 conference, Impact Assessment and Project Appraisal, 19:3, 175-185.

Ashley, P. and Boyd, B.W., 2006. Quantitative and qualitative research approaches to research in environmental management. Australian Journal of environmental management, 13: 70-78.

Asthana, H.S. and Braj, B., 2016. *Statistics for Social Sciences (With SPSS Applications*). PHI Learning Pvt. Ltd.

Babbie, E.R., 2011. The basics of social research (Vol. 6th). *Belmont, CA*.

Byer, P., Cestti, R., Croal, P., Fisher, W., Hazell, S., Kolhoff, A. and Kørnøv, L., 2012. Climate change in impact assessment: International best practice principles. In *Special Publication Series No. 8*. International Association for Impact Assessment.

Byer, P., Cestti, R., Croal, P., Fisher, W., Hazell, S., Kolhoff, A. and Kørnøv, L., 2018. Climate change in impact assessment: International best practice principles. In *Special Publication Series No. 8*. Fargo, N,D, USA. International Association for Impact Assessment.

CARICOM, 2004. Guidance for incorporating Climate Change adaptation into the EIA process.

Capstick, S., Kelly, J., Barrett, A. and Penailillo, R., 2014. Incorporating climate change impacts into environmental assessments. In *34th Annual Conference of the International Association for Impact Assessment. Retrieved from http://conferences. iaia. org/2014/IAIA14-final-papers/Capstick,% 20Sean* (Vol. 20).

Canadian Environmental Assessment Agency (CEAA), 2003. Incorporating climate change considerations in Environmental Assessment: General Guidance for practitioners, Federal-Provincial-Territorial Committee on Climate Change and Environment.

Chang, I.S. and Wu, J., 2013. Integration of climate change considerations into environmental impact assessment—implementation, problems and recommendations for China. *Frontiers of Environmental Science & Engineering*, *7*(4), pp.598-607.

Chamaides, B. and Wang, J., 2005. *Global Warming's Increasingly Visible Impacts*, Environmental Defence: Ney York, NY, USA.

Canadian Environmental Assessment Agency (CEAA)., 2009. Basics of Environmental Assessment. [Online] Available at: http://www.ceaa-acee.gc.ca. (Accessed on 4 February 2020).

Canadian Environmental Assessment Agency (CEAA)., 2020. Basics of Environmental Assessment. [Online] Available at: http://www.ceaa-acee.gc.ca. (Accessed on 2 March 2020).

Cohen, B. and Winkler, H., 2014. Greenhouse gas emissions from shale gas and coal for electricity generation in South Africa. *South African Journal of Science*, *110*(3-4), pp.01-05.

Conti, J.J., Holtberg, P.D., Beamon, J.A., Schaal, A.M., Ayoub, J.C. and Turnure, J.T., 2014. Annual energy outlook 2014. *US Energy Information Administration*, pp.1-269.

Cook, A.P. and Lloyd, P.J., 2012. The estimation of greenhouse gas emissions from South African surface and abandoned coal mines. *Journal of the Southern African Institute of Mining and Metallurgy*, *112*(12), pp.1087-1090.

Day, S.J., Carras, J.N., Fry, R. and Williams, D.J., 2010. Greenhouse gas emissions from Australian open-cut coal mines: contribution from spontaneous combustion and low-temperature oxidation. *Environmental monitoring and assessment*, *166*(1-4), pp.529-541.

Department of Environmental Affairs (DEA)., 2010. National Climate Change Response. Green Paper 2010, Pretoria, South Africa.

Department of Environmental Affairs (DEA)., 2011. National Climate Change Response. White Paper 2011. Pretoria, South Africa.

Department of Environmental Affairs (DEA)., 2013a. Long-Term Adaptation Scenarios Flagship Research Programme (LTAS) for South Africa. Climate Trends and Scenarios for Biodiversity Sector in South Africa. Pretoria, South Africa.

Department of Environmental Affairs (DEA)., 2013b. Climate Change Implications for Biodiversity Sector in South Africa. Pretoria, South Africa.

Department of Environmental Affairs (DEA)., 2014. EIA and Management Strategy for South Africa. Pretoria, South Africa.

Department of Environmental Affairs (DEA)., 2015. National Environmental Management: Air Quality Act. 2004, Draft National Greenhouse Gas Emission Reporting Regulations. Pretoria, South Africa.

Department of Environmental Affairs., 2017. 20 Years of Environment Impact Assessment in South Africa. Pretoria, South Africa.

Department of Environmental Affairs (DEA)., 2018a. Climate change bill. Government gazette 41689. Volume 636. Pretoria, South Africa.

Departmental of Environmental Affairs (DEA)., 2018b. Mitigation Monitoring and Evaluation Guidelines Series of the National Climate Change Response Monitoring and Evaluation System. Pretoria, South Africa.

Department of Environmental Affairs and Tourism (DEAT)., 2004. The National Climate Change Response. Pretoria, South Africa.

