An exploration of the just transition to renewable energy on the coal value chain in Mpumalanga

BC SUMMERS


orcid.org/0000-0002-31200-75440

Mini-dissertation accepted in partial fulfilment of the requirements for the degree Master of Business Administration at the North-West University

Supervisor: Mrs JM Manyaapelo

DECLARATION

I, BURTON SUMMERS, declare herewith that the mini-dissertation entitled

An exploration of the just transition to renewable energy on the coal value chain in Mpumalanga

which I herewith submitted to the North-West University was in compliance with the requirements set for the degree: *Master in Business Administration*

is my own work, has been text-edited in accordance with the requirements and has not already been submitted to any other university.

SIGNATURE: **BC Summers**

DEDICATION

I want to express profound gratitude to my late father, Benjamin Summers. His enduring belief in the pursuit of academia and the relentless commitment to excellence, coupled with humility, has been a guiding light throughout my academic journey.

Thank you, Dad, for the unwavering support, love, and guidance you bestowed upon me over the years. This dissertation is dedicated to your excellence in parenting and to your legacy as an academic. Your values and encouragement have left an indelible mark on my educational path.

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To my immediate family, friends and work colleagues, thanks for the support structure that was afforded to me throughout this journey.

Last but not least, I want to thank my supervisor, Mrs Johanna Manyaapelo, for the dedication and patience that she applied over the course of this dissertation period. The time she spent guiding and directing me allowed me to master the concept of scientific writing. This dissertation serves as a testament to that dedication.

As I reflect on this academic voyage, I not only celebrate the achievement but also the recognise the profound impact each of the abovementioned people had on my personal and professional growth. I eagerly anticipate applying the lessons learned in the exciting chapters that lie ahead.

ABSTRACT

This study explores the just transition to renewable energy, addressing the socio-economic implications of the transition from fossil fuels to renewable energy in Mpumalanga, South Africa, focusing on the coal value chain. As the region heavily relies on coal for energy, the study explores the challenges and opportunities for various stakeholders, including mineworkers, local communities, small-scale miners, suppliers, and coal-dependent regions. The research, guided by the just transition framework, analyses the short-term impacts and potential long-term consequences of this transition. Utilising a qualitative content analysis, including a literature review, case studies and an integrative content analysis. The study identifies critical themes, such as energy transition, employment sustainability and community resilience. The findings underscore the need for context-specific strategies that address the unique challenges of Mpumalanga, emphasising inclusivity, community engagement and policy alignments and looking at the implications thereof. Recommendations are provided for policymakers in the South African energy sector to navigate a just and sustainable transition while mitigating adverse effects on vulnerable groups. The study contributes to the broader discourse on global energy transitions by offering insights into the intricate socio-economic dynamics of transitioning from coal-dependent economies to renewable energy sources.

Key terms

Coal value chain, coal-dependent region, fossil fuel, local communities, just transitioning, renewable energy, mineworkers, Mpumalanga

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CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Russia's invasion of Ukraine on the 21st of February 2021 made many European countries rapidly rethink their energy mix. Before the invasion, Russia roughly supplied 40% of all the imported gas to the European Union (EU) (McWilliams *et al.,* 2022). However, that has drastically changed since the invasion by Russia, and the gas supply to the EU has decreased by 80%. Several countries require assistance with energy resources in order to meet the demands of their clients and citizens. Governments across the globe have had to produce alternative resources for energy production. This has strengthened the case for the just transition to alternative energy (McWilliams *et al.,* 2022).

South Africa has also been affected by overall energy shortages to meet supply and demand. In 2022, the country had an estimated 223 days of continuous blackouts, meaning that the demand for electricity outweighed the supply of the energy capacity. As a result, this has also strengthened the course to transition to renewable energy or to adopt an alternative energy mix (Business Tech,2023. According to Monique le Roux, a senior researcher at the Council for Scientific and Industrial Research (CSIR), "South Africa's economy lost R560 billion due to load-shedding in 2022, and things are unlikely to change in the next several years" (Business 4e7d b, 2023).

The coal value chain consists of coal mines in Mpumalanga and the transportation of coal by freight or road to leading players in South Africa, namely Eskom and Sasol. Eskom produces electricity and supplies it to municipalities, who thereafter supply the electricity to different industrial sites and households (Makgetla & Patel, 2021).

This study took a point of departure on the coal value chain by concentrating on coal mining in Mpumalanga. The vulnerable groups in reference are the coal miners, small businesses, coal truck drivers and directly impacted mines and municipalities. The study further explored case studied or best practices from other regions and countries that have successfully transitioned from coal to renewable energy.

The primary objective of the transition from coal to renewable energy in Mpumalanga is to reduce the province's dependence on coal as a source of energy and to increase the use of renewable energy sources, such as solar, wind and hydroelectricity power. This will help mitigate adverse impacts on the air quality and the environment and also create new job opportunities (Makgetla & Patel, 2021). The term, just transition, emphasises a fair and inclusive process that considers

the social, economic and environmental implications of moving away from coal (Wang & Lo, 2021). It involves addressing potential challenges faced by various groups, such as mineworkers, local communities, small-scale miners and suppliers, during the transition.

1.2 BACKGROUND TO THE STUDY

The coal value chain has been essential to South Africa's growth for over a century, particularly for the energy, petrochemical, and metal refineries (Marais *et al.*, 2022). Coal has been a source of energy for centuries. However, the widespread use of coal as an energy source came about during the Industrial Revolution in the 18th and 19th centuries (Montagna, 1981). Throughout this period, there was a rapid increase in the use of coal to power steam engines, which were used to power machinery in factories and mines (Montagna, 1981). Coal was cheaper and was an abundant alternative compared to other energy sources, such as wood and waterpower, which were increasingly becoming scarce. As a result, coal became the primary energy source for the growing industrial economy (Montagna, 1981).

Currently, coal is the primary energy source for most of South Africa's electricity generation capacity. The coal mining industry employed over 93,000 people in 2021 (Minerals Council South Africa, 2022). In South Africa, Sasol employed around 26,000 individuals (Sasol, 2018). All told, this indicates that 125,000 actual employees could be impacted, either directly or indirectly, by the move away from coal. Mpumalanga produces over 97% of all electricity in South Africa (Makgetla & Patel, 2021). Mpumalanga has a highly localised coal value chain, which includes coal mining, electricity, and petrochemical production (Makgetla & Patel, 2021). These economic activities are concentrated in several communities throughout the province. Their economies are mostly dependent on coal, but there are other local businesses that are supported by the coal value chain activities and fall outside of it, such as food, lodging, and retail. These findings suggest that the risks associated with climate change, whether it originates domestically or as a result of broader macroeconomic effects, threaten the value chain's economic contributions (Marais *et al.*, 2022).

According to Strambo and Runciman, "Eskom, South Africa's state-owned energy company, announced the impending closure of five coal-fired power plants in 2017" (Strambo *et al.*, 2019; Runciman, 2019). Trade unions responded angrily to the announcement, which, in turn, triggered public discussions on how communities and employees in South Africa will be affected by changes to the country's electricity grid. The debate was dominated by technical and economic factors that relate to the energy system. Nonetheless, more needs to be revealed about the more comprehensive, especially upstream, social effects that the inevitable move from coal implies.

Nonetheless, there may be significant local, social, and economic effects, particularly in regions where coal extraction is practised. Up until now, discussions on the energy system have focused more on its financial problems than on the social and economic implications (Pollet *et al.*, 2015).

The shutdown will severely impact the majority of Eskom's coal plants and the mines that supply them. Conversely, the mine closures will make it easier for qualified employees, such as engineers and managers, to transition into other mainstream jobs (Nel, 2018). The mine workers, small businesses, and truck drivers will be the most affected compared to the vulnerable group (Nel, 2018). This risk is generally recognised in the coal transitioning literature (Statistics South Africa, 2018).

The inadequate support provided to vulnerable individuals in former coal mining cities lags behind economically and socially compared to other nations, such as the United Kingdom and Poland, that have restructured their coal sector. The affected mining towns affected by these changes suffer devastating economic repercussions compared to areas with more diverse local economies. This is because they have few viable economic alternatives to coal mining (World Bank, 2018).

The literature on mine closures and coal transitions identifies certain attributes of mining communities as aggravating the social effects of declining coal employment. For instance, the pay for working in the coal sector is comparatively good when compared to other economic prospects for persons with the same level of education and succeeding generations of coal miners typically stay in the profession. Additionally, the economic foundation of these mining communities is limited, heavily reliant on coal, and somewhat remote due to their unique coal mining characteristics (World Bank, 2018). The local economies of South African coal mining districts also display these varied attributes.