Duus, S., 2013. Coal contestations: Learning from a long, broad view. *Rural Society*, *22*(2), pp.96-110.

Eberhard, A., 2011. The future of South African coal: Market, investment and policy challenges. *Program on energy and sustainable development*, pp.1-44.

Engelbrecht, F.A., Engelbrecht, C. and Malherbe, J., 2019. Climate modelling and Projections of Future Climate Change in Africa. IPCC SR 1.5, IPCC AR6 Global Change Institute. Wits.

Fuggle, R.F. and Rabie, M.A., 2009. *Environmental management in South Africa,* 2nd edn., Juta, Cape Town.

Glasson, J., Therivel, R. and Chadwick, A., 2013. Introduction to Environmental Impact Assessment.

Hands, S. and Hudson, M., 2016. Incorporating climate change mitigation and adaptation into environmental impact assessment: a review of current practice within transport projects in England, impact assessment and project appraisal, 34:4, 330-345

Hansen, J., Sato, M., Ruedy, R., Lo, K., Lea, D.W. and Medina-Elizade, M., 2006. Global temperature change. *Proceedings of the National Academy of Sciences*, *103*(39), pp.14288-14293.

He, X., 2013. Integrating Climate Change Factors within China's Environmental Impact Assessment Legislation: New Challenges and Developments. *Law Env't & Dev. J.*, *9*, p.50.

Humby, T.L., 2018. The Thabametsi Case: Case No 65662/16 Earth life Africa Johannesburg v Minister of Environmental Affairs. *Journal of Environmental Law*, *30*(1), pp.145-155.

Initiative for Responsible Mining Assurance (IRMA)., 2020. The answer to global demand for more socially and environmentally responsible mining. [Online] Available at: https://www.responsiblemining.net./about/about-us/. (Accessed on 3 March 2020).

Institute of Environmental Management and Assessment (IEMA). 2010. *EIA and climate change.* [Online] Available on: http://wwwiema.net/eia-climate change. [Accessed on 16 June 2020]

Institute of Environmental Management and Assessment (IEMA). 2015. *IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation.* [Online] Available on: https://iema.net/assets/templates/documents/iema guidance documents iema climate change resilience and adaptation%20(1).pdf [Accessed on18 June 2019]

Institute of Environmental Management and Assessment (IEMA). 2020. *IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation.* [Online] Available on: https://iema.net/documents/iema [Accessed on18 January 2020]

Intergovernmental Panel on Climate Change (IPCC)., 2007. AR4 Climate Change 2007: Impacts, Adaptation, and Vulnerability. Cambridge, United Kingdom and New York, USA.

Intergovernmental Panel on Climate Change (IPCC)., 2014. Summary for policy makers In: Climate Change 2014, mitigation of climate change. Cambridge, United Kingdom and New York, USA.

Intergovernmental Panel on Climate Change (IPCC)., 2015. Climate Change, Impacts, Mitigation, Adaptation and Vulnerability. Cambridge, United Kingdom and New York, USA.

Intergovernmental Panel on Climate Change (IPCC)., 2016. Climate Change, Impacts, Mitigation, Adaptation and Vulnerability. Cambridge, United Kingdom and New York, USA.

Intergovernmental Panel on Climate Change (IPCC)., 2019. Refinement to 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Cambridge, United Kingdom and New York, USA.

International Association for Impact Assessment (IAIA)., 1996. [Online] Available at: https://www.iaia.org (Accessed on 28 February 2020).

International Association for Impact Assessment (IAIA), 2013. Challenges to integrate climate change consideration in EIA: IAIA 13 Conference proceedings. [Online] Available at: https://www.iaia.org . (Accessed on 15 February 2020).

International Association for Impact Assessment (IAIA), 2020. Challenges to integrate climate change consideration in EIA: IAIA [Online] Available at: https://www.iaia.org. (Accessed on 15 March 2020).

International Council of Mining and Minerals (ICMM)., 2020. Climate Change Policy Design. International Council of Mining and Minerals, London, United Kingdom. [Online] Available at: https://www.icmm.com/en-gb/environment/climate-change/climate-changepolic-design. (Accessed on 29 February 2020).

Jain, S., Klagsbald, O., Leigh, G. and Sulakshana, E., 2017. How did the Federal Environmental Impact Statements address climate change in 2016? Sabin Center for Climate Change Law. Colambia Law School.

Kumar, C.R., 2008. *Research Methodology*. APH Publishing, New Delhli.

Laukkonen, J., Blanco, P.K., Lenhart, J., Keiner, M., Cavric, B. and Kinuthia-Njenga, C., 2009. Combining climate change adaptation and mitigation measures at the local level. *Habitat international*, *33*(3), pp.287-292.