By the early 2020s, the coal value chain in South Africa was already on a constant decline, and the inevitable was experienced worldwide. The two variables that contributed to the decrease were: one, the use of coal for power generation momentarily became outdated, disintegrating the value chain due to cleaner energy being promoted internationally. And two, due to climate change and the dilemma worsening, there was more pressure both internationally and locally to restrict the use of coal-based products (Wright *et al.,* 2019*).*

This study aimed to explore the just transition to renewable energy and its effect on the coal value chain, which consists of the coal industry workers, coal miners, power plant operators, and other professionals in Mpumalanga (Montmasson, 2021).

1.2 PROBLEM STATEMENT

The concept of a ‘just transition’ underscores the importance of a fair and inclusive process that considers the social, economic and environmental implications of moving away from coal (Wang & Lo, 2021). It involves addressing potential challenges faced by various groups during the transition, such as mineworkers, local communities, small-scale miners and suppliers.

Despite the environmental and economic benefits of renewable energy, Mpumalanga remains heavily reliant and dependent on coal as an energy source (Montmasson, 2021). South Africa had to transition away from coal in the medium term. The most significant undertaking was to manage the value chain from top to bottom with the most negligible negative impact and considerable societal benefit. If successfully implemented, the economy will be more diverse and competitive and will create a more reliable and economical electrical grid (Wright *et al.,* 2019).

Two possibilities are available to Mpumalanga as coal-based activities are phased out over the next eras. Firstly, to continue on the coal path until it becomes depleted or to explore alternative possibilities that could boost the region’s economic diversification and renew its economy and society (Montmasson-Clair, 2021).

The Paris Agreement was signed with the main aim of combating climate change and lowering fossil fuel emissions (Burton *et al.,* 2019). Because coal accounts for 90% of the country's electricity, South Africa faces unique challenges as a result of the Paris Agreement (Bodansky, 2016). The reduction of coal-generated electricity will lead to severe implications for areas such as Emahleni in Mpumalanga, where such generation occurs (Bodansky, 2016). It is likely that jobs in coal-generated power plants and among coal miners will be lost. The effects of coal mine closures will be highly concentrated because the majority of Eskom’s coal facilities are located in the province of Mpumalanga.

The Presidential Climate Change Policy (PCC) emphasised the need to develop and implement strategies to transition away from coal and move towards renewable energy in the province in order to alleviate its negative effects and create new opportunities and economic growth (du Venage, 2022). The problem identified requires sensible management, considering the reduction in CO2 and global warming, but not at the expense of lively local hood (Marais *et al*., 2022).

Job losses in coal mines, power plants, and the transportation industry are potential consequences, along with the decline in municipal government revenue collection as well as the knock-on effect on local economies. As the economy goes greener, due to the Economic Social

governance (ESG) responsibilities, substantial effects on the coal value chain will be experienced and societies that are linked to it (Marais *et al*., 2022).

The research gap that was identified with regard to the just transition to renewable energy in Mpumalanga was the lack of comprehensive understanding of the socio-economic impact on the coal mineworkers and vulnerable groups in the coal value chain during the transitioning stage. The main focus of previous comprehensive research studies conducted was on the environmental and economic effects; however, limited research exists on the exploration of the experiences and challenges faced by coal mineworkers and vulnerable groups in Mpumalanga. Heffro (2021) defined the just transition as "justice scholarship". It combines climate justice, environmental justice, and climate justice into one due to the limited research uniting these three perspectives into one (McCauley & Heffron, 2018). In this study, the just transition encapsulated all three perspectives, and explored the impact that it will have on the coal value chain (Makgetla & Patel, 2021).

1.4 RESEARCH OBJECTIVES OF THE STUDY

The following objectives were formulated for the study:

1.4.1 Primary objective

The primary objective was to understand the potential challenges and opportunities for the just transition in Mpumalanga, considering the perspective of coal mineworkers, local communities, small-scale miners, suppliers, and coal-dependent regions that would impact the coal value chain in Mpumalanga.

1.4.2 Secondary objectives

- Conducting a literature review on renewable energy and its theoretical relevance.
- Review the best practices from other regions or countries that have successfully transitioned from coal to renewable energy.
- Based on existing case studies of transitioning and the challenges and opportunities explored, what are the recommendations to ensure a just transition to renewable energy in Mpumalanga?
- Summarising the study with recommendations relevant to policymakers in the South African energy sector context.

1.5 RESEARCH QUESTION

What are the potential challenges and opportunities for coal mineworkers, local communities,

small-scale miners, suppliers and coal-dependent regions in Mpumalanga with the transitioning away from fossil fuel to renewable energy?

Based on existing case studies of transitioning and the challenges and opportunities explored, what are the recommendations to ensure a just transition to renewable energy in Mpumalanga?

1.6 DELIMITATIONS (SCOPE) AND LIMITATIONS OF THE STUDY

1.6.1 Field of Study

This study discipline is business management and is linked to the field of study of Information Communication and Technology Management.

1.6.2 Geographical demarcation

The study was conducted using data concerning the Mpumalanga Province, South Africa 90% of the coal mines are situated in Mpumalanga, giving a greater reach and significance of the explorative nature of the study.

The province had a population size of 5,142,216 during 2022 and ranked 6th in South Africa.

1.6.3 Sector under investigation

The study focused on the South African Energy sector, particularly on the coal mining sector. Therefore, the results of this study cannot be generalised to other sectors of the Economy in South Africa.

1.6.4 Business under investigation

The business under investigation is Eskom Holdings SOC Ltd and coal mines in Mpumalanga.

1.6.5 Limitations to the study

The results of this study could not be generalised as the key focus of the study was only on South Africa, particularly the Mpumalanga province, which may not apply universally. Different contexts may possibly result in different challenges and opportunities in transitioning away from coal to renewable energy. Another limitation of the study was temporal relevance as most of the literature and data used was up to the early 2020s; the transition towards renewable energy is dynamic. Additionally, the rapid pace of change in fields like renewable energy and the coal industry may also contribute to the study's focus on data up to the early 2020s. This may reflect something

other than recent developments and energy landscape shifts. Future uncertainties: the energy transition was subject to various uncertainties, including policy changes, technological advancements, and market fluctuations. The literature review may need to capture uncertainties and their implications fully.

1.7 STUDY CONTRIBUTION

1.7.1 Theoretical Contribution

This study contributed to the existing body of knowledge regarding the just transition away from the use of fossil fuels to renewable energy.

1.7.2 Policy Contribution

The study provided South African policymakers a better understanding of the current state of prospective challenges and opportunities that exist in the just transitioning from fossil fuel to renewable energy.

1.8 RESEARCH DESIGN AND METHODOLOGY

The study comprises a literature review and an empirical study. Qualitative research, using content analysis, was used for the empirical portion of the study. Content analysis involved selecting diverse documents from the Department of Mineral Resources, mine websites and published academic journals. The nature of documents varied from formal reports to informal written materials, offering a rich data source. A thematic analysis was applied in five phases, which includes familiarisation, generation of initial codes, searching and reviewing themes and, lastly, defining, or naming themes.

1.8 RESEARCH DESIGN AND METHODOLOGY

1.8.1 Literature review

A literature review is a critical and comprehensive analysis of published articles, textbooks and other scholarly resources related to a specific research topic or question (Rowley & Slack, 2004). A literature study was performed on the following:

- Electronic journal articles, newspaper articles and published scholarly theses provide general information regarding the coal value chain and renewable energy
- The Paris Agreement, adapted on 12 December 2015
- The National Employment Vulnerability Assessment (NEVA)

- Sector Job Resilience Plans (SJRPs)
- NEVA and SJRPs, as stipulated in the National Government Climate change response white paper 2011)
- The Presidential Climate Change Policy (PCC), adopted 2020
- Integrated Resource Plan (IRP 2010-2030) adopted in October 2019
- Any other Acts that were deemed to be applicable to this study.

1.8.2 Qualitative review

For the purpose of this study, a content analysis, in the form of an integrative literature review, was conducted in order to obtain the necessary secondary data. The purpose of the content analysis was in line with the objective, which was to explore the theoretical underpinnings of renewable energy and its relevance to the South African context.

1.8.3 Population

The target population refers to the entire group of individuals or elements which the researcher intends to generalise the study findings; it represents the larger group that the study aims to draw conclusions about (Creswell, 2014). The target population for the study was existing publications related to mining companies. The study focused on 152 mines operating within the study area. These mines represented a diverse range of operations across the value chain, including exploration, development, extraction, processing and distribution.

1.8.4 Sampling and Sampling Size

The unit of analysis for this study was coal extracting mines in Mpumalanga. This was based on the Department of Minerals and Energy analysis of the 152 active coal-producing mines(Energy, 2011) .

1.8.5 Data collection and analysis

The strategy used for the collection of secondary data was based on Kitchenham and Brereton's (2013) research study. The review methodology was based on the method of systematic review that is frequently used in the field of energy studies (Kitchenham *et al.,* 2009). The researcher combined a keyword-based search and a citation-based snowballing approach, resulting in thematically related publications. Snowballing is a search approach used for systematic literature studies.

1.9 CHAPTER OUTLINE

This study comprises the following chapters:

Chapter 1: Introduction and Background to the Study

This introductory chapter provides background to the study and problem statement. In this study, the purpose and research objectives were also discussed.

Chapter 2: Literature review: Renewable Energy and its Theoretical Relevance

This chapter consists of a detailed literature review on the coal value chain in Mpumalanga, as well as the developments in the renewable energy sector. This enabled an understanding of the key theoretical regulations in government. A review of empirical analyses from previous studies was undertaken, which highlighted some of the fundamental requirements and considerations for the successful transitioning away from fossil fuel to renewable energy.

Chapter 3: Research design methodology

This chapter presents the research approach and an overview of the research methodology used in gathering data for the purpose of this study.

Chapter 4: Results

Chapter 4 presents, interprets, and discusses the results on potential challenges and opportunities that exists for coal mineworkers and vulnerable groups in the coal value chain during the just transition to renewable energy.

Chapter 5: Conclusion

The conclusion to this study, with a set of recommendations relevant to policymakers as well as considerations for reform implementation in the South African energy context, is set out in the final chapter, Chapter 5.

1.10 CONCLUSION

South Africa stands at a key stage in its energy landscape as it endeavours to transition towards a more sustainable and renewable energy future. A brief overview of the background of the coal value chain in Mpumalanga is essential to better understand its critical role in the economy. A

critical analysis, the aim which is to determine the socio-economic impact on the coal mineworkers and vulnerable groups in the coal value chain during the transitioning stage, follows in Chapter 2

CHAPTER 2: LITERATURE REVIEW: RENEWABLE ENERGY AND ITS THEORETICAL RELEVANCE

2.1 INTRODUCTION

The literature on renewable energy and its theoretical relevance provides a foundation for understanding the complexities and opportunities of transitioning from fossil fuels to renewable energy. Chapter 2 critically analysed existing research on renewable energy, applicable policy frameworks and socio-economic implications, contributing to a comprehensive understanding of this topic. Furthermore, a review was conducted to explore case studies and best practices from other regions or countries that have successfully undertaken the transition from coal to renewable energy. Drawing lessons from these examples offers valuable insights and potential strategies that can be adapted to the unique context of Mpumalanga, helping to inform decision-making and policy development. South Africa boasts some of the world's largest coal-fired power stations. Eskom, a prominent utility company, pioneered innovative methods for burning low-grade coal in

these power stations. Notably, Eskom even financed privately owned coal mines, which provided low-grade coal for its operations, while the mines exported higher-quality coal, generating substantial profits for their owners (Timmons *et al.*, 2014). However, the landscape has evolved in recent years. Over the last decade, renewable energy technologies, such as solar and wind power, have become more cost-effective than coal (Roser, 2020). Yet, coal-fired power stations typically have lifespans of 40 years or more and it takes considerable time and financial resources to recover their initial capital costs. As a result, transitioning away from coal is a complex process that requires both time and investment.

2.2 THE ROLE OF COAL MINES IN SOUTH AFRICA

The developmental path of South Africa has been strongly influenced by the relationship between mining and cheap coal-based energy (Funds, 2020). Coal is central to South Africa's economy and lies at the heart of the mineral energy complex that has dominated economic and political development in the country for more than 100 years (Hancox & Götz, 2014). The mining industry is an essential part of the South African economy, contributing 480.9 billion rands to the country's gross domestic product (Statista, 2023). Coal currently powers the majority of South Africa's electrical generation capacity. During 2021, the sector employed approximately 93,000 workers (Minerals Council South Africa,2022). Over 26,000 people worked at Sasol in South Africa (Sasol, 2018).

Coal has been a source of energy for centuries; however, the widespread use of coal as an energy source came about during the Industrial Revolution in the 18th and 19th centuries (Newell & Mulvaney, 2013). During this period, there was a rapid increase in the use of coal to power steam engines, which were used to power machinery in factories and mines (Montagna, 1981). Coal was a cheaper alternative and more readily available compared to other energy sources, such as wood and waterpower, which were becoming increasingly scarce. As a result, coal became the primary energy source for the growing industrial economy (Cock, 2019). The discovery of vast coal reserves in Mpumalanga led to a significant economic boom in the region. Coal mining operations attracted investment and provided employment opportunities for many people. As a result, the mining industry became a crucial driver of economic growth and development in the province. With the growing demand for coal as an energy source, Mpumalanga emerged as a leading coal-producing province in South Africa (Montagna, 1981).

Mpumalanga is a province located in the north-eastern region of South Africa and has played a pivotal role in the country's coal mining and energy generation sectors. The history of coal mining in Mpumalanga can be traced back to the late 19th century when coal was first discovered in the

region. The exploitation of coal resources gained momentum in the early 20th century with the establishment of several mines and the development of infrastructure to facilitate coal extraction and transportation. The coal extracted from the Mpumalanga mines not only serves the domestic market but also contributes significantly to South Africa's export earnings. Coal is one of the country's largest exports by value and 30% is exported (du Venage, 2022). The country's reliance on coal for electricity generation further reinforced the importance of Mpumalanga in meeting the nation's energy needs. Eskom, the state-owned power utility, operates several large coal-fired power plants in the province, supplying a substantial portion of South Africa's electricity (Campbell & Coenen, 2017)

South Africa is also affected by the overall energy shortages to meet the supply and demand of electricity. In 2022, the country had an estimated 223 days of continuous blackouts, meaning that the demand for electricity outweighed the supply of energy capacity. As a result, this has strengthened the course to transition to renewable energy or alternative energy mix (business tech,2023). The just transition for South Africa has become critical due to the country’s reliance on coal. Coal accounts for 90% of the country’s electricity generation and 74% of the power supply. For many centuries, coal has played a fundamental role in the economy. However, market and policy signals, along with targets to cut greenhouse gas emissions, indicate that the decline of the coal sector will be inevitable. It is, therefore, much more crucial that the need to manage an accelerated transition to cleaner energy in a country facing extreme inequality, unemployment and poverty makes it all more important for the transition to be inclusive and just (Funds, 2020).

2.3 COAL VALUE CHAIN

Mpumalanga has a highly localised coal value chain, including coal mining, electricity, and petrochemical production (Makgetla & Patel, 2021). These economic activities are, to a large extent, concentrated in several communities. Its economies are based chiefly on coal. However, nearby commercial activities include retail, food, and lodging, which are beyond the coal value chain and are primarily supported by coal value chain activities. These findings suggest that the risks associated with climate change, whether it originates locally or as a result of broader macroeconomic effects, compromise the value chain's economic contributions (Marais *et al.*, 2022). Despite its economic significance, the coal value chain in Mpumalanga has been subject to various challenges and criticisms over the years. The coal mining industry has been associated with environmental degradation, including water pollution, deforestation, and greenhouse gas emissions. Moreover, the extraction and burning of coal have contributed to air pollution and have been linked to adverse health effects for communities residing near mining and power plant sites (Timmons *et al.*, 2014). The coal value chain in South Africa encompasses various stages

involved in the extraction, processing, distribution, and utilisation of coal resources, as shown in Figure 2.1. The different stages of the coal value chain are briefly explained thereafter.