Lukey, P., 2011. The National Climate Change Policy- The Policy Development Process. Working Together: Saving Tomorrow Today. NCOP Land and Mineral Resources Committee Meeting on Department of Environmental Affairs Breefing. 31 October 2011. (https://pmg.org.za/committee meeting/13662/).

Midgley, G.F., Hannah, L., Millar, D., Rutherford, M.C. and Powrie, L.W., 2002. Assessing the vulnerability of species richness to anthropogenic climate change in a biodiversity hotspot. *Global Ecology and Biogeography*, *11*(6), pp.445-451.

Minerals Council of South Africa., 2019. Coal Mining Facts and Figures in South Africa. [Online] Available at: https:www.mineralscouncil.org.za. (Accessed on 11 March 2020).

National Centres for Environmental Information (NCEI)., 2019. National Centers for Environmental Information, State of the Climate: Global Climate Report for 2019. [Online] available at: https: ncdc.gov/sotc/global/201902. (Accessed on 29 January 2020).

National Centres for Environmental Information (NCEI)., 2020. National Centers for Environmental Information, State of the Climate: Global Climate Report for 2019. Published online February 2020. [Online] Available at: https: ncdc.gov/sotc/global/202002. (Accessed on 4 February 2020)

Odell, S.D., Bebbington, A. and Frey, K.E., 2018. Mining and climate change: A review and framework for analysis. *The Extractive Industries and Society*, *5*(1), pp.201-214.

Organisation for Economic Co-operation and Development (OECD)., 2009. Integrating Adaptation to climate change into Development Co-operation: Policy Guidance, OECD, Paris.

Roudgarms, P., 2011. Qualitative research for environmental sciences: a review, *Journal of food, Agriculture and Environment*, 9: 871-879.

Sala, S., Pant, R., Hauschild, M. and Pennington, D., 2012. Research Needs and Challenges from Science to Decision Support. Lesson Learnt from the Development of the International Reference Life Cycle Data System Recommendations for Life Cycle Impact Assessment, Sustainability 4, 1412-1425.

Schaltegger, S., Hansen, E.G. and Lüdeke-Freund, F., 2016. Business models for sustainability: Origins, present research, and future avenues.

Schmidhuber, J. and Tubiello, F.N., 2007. Global food security under climate change. *Proceedings of the National Academy of Sciences*, *104*(50), pp.19703-19708.

Shumba, E.M., Wallgren, V.L., Carlson, A., Kuona, M. and Moyo, N., 2012. *Community Climate Change Vulnerability Assessment in Miombo Woodlands*. World Wide Fund for Nature, Miombo Eco-region Programme, Harare, Zimbabwe.

Spector, P.E., 1994. Using self-report questionnaires in OB research: A comment on the use of a controversial method. *Journal of organisational behaviour*, Wiley Online Library.

UNFCCC., 2014. Unfcc article/climate change pdf. [Online] Available at: https://www.google.unfccc.co.za Accessed 15 February 2020

United Nations., 1987. General Assembly: Report of the World Commission on Environment and Development. 96th plenary meeting, 42/187, UN Department of Economic and Social Affairs (DESA).

Wentz, J., Glovin, G. and Ang, A., 2016. Survey of Climate Change Considerations in Federal Environmental Impact Statements, 2012-2014. *Columbia Public Law Sabin Center for Climate Change Law Research Paper*.

Weston, J., 2004. EIA in a risk society. *Journal of Environmental Planning and Management*, *47*(2), pp.313-325.

Wood, C., 1995. *Environmental Impact Assessment: A Comparative Review* (Longman Harlow, 1995).

Woolsey, P., 2012. Consideration of Climate Change in Federal EISs, 2009-2011. *Center for Climate Change Law. Columbia Law School. https://web. law. columbia. edu/sites/default/files/microsites/climate-change/files/Publications/Students/Woolsey NEPA report. pdf (21.3. 15)*.

Yi, J. and Hacking, T., 2012, May. Gaps in EIA Incorporating Climate Change. In *IAIA12 Conference Proceedings' Energy Future The Role of Impact Assessment 32nd Annual Meeting of the International Association for Impact Assessment*.

Yi, J. and Hacking, T., 2011. Incorporating climate change into environmental impact assessment: perspectives from urban development projects in South Korea. *Procedia Engineering*, *21*, pp.907-914.

List of South African Acts and Regulations

MPRDA (Act No. 28 of 2002).
NEMA (Act No. 107 of 1998).
NEMA: AQA (Act No. 39 of 2004).
NEMA: AQA (Act No. 39 of 2004): The National Greenhouse Gas Emission Reporting Regulations.
NEMA: AQA (Act No. 39 of 2004): The National Pollution Prevention Plan Regulations.
NEMA EIA Regulations (GNR. 982) of December 2014.
NEMA EIA Guidelines (GG No. 41432) of February 2018.
The Constitution of South Africa.
The Technical Guidelines for Monitoring, Reporting and Verification of GHG Emissions by Industry.
The Thabametsi Court Ruling of 2017.