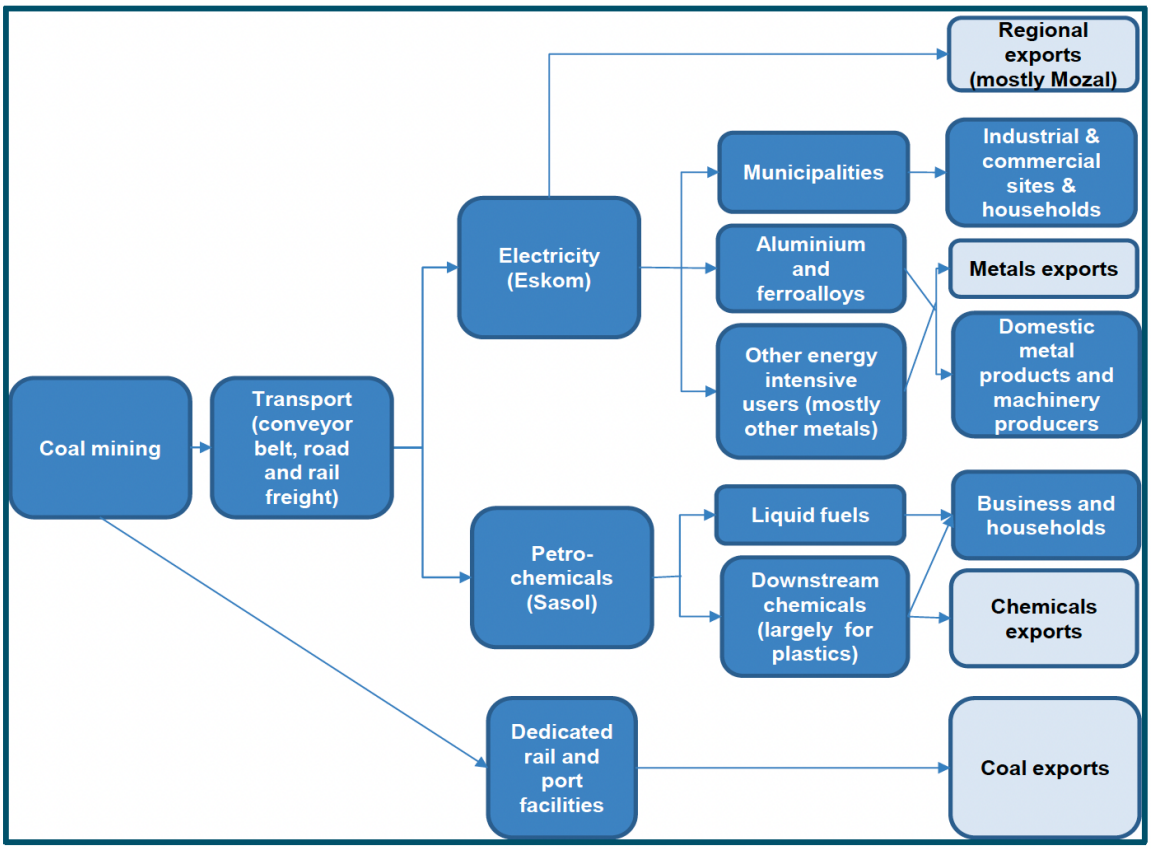

Figure 2.1: Coal value chain

Figure 2.1 explains the different stages of the coal value chain, which are unpacked below from point (2.3.1-2.3.5)

Source: (Energy, 2011)

2.3.1 Coal mining

The coal value chain in South Africa starts with exploration to find coal deposits, followed by mine development to prepare the site, and obtain permits. Extraction involves mining the coal and South Africa's diverse coal types offer varying energy content and quality. This value chain is crucial to the country's economy and energy production (Makgetla & Patel, 2021).

2.3.2 Coal processing

Post-extraction processing of coal in South Africa includes crushing and sizing to achieve the desired particle size, washing to remove impurities like ash and sulphur and beneficiation to enhance coal quality for various applications and environmental considerations (Montmasson-Clair, 2021).

2.3.3 Coal transportation

In South Africa's coal value chain, transportation plays a crucial role. Coal transportation involves rail for long-distance haulage, trucks for shorter journeys to local destinations and strategic ports for coal export, contributing to the nation's prominent position in the global coal trade (Dincer, 2000; Strambo *et al.,* 2019).

2.3.4 Coal export

South Africa is one of the world's largest coal exporters, and coal is a significant contributor to the country's economy. The primary destinations for exports are countries in Asia, particularly India and China, as well as other parts of Africa (Clarke, 2017)

2.3.5 Domestic use

Coal in South Africa serves multiple purposes. Coal is supplied to Eskom for power generation, and coal power plants are vital for electricity generation in South Africa. Coal is also used in a number of industries, such as steel manufacturing, cement production and chemical manufacturing. In some parts of the country, coal is used for household heating and cooking (Montmasson-Clair, 2021).

South Africa boasts some of the world's largest coal-fired power stations. Eskom, a prominent utility company, pioneered methods for burning low-grade coal in these power stations. Notably,

Eskom even financed privately-owned coal mines, which provided low-grade coal for its operations, while the mines exported higher-quality coal, generating substantial profits for their owners (Hancox & Götz, 2014)

However, the landscape has evolved in recent years. Over the last decade, renewable energy technologies, such as solar and wind power, have become more cost-effective than coal (Roser, 2020). Yet, coal-fired power stations typically have lifespans of 40 years or more and it takes considerable time and financial resources to recover their initial capital costs. As a result, transitioning away from coal is a complex process that requires both time and investment.
To combat climate change, reducing greenhouse gas emissions is crucial, but this poses challenges for several groups, including fossil fuel industry workers and communities, as well as vulnerable populations like women, youth, and the poor, who are already facing numerous hardships in South Africa. Managing this transition requires strategies that address the inevitable challenges arising from the shift away from fossil fuels while also capitalising on the opportunities presented by the green economy to benefit a wide range of stakeholders (Makgetla & Patel, 2021).

2.4 VULNERABLE GROUPS

In the context of this study, vulnerable groups encompass individuals who require protection and consideration during the just transition process(Wang & Lo, 2021). Specifically, these vulnerable groups are those connected to the coal value chain, including mine workers, coal furnace operators and their immediate families(Makgetla & Patel, 2021). While the predominant just transition discourse often centres on the green economy and reducing carbon emissions, this study emphasises the importance of addressing the unique challenges and needs of these coal-related stakeholders (Strambo *et al.*, 2019). Due to inadequate support for these vulnerable people, former coal mining cities lag economically and socially in other nations, such as the United Kingdom and Poland, which have restructured the coal sector. The affected mining towns suffer catastrophic economic repercussions compared to areas with more diverse local economies since they have few viable economic alternatives to coal mining (World Bank, 2018).

The literature on mine closure and coal transitions identifies specific attributes of mining communities that worsen the social effects of declining coal employment. For example, successive generations of coal miners tend to stay in the industry and the pay for working in the coal sector is relatively high compared to other economic opportunities for people with the same level of education. These mining towns also have a narrow economic base that is heavily

dependent on coal, are somewhat geographically isolated and have a coal mining "identity" (World Bank, 2018). The local economies of South African coal mining districts exhibit these varied traits.

The just transition agenda aims to ensure that vulnerable stakeholders are better off through the transition process, or at least not adversely affected by it. The concept originated from the 1970s labour movement in the United States (USA) in reaction to toxic waste clean-up policies, which disproportionately affected vulnerable workers (du Venage, 2022; Montmasson-Clair, 2021). Just transition discussions have almost mostly focused on the coal value chain, the phasing out of coal-fired power plants and related coal mines and the ensuing impacts on affected groups (Stevis & Felli, 2015). Many countries have required assistance with energy resources to meet the demands of their clients and citizens. Governments across the globe have had to produce alternative resources for energy production. This has strengthened the case for the just transition to alternative energy (McWilliams *et al.,* 2022*).*

The socio-economic landscape in Mpumalanga is experiencing a significant shift as the region transitions from coal to renewable energy. This change is prompted by global events, environmental concerns, and the need to align with sustainability goals (Burton *et al.*, 2019). The coal value chain, historically vital for South Africa's growth, is declining globally due to outdated power generation methods and increased pressure to limit coal use. This decline affects various sectors, including coal mining, power plants, and transportation, impacting workers, small businesses, and local economies (Montmasson-Clair, 2021). The government aims for a just transition, but challenges include potential job losses, revenue decline and economic restructuring. The socio-economic impacts are intricate, requiring sensitive management to balance environmental goals with the well-being of local communities(Montmasson-Clair, 2021). Overall, the socio-economic theme or impact analyses emphasise the need for comprehensive strategies that mitigate negative impacts and foster inclusive growth during the transition(Strambo *et al.*, 2019).

This study took a point of departure on the coal value chain by concentrating on coal mining in Mpumalanga. The vulnerable groups in reference are the coal miners, small businesses, coal truck drivers and directly impacted municipalities (Montmasson-Clair, 2021).

2.5 THE REPLACEMENT OF COAL WITH RENEWABLE ENERGY

Numerous national and international studies advocate that the energy transition in South Africa

and particularly the transition from coal, will likely occur far more rapidly than anticipated in the government's 2019 long-term energy plan. This, in turn, suggests the need for far greater urgency in the planning for just transitions in South Africa. Changes in the South African energy system and international coal markets are interlinked. The majority of South Africa's mines are commercially viable due to their ability to sell a portion of their product to the international markets at higher prices (Burton & Winkler 2011; SACRM 2011). If the demand for coal exports declines or disappears, some mines would no longer be able to make a profit regardless of the local demand from South Africa's energy system (Wang & Lo, 2021; Huxham *et al*., 2021).

By the early 2020s, the value chain in South Africa was already on a steady decline and the inevitable was experienced worldwide (Burton *et al.*, 2019). Two variables contributed to the decline: the use of coal for power generation quickly became outdated, disintegrating the value chain due to cleaner energy being marketed internationally; and due to climate change and the problem worsening, there was more pressure both internationally and locally to restrict the use of coal-based products *(*Wright *et al.,* 2019*).* As the production of coal decreases, jobs and regional economic development will need attention. Significant changes in the mining and power sectors are also likely to have implications for South Africa's political landscape (Marais *et al.,* 2022).

Job losses in coal mines, power plants and the transportation industry are potential consequences, along with a deterioration in municipal government revenue and a knock-on effect on local economies. As the economy goes greener, due to the Economic Social Governance (ESG) responsibilities, there will be direct, consequential effects on the coal value chain and the societies linked to it and everyone that is linked to it (Marais *et al.,* 2022).

2.5.1 Environmental and regulation considerations

The coal value chain in South Africa has environmental concerns, including pollution, greenhouse gas emissions and habitat disruptions. To address these concerns, the country has implemented regulations establishing emissions standards and mandating practices for land reclamation, focusing on managing the environmental impacts that mining has and its utilisation (Makgetla & Patel, 2021).

2.5.3 Social and economic impact

The coal industry in South Africa has a significant impact on local economies and communities, providing employment and contributing to government revenue. This industry faces numerous challenges related to labour, social responsibility, and community engagement. South Africa is transitioning away from coal in favour of cleaner and more sustainable energy sources, aligning

with the Paris Agreement policy and global efforts to combat climate change (Makgetla & Patel, 2021).

2.6 ENERGY TRANSITION

As economies develop and become more complex, the need for more energy increases (Winkler, 2005). Each stage of economic development has been accompanied by a characteristic energy transition from one major fuel source to another. Fossil fuels such as coal, oil and natural gas are currently the primary energy source in industrial economies and the dominating energy source in in developing economies. In the twenty-first century, we are witnessing a significant transition in energy sources, shifting from fossil fuels to renewable energy sources. The transition to renewable energy is motivated by several factors, namely, environmental impacts such as climate change, limits on fossil fuel supplies, technology changes and prices (Timmons *et al.,* 2014*)*.

Renewable energy encompasses various sources such as solar, wind, hydro, biomass, and geothermal energy. Solar energy harnesses the power of sunlight, while wind energy utilises wind turbines to generate electricity. Hydroelectric power is generated through the flow of water, biomass energy utilises organic matter, and geothermal energy harnesses heat from the interior of the earth (Winkler, 2005). Many economies rely on fossil fuels for 80% of their energy supplies due to the low cost and abundance of these sources.

But in recent years, the cost advantage of fossil fuels over renewable energy sources has been decreasing, and certain renewables can compete with fossil fuels in terms of price or profitability. In the long term, we will see the cost of renewables decrease, and the cost of fossil fuels increase. Thus, even without policies encouraging the transition towards renewable energy, economic factors are currently moving most countries in that direction (Solomon & Krishna, 2011). Renewable energy supplies cannot be matched to demand as easily as fossil fuels (Van den Berg, 2001). The majority of renewable energy sources are more expensive than fossil fuels because they have low-capacity factors and are less consistent than fossil fuels, which increases cost. The transition to renewable energy has been slow due to long-held assumptions that it is expensive for large-scale developing countries. The immediate priority for these developing countries in Africa is to elevate hunger and extreme poverty (Deichmann *et al.,* 2011). However, this notion is changing as there has been a breakthrough in development due to global investment. Large portions of the transition to renewable energy will not come from providing new energy sources but by redesigning systems that consume less energy. It is inevitable that there will be an eventual transition to renewable energy, which is unavoidable. The challenge now is how to manage this shift to minimise the overall cost of energy services as well as the cost of

damages caused by energy consumption. Eventually, the current energy system, which is dominated by fossil fuels, will be replaced by a combination of renewable energy sources and conservation. Addressing climate change suggests that this needs to happen sooner rather than later. Renewable energy is entering the market at a scale that can compete with fossil fuels. South Africa and other developing countries are reconsidering the notion that their economic future depends on fossil fuels (Deichmann *et al.,* 2011). We see more and more renewable energy projects being rolled out and are viable due to the cost of wind and solar technology.

2.6.1 Policies

It is evident that a number of renewable energy transition government policies can affect the progress made in terms of the transition to renewable energy.

A brief outline of key policies in the South African context are set out in Table 2.1.

Table 2.1: Key policies on renewable energy transition

Policy	Description	Date of Inception	Impact on the JIT
Paris Agreement	The Paris Agreement is an international treaty that aims to combat climate change by limiting global warming to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit the temperature increase to 1.5 degrees Celsius. The Agreement marked a historic milestone in global efforts to address climate change and garnered widespread support from countries around the world (Burton et al., 2016)	It was adopted on December 12, 2015, during the 21st Conference of the Parties (COP21) of the United Nations Framework Convention on Climate Change (UNFCCC,2016) held in Paris, France.	The Paris Agreement, which requires countries to reduce greenhouse gas emissions, poses a significant challenge to South Africa due to its historical reliance on coal for energy. This shift away from coal has a direct impact on Mpumalanga, a province known for coal mining and coal-based energy production. To align with the Paris Agreement's goals, South Africa is increasingly adopting renewable energy sources like solar, wind and hydropower. However, this transition necessitates a just transition strategy that addresses the social and economic consequences on communities and workers in coal-dependent regions like Mpumalanga. The focus is on ensuring that the move towards renewable energy is fair and inclusive and considers the wellbeing of those affected.

Policy	Description	Date of Inception	Impact on the JIT
Integrated Resource Plan (IRP2010-2030) Section 35(4) Electricity Act, 2006 (4 of 2006). Electricity Regulation on New Generation	The IRP is an electricity infrastructure development plan based on least -cost electricity supply and demand balance, taking into account security of supply and the environment (minimise negative emissions and water usage). The IRP aims to ensure a reliable and secure energy supply for the country. By diversifying the energy mix and incorporating different energy sources, such as renewables, natural gas, and nuclear power. The country can reduce its dependence on a single energy source and enhance its energy source	The document came into existence on the 17 of October 2019.The document was signed by the Minister of Mineral Resources and Energy, Mr Samson Gwede Mantashe	The IRP provides a comprehensive and strategic framework for a country's energy sector development. The IRP also outlines a long-term vision and strategy for how the country plans to meet its future energy needs while considering factors like energy security, affordability, environmentally sustainable and economic development

Policy	Description	Date of Inception	Impact on the JIT
PCC (Presidential Climate Change Policy)	The Presidential Climate Commission (PCC) is a multi-stakeholder body established by the president to advise on the country's climate change response, support the just transition to low -carbon climate resilient economy and society. One of the tasks of the commission was to design a just transition framework for South Africa	December 2020	The framework developed by the council is based on thorough research, policy consultations and the application of best practices. Its primary objective is to create comprehensive and effective strategies that address climate change mitigation, adaptation to its impacts and a just transition for all sectors of society. The Council's role is to safeguard the wellbeing of its citizens, with a particular focus on those vulnerable to economic and environmental changes. In essence, the framework seeks to balance environmental sustainability with social equity and economic fairness to benefit the entire population (du Venage, 2022).

Source: Author's creation

A major factor influencing how quick we transition to renewable energy will be highly influenced by policy choices. Reforming fossil fuel subsidies and institutional pigovian taxes are two options that can yield more economically efficient outcomes. Furthermore, implementing plans to increase research and development expenditures, feed-in tariffs and setting renewable targets. Additionally, reducing the costs of solar PV and costs of energy storage devices such as batteries are two essential areas for technological development that could significantly reduce renewable energy costs in the long run (Timmons *et al., 2014*)

The South African government is actively promoting a just transition to a low-carbon economy in South Africa through two key initiatives, namely:

- **National Employment Vulnerability Assessment (NEVA)**

The purpose of the National Employment Vulnerability Assessment (NEVA) is to assess the effect of climate change and climate change responses on employment, both by sector and location. It seeks to understand the potential impact on employment and determine what job-related interventions are required and where these should be implemented (Timmons *et al.*, 2014).

- **Sector Job Resilience Plans (SJRPs)**

Ministries are tasked with the development of SJRPs, which focus on specific sectors of the economy. These plans explore opportunities for job creation within these sectors, particularly in the context of transitioning to a low-carbon economy.

The abovementioned initiatives align with the objectives that are outlined in the National Climate Change Response White Paper (Department of Environmental Affairs, 2011) and form part of South Africa's broader strategy to ensure that the transition to a sustainable, low-carbon economy is equitable and inclusive, taking into account both environmental and employment considerations.

2.7 SWOT ANALYSIS

Gurl (2017) defines SWOT analysis as an analysis method used to evaluate the strengths, weaknesses, opportunities, and threats involved in an organisation or project. It is popular among business researchers. The strategy is historically credited to Albert Humphrey in the 1960s (Teoli *et al.*, 2019). SWOT analyses have more advantages than shortcomings, especially when you have multiple projects and they become beneficial as they reduce ambiguity during the data modelling stage (Gurl, 2017).

A SWOT analysis was conducted to determine possible challenges and opportunities that various key stakeholders within the coal value chain face if the country opts to transition away from the use of fossil fuels to renewable energy.

Table 2.2 illustrates the various strengths, opportunities, and threats identified with respect to coal miners, local communities, small-scale miners, suppliers, and coal-dependent regions within the value chain.

Table 2.2: SWOT analysis

Coal Miners	
Strengths	**Weaknesses**
• Skilled workforce with experience in the mining industry(Marais *et al.*, 2022). • Opportunity for retraining and transitioning to renewable energy jobs(Strambo *et al.*, 2019). • Strong labour unions advocating for workers' rights (Fourie, 2018; Montmasson-Clair, 2021).	• Risk of job displacement and unemployment during the coal phase-out(Funds, 2020). • Transitioning to new industries may require retraining and adaptation(Stevis & Felli, 2015). • Possible resistance to change within the workforce (Campbell & Coenen, 2017).
Opportunities	**Threats**
• Employment opportunities in renewable energy projects (solar, wind, hydropower)(Campbell & Coenen, 2017). • Green job creation in areas like maintenance, installation, and grid integration(Timmons *et al.*, 2014). • Diversification of skills for a more sustainable job market (Burton & Winkler, 2014).	• Immediate job losses if coal mines close without alternative employment opportunities. • Potential wage disparities in the renewable energy sector(Marais *et al.*, 2022). • Relocation and disruption of communities as mining activities decrease (Campbell & Coenen, 2017; du Venage, 2022).

Local communities	
Strengths	**Weaknesses**
• Potential for improved air quality and reduced health risks as coal operations decline(Stevis & Felli, 2015). • Investment opportunities in renewable energy projects. • Potential for community engagement and local ownership of renewable projects (Stevis & Felli, 2015).	• Economic reliance on the coal industry, leading to potential decline in local economies. • Disruption due to job losses and population movement(Stevis & Felli, 2015). • Need for infrastructure development to support new industries (Makgetla & Patel, 2021).
Opportunities	**Threats**
• Diversification of the local economy through renewable energy investments. • Community-driven renewable projects for economic empowerment. • Sustainable development initiatives, such as eco-tourism, in the post-coal era (Burton & Winkler, 2014).	• Socioeconomic challenges during the transition period. • Resistance to change within the community. • Lack of access to training and resources for participation in the renewable energy sector (Nkoana, 2018; Winkler, 2005).
Small-scale miners and suppliers	
Strengths	**Weaknesses**
• Existing infrastructure and expertise in the mining supply chain. • Potential to adapt and provide services to renewable energy projects. • Opportunities to diversify product and service offerings (Makgetla & Patel, 2021).	• Dependence on the coal industry for a significant portion of revenue. • Potential decrease in demand for traditional mining supplies. • Competition with larger renewable energy suppliers(Makgetla & Patel, 2021).
Opportunities	**Threats**
• Shifting focus toward supplying renewable energy projects (e.g., solar panel manufacturing, wind turbine components)(Stevis & Felli, 2015). • Diversifying product lines to meet new industry demands.	• Financial instability due to reduced demand for coal-related products. • Lack of diversification may lead to business closures(Stevis & Felli, 2015). • Limited access to resources and information on transitioning to the renewable energy market (Dincer, 2000).

• Collaborating with renewable energy companies (Dincer, 2000).	

Coal-dependent regions	
Strengths	**Weaknesses**
• Access to energy infrastructure and grid networks(Stevis & Felli, 2015). • Potential for repurposing existing facilities for renewable energy generation(Merven *et al.*, 2017). • Support from government initiatives for transitioning regions(Stevis & Felli, 2015).	• Economic dependence on the coal sector, leading to job losses and revenue decline(Merven *et al.*, 2017). • Environmental rehabilitation challenges in former mining areas (Arndt *et al.*, 2019). • Need for rebranding and attracting new industries(Merven *et al.*, 2020).
Opportunities	**Threats**
• Investment in renewable energy projects to repurpose coal-related infrastructure(Merven *et al.*, 2017). • However, health will improve as a result of lower air pollution, more access to clean energy and community ownership models in renewable project types (Winkler, 2005) • Government grants and incentives for transitioning regions. • Sustainable development projects to diversify the local economy (Funds, 2020).	• Economic instability during the transition period(Marais *et al.*, 2022). • Social unrest and opposition to renewable energy projects(Marais *et al.*, 2022). • Environmental rehabilitation costs and liabilities (Beveridge & Kern, 2013).

2.8 ANTICIPATED CHALLENGES IN THE IMPLEMENTATION OF THE JUST TRANSITION IN MPUMALANGA

2.8.1 Social consideration

There are societal difficulties and opportunities associated with South Africa's transition to renewable energy, notably in the province of Mpumalanga (Bodansky, 2016). For mineworkers, local communities, small-scale miners and suppliers, challenges include possible job loss and economic restructuring. South Africa places a high value on coal economically because it is a big

employer in the mining industry and a large contribution to the nation's Gross Domestic Product (GDP). Strong opposition to switching to alternative energy sources has resulted from the established position of coal in the economy. Strong economic and political entities with vested interests in the coal industry, as well as local governments and labour unions that profit from the broad value chains linked to coal, are driving this pushback (Bodansky, 2016). To achieve a just transition to cleaner and more sustainable energy sources while taking into account the economic and social ramifications for all stakeholders, it is challenging to navigate these complex dynamics (Funds, 2020; Strambo *et al.*, 2019).

2.8.2 General challenges in the implementation of the just transition

In examining the just transition, several general challenges emerged. The rising costs associated with coal use present a financial hurdle exacerbated by the availability of cheaper alternative energy sources (Roser,2020). The decommissioning of ageing coal-fired power plants without immediate replacement raises questions about the reliability of the energy supply(Beveridge & Kern, 2013; He *et al.,* 2020). Furthermore, lower electricity demand, contrary to projections, poses an additional challenge. As the urgent need to reduce greenhouse gas emissions becomes more pressing, the coal-dependent region faces environmental concerns, particularly regarding air and water quality (Marais *et al.*, 2022).

These drivers underscore the need for a swift transition to cleaner and more sustainable energy sources in South Africa's energy landscape. Economic (least cost trajectory, technologically increasing automation), and environmental (national determined contributions of CO2 emissions and water scarcity) limitations are projected to cause a decline in employment in the coal mining sector (Funds, 2020).

2.8.3 Political implications

Unions representing fossil fuel sector workers have been cautious or sceptical about taking immediate action to reduce greenhouse gas emissions. Government support for a 'just transition' and 'green jobs' has been questionable, especially given historical instances like the gold industry's decline in the post-1994 era, where affected workers received little assistance (Timmons *et al.*, 2014).

Currently, around 90,000 miners and 60,000 workers in the coal value chain are hesitant to embrace changes, including opposing the carbon tax, as they attempt to preserve fossil fuel industries(Marais *et al.,* 2022). Nevertheless, it is clear that the industry is changing rapidly. Major mining companies are divesting from coal, Eskom plans to decommission coal-fired power

stations faster, and the Integrated Resource Plan anticipates a significant decline in coal-based electrical energy production between 2030 and 2050 (Energy, 2011).

In light of these changes, unions would be better advised to advocate for their members' training in new roles within the sustainable energy sector and collaborate with the government to define the parameters of a just transition (Nicol, 2021).

As coal production wanes, addressing job losses and regional economic development becomes crucial. Furthermore, these shifts in the mining and power sectors are likely to impact South Africa's political landscape.

In conclusion, the just transition in Mpumalanga could encounter similar multifaceted general challenges ranging from economic considerations and reliability issues to environmental impacts. Addressing these general challenges will be crucial in navigating the transition effectively and ensuring a sustainable future for the region and that all its key stakeholders are considered.

2.9 ANTICIPATED OPPORTUNITIES IN THE IMPLEMENTATION OF THE JUST TRANSITION IN MPUMALANGA

The shift towards renewable energy presents both challenges and opportunities in the economic sphere. While the coal industry has been a significant source of employment in Mpumalanga, renewable energy adoption can lead to new job opportunities and economic growth. Studies have indicated that the renewable energy sector has the potential to create a significant number of jobs, particularly in the manufacturing, installation, and maintenance of renewable energy infrastructure. The theoretical relevance of these findings lies in the potential for a just transition, where workers from the coal sector can be reskilled and absorbed into the renewable energy industry (Marais *et al.,* 2022).

2.10 KEY BENEFITS OF RENEWABLE ENERGY

Eskom is struggling to keep the lights on; South Africa had more blackouts in 2023 than the previous year, which is due to the utility struggling with ageing infrastructure and coping with the demand (Van den Berg, 2001).To date, the situation has not improved, and it strengthens the mandate for a greater energy mix of renewables (CNN,2023).

2.10.1 Renewable energy can improve energy security

Diversifying the energy mix of renewable sources can help reduce the dependence on fossil fuels and improve energy security for South Africa (Winkler, 2005).

2.10.2 Job creation for economic growth

The renewable energy sector has the potential to create new jobs and support economic growth in South Africa, particularly in rural areas.

2.10.3 Improved Public Health

Reducing air pollution, specifically from fossil fuel combustion, can significantly benefit South Africans, particularly those living near coal-fired power plants (Van den Berg, 2023).

The transition to renewable energy presents challenges and costs, including substantial infrastructure investments, potential job losses in affected industries and grid integration issues. However, coal mining areas in Mpumalanga benefit from a robust electricity transmission system and proximity to a significant load centre in Gauteng province (Merven *et al.*, 2020).

2.11 COMMON TRENDS AND COMMONALITIES OF COUNTRIES THAT HAVE TRANSITIONED AWAY FROM COAL

This section presents lessons to be learnt from countries that successfully transitioned to renewable energy.

Germany, Poland, Portugal, and China have made varying degrees of progress in transitioning away from coal. While each country's situation is unique, they share some commonalities with South Africa, which can provide insights into successful coal transition strategies. Here are some key aspects of their transitions and commonalities with South Africa:

2.11.1 Commitment to renewable energy

Germany, Portugal, and China have heavily invested in renewable energy sources, such as wind, solar and hydropower. They have set ambitious targets for expanding renewable energy capacity, which aligns with South Africa's shift towards renewables to meet climate commitments (Arndt et al., 2019; He et al., 2020).

2.11.2 Energy diversification

All these countries have recognised the importance of diversifying their energy mix. They are not solely dependent on coal and have introduced natural gas, nuclear power, and other cleaner alternatives, similar to South Africa's approach (Energy, 2011).

2.11.3 Policy support

Clear and consistent government policies have played a crucial role in facilitating these transitions. Supportive policies include incentives for renewable energy, emission reduction targets and strategies for just transitions for coal-dependent communities (Beveridge & Kern, 2013).

2.11.4 Phasing out coal

These countries have implemented coal phase-out plans with defined timelines. While the pace varies, the commitment to gradually reducing coal use and, ultimately, phasing it out is a common strategy (Beveridge & Kern, 2013).

2.11.6 Investment in innovation and technology

Investments in research and development, as well as innovative technologies, have been vital in enhancing energy efficiency and transitioning to cleaner energy sources. This approach aligns with South Africa's efforts to develop and adopt advanced technologies (Beveridge & Kern, 2013).

2.11.7 Job Transition and community support

Just transition policies are in place to support workers and communities affected by coal mine closures and power plant shutdowns. Similar to South Africa, these countries have sought to minimise the socio-economic impact on coal-dependent regions *(*Marais *et al., 20*22).

2.11.8 International collaboration

Collaboration with international organisations and countries has been a feature of these transitions. They have sought expertise, financial support, and technology transfer from global partners, which is in line with South Africa's need for international collaboration (He *et al.*, 2020).

2.11.9 Adaptability and flexibility

Adaptability in response to changing energy market dynamics and technology advancements has been a common feature. These countries have adjusted their energy transition plans when

needed, which South Africa may also need to do to remain flexible and responsive *(*Arndt *et al.,* 2019*).*

2.11.10 Public engagement and education

Public engagement and education campaigns have been used to garner support for transitioning away from coal. Public awareness and involvement are critical in gaining acceptance of these changes.

2.11.11 Economic diversification

Efforts to diversify the local economy in coal-dependent regions have been undertaken. This includes investments in new industries, skills development, and job creation, which are crucial for successful transitions (Deichmann *et al.,* 2011). While these countries' experiences can provide valuable lessons for South Africa, it is essential to recognise that each transition is context-specific. South Africa's unique challenges, including high unemployment and a history of coal dependence, will require tailored strategies and policies to ensure a just and successful transition away from coal.

2.12 SUMMARY AND CONCLUSION

This chapter delves into the intricate landscape of renewable energy transition, with a particular focus on the South African context, with a focus on Mpumalanga. The urgency for transitioning from fossil fuels has gained momentum globally, driven in part by geopolitical events such as Russia's invasion of Ukraine in 2021, prompting European countries to reconsider their energy mix rapidly. In the South African context, energy shortages, exemplified by 223 days of continuous blackouts in 2022, underscore the need for a shift towards renewable energy sources. The coal value chain, a cornerstone of the South African economy, especially in provinces such as Mpumalanga, faces challenges and criticisms.

The chapter underscores the importance of policy choices in influencing the speed of the transition, citing examples such as reforming fossil fuel subsidies and implementing institutional Pigovian taxes. The Paris Agreement plays a pivotal role, necessitating South Africa's transition away from coal. However, the chapter highlights the potential socio-economic consequences, including job losses and revenue declines at local levels. Environmental concerns associated with

the coal value chain, such as pollution and habitat disruptions, are also discussed, with regulations in place to mitigate the impacts.

The concept of just transition emerges as a guiding principle, aiming to ensure that vulnerable stakeholders are not negatively impacted by the transition process. However, historical instances, such as the decline of the gold industry post-1994, raise scepticism about government support for this transition. Unions representing fossil fuel workers have been cautious, and the potential for job creation and economic growth in the renewable energy sector is acknowledged.

In conclusion, Chapter 2 emphasises the complexities and opportunities inherent in the transition to renewable energy in South Africa, particularly in coal-dependent regions like Mpumalanga. Balancing economic interests, environmental sustainability, and social justice is a formidable task, requiring thoughtful policy decisions and stakeholder engagement. The overarching goal was to navigate the transition in a manner that not only addresses the urgent need for sustainable energy but also ensures the well-being of all stakeholders involved.

Findings suggest the urgent need for South Africa, particularly regions like Mpumalanga, to transition from fossil fuels to renewable energy due to factors such as energy shortages and environmental concerns associated with the coal value chain. The speed of this transition is identified as highly influenced by policy choices. To expedite the transition, the chapter suggests a comprehensive policy framework, including measures such as reforming fossil fuel subsidies, implementing institutional Pigovian taxes and setting renewable targets. These policy choices aim to create a conducive environment for the shift towards renewable energy. However, the transition is not without its challenges. The chapter acknowledges potential socio-economic consequences, including job losses and revenue decline, especially at the local level. The concept of a 'just transition' is recognised as essential to mitigate the negative impacts on vulnerable stakeholders.

Despite the challenges, there are opportunities for renewable energy adoption. The shift presents the potential for economic growth and job creation, offsetting losses in the coal industry. However, historical instances, such as the decline of the gold industry, raise concerns about the effectiveness of government support for a 'just transition.' To address these concerns, the chapter suggests strengthening government commitment to a 'just transition' by providing robust support mechanisms for affected workers. This includes reskilling initiatives and financial assistance during the transition period. Stakeholder engagement is emphasised as crucial to ensuring an inclusive transition that considers the concerns and needs of all involved parties. Furthermore, the chapter recommends allocating resources for the development of renewable energy infrastructure, including research and development expenditures. International collaboration is

also suggested to leverage expertise, technology, and financial support in alignment with global efforts to combat climate change. To ensure environmental sustainability, the chapter emphasises the need to strengthen and enforce environmental regulations addressing pollution, greenhouse gas emissions and habitat disruptions associated with the coal value chain.

Lastly, the chapter proposes the implementation of a system for continuous monitoring of the transition process. This allows for adaptive strategies based on evolving circumstances, ensuring the effectiveness of policies and minimising unintended consequences. In summary, the suggested measures aim to navigate the complexities of the transition, balancing economic, environmental, and social considerations for a successful shift to renewable energy in South Africa. The research design and research methodology process follow in Chapter 3, where it is discussed in detail and applied to this study.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter 2 discussed the contextual background of the study. Chapter 3 provides a brief overview of the research design, research methodology and the specific strategies employed in data collection and analysis in terms of this study. Creswell (2017) defines research as a process of steps used to collect and analyse information with the intention to increase one's understanding of the topic or issue. Three key steps were identified, namely posing a question, collecting data to answer the question, and presenting an answer to the question (Creswell & Creswell, 2017). The study on the just transition to renewable energy was conducted using content analysis as the primary research method. This method involved systematically reviewing written and visual materials, such as articles, academic journals, social media content and transcripts, to identify recurring themes related to the shift from using fossil fuels to renewable energy. Content analysis ensures a structured review, providing valuable research onion insights for the study's objectives. Building on this approach, the study relied on secondary data. Its focus was to collect information relating to the just transition from coal to renewable energy in Mpumalanga, South Africa. Specifically, the investigation centres to better understand the potential challenges and opportunities that have an impact on the coal value chain. The research onion was used as a framework. The research onion serves as a structured guide for researchers to make informed decisions at each layer, ensuring that their research design aligns with their philosophical stance and research goals (Saunders *et al., 2009)*.

3.2 RESEARCH METHODOLOGY

A research methodology is an approach, technique, or process used in research (Bryman & Bell, 2014:44). A research methodology involves a range of steps that include general procedures and methods to collect, analyse and interpret data using comprehensive methods (Chetty, 2016:52). The methodological choice for this study consisted of a literature study and empirical investigation.

3.2.1 Literature review

A literature review is a critical and comprehensive analysis of published articles, textbooks and other scholarly sources related to a specific research topic or question. It involves systematically reviewing and synthesising existing literature to identify gaps in the current knowledge, evaluate the quality, validate previous research, and provide a foundation for the current research (Rowley & Slack, 2004). The researcher conducted a literature review on the role of the coal value chain

in South Africa and its key stakeholders. This provided the foundation of the research study and assisted in identifying relevant theories, concepts, and existing research on the topic. It also allowed the researcher to identify gaps in the literature that the current research study could address (Schell, 1992). The sources that were used in the research study were publicly available and are listed below:

- Government Gazette
- Statistics South Africa (Stats SA)
- South African Audience Research Foundation (SAARF)
- Department of Mineral Resources and Energy (DMRE)
- Integrated Reporting (IR)
- Trade & Industrial Policy Strategies (TIPS)
- Electronic academic journals
- Newspaper articles
- Published theses and dissertations.

3.2.2 Qualitative investigation

An empirical study refers to a research approach that involves the collection and analysis of data to answer the posed research question in the study (Yin, 2018). This study was based on secondary data that were collected. It focused on collecting information relating to the transition from the use of coal as a source of energy to renewable energy in Mpumalanga, South Africa, specifically focusing on the potential challenges and opportunities that exist in the coal value chain.

3.3 RESEARCH PARADIGM

Kuhn (1970, cited by Orman, 2016:47) defined a paradigm as “an intellectual framework which makes research possible” or "the shared ideas and concepts that guide the members of a given scientific field" (Goldstein, 2012, cited by Orman 2016:47); this definition is found in Kuhn's 1970 publication, "The Structure of Scientific Revolutions". Research philosophies include positivism, realism, pragmatism and interpretivism (Saunders *et al*., 2009). Interpretivism is a research paradigm that emphasises understanding and interpreting social phenomena from the perspective of the individuals involved. It is often used in qualitative research methods to explore the subjective meanings and interpretations that people give to their experiences (Saunders *et al.,* 2009*)*. Consistent with Saunders *et al*. (2009:108), philosophical choices are influenced by one’s worldview and the surrounding practical considerations. Besides, philosophical commitments affect the entire research process, including the research approach, strategies,

choices, time horizons and techniques or procedures adopted for the study (Saunders *et al*., 2009:108). Interpretivism promotes an in-depth exploration of social phenomena. Researchers using this approach can delve into the details, motivation and underlying factors that influence human behaviour and decision-making. By focusing on the perspective of individuals, interpretivism allows for a nuanced analysis that goes beyond surface-level explanations. This study undertook an interpretivism viewpoint using a qualitative research approach. Positioned within the interpretivism research paradigm, the study emphasises understanding social phenomena through the diverse perspectives and experiences of stakeholders (Saunders *et al.,* 2009). In exploring the just transition to renewable energy, this approach allows for a deeper examination of the transition's impacts, particularly its socio-economic implications and perceived effects. By focusing on subjective interpretations, the study provides valuable insights into the lived experiences of those affected by the transition (Walsham, 2006).

3.4 RESEARCH APPROACH

An inductive approach is a research methodology that involves deriving general principles or theories from specific observations or data. It is a bottom-up approach, where researchers start with specific data and gradually develop broader concepts or theories based on patterns and relationships observed in the data (Dash, 2005). The inductive approach is primarily used in qualitative research; however, it can also be applied in mixed methods (Creswell & Creswell, 2017). This study followed an inductive approach, which allowed an exploratory, context-specific, and comprehensive understanding of the complexities and dynamics of the energy transitioning process. This approach provided a framework for generating themes, subthemes and concepts, based on specific secondary data and enabled a deeper understanding of the complexities and dynamics of the transition process (Zhang & Wildemuth, 2005). Qualitative content analysis involves a process designed to condense secondary data into categories or themes based on inference and interpretation. This study undertook an inductive approach, whereby themes and categories emerged through the researcher's constant analyses and comparisons of the databases (Zhang & Wildemuth, 2005).

3.5 METHODOLOGICAL CHOICE

Research methods, techniques or strategies refer to the operationalisation of the research process (Creswell & Creswell, 2017). There are three commonly used research methods, namely quantitative, qualitative, and mixed methods. A qualitative approach is a research methodology that focuses on understanding and interpreting social phenomena through the collection and analysis of non-numeric data. It aims to explore the depth and complexity of human experiences,

perspectives, and behaviours. Qualitative research is typically characterised by its emphasis on subjective meanings, context, and research interpretation (Creswell & Creswell, 2017). Creswell (2003) defined quantitative research as a process that involves collecting data so that the information can be quantified and subjected to statistical treatment to either support or refute a claim. The purpose of quantitative research is to generate knowledge and create an understanding of the social world (Creswell *et al.*, 2003). This study undertook a qualitative approach, allowing the researcher to delve deeply into the experiences, perspectives and behaviours of individuals and groups involved in the just transition. This study aimed to provide a comprehensive understanding of the complexities and dynamics of the transition process (Creswell & Creswell, 2017).

3.6 RESEARCH STRATEGY

Qualitative research employs various strategies, including interviews, observations, case studies, ethnography, action research and archival or historical research (Mukhopadhyay & Gupta, 2014:111). Qualitative content analysis is defined as "[a] research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Zhang & Wildemuth, 2005). In this study, qualitative content analysis was employed to systematically analyse written or visual materials, such as news articles, academic databases, academic journals, social media posts or transcripts and to identify patterns as well as themes regarding the just transition to renewable energy.

3.7 TIME HORIZON

Two types of research time horizons exist, namely cross-sectional and longitudinal data collecting (Saunders *et al.,* 2009:108). Cross-sectional studies explore a phenomenon (or phenomena) over a short period. These studies are also called "snapshot" research (Saunders et al., 2009:155). Longitudinal data collection involves gathering information from the same subjects or participants over an extended period. Unlike cross-sectional studies, which collect data at a single point in time, longitudinal studies track changes and developments in variables over time. This approach allows researchers to observe how phenomena evolve, providing insights into trends, patterns, and causality (Saunders *et al.,* 2009:155). This study adopted cross-sectional research to collect data over a short time horizon. The research design could be suitable for studying the potential challenges and opportunities for the transition because it allows researchers to collect data at a single point in time from multiple sources. The focus was on understanding the challenges and opportunities, a snapshot of current affairs related to the just transition. This design enables the

researchers to capture a broad view of the situation, examining various factors simultaneously (Saunders *et al.,* 2009:155).

3.8 STUDY POPULATION

The target population refers to the entire group of individuals or elements which the researcher intends to generalise the study findings; it represents the larger group that the study aims to draw conclusions about (Creswell, 2014). The target population for the study was existing publications related to mining companies. The study focused on 152 mines operating within the study area. These mines represented a diverse range of operations across the value chain, including exploration, development, extraction, processing and distribution.

3.9 SAMPLING AND SAMPLING SIZE

The unit of analysis for this study was coal extracting mines in Mpumalanga. This was based on the Department of Minerals and Energy analysis of the active 152 coal-producing mines dataset. In the 152 Mpumalanga's collieries, 16 legal entities own more than one colliery, and these entities are referred to as the key coal players in Mpumalanga province.

3.10 DATA COLLECTION

In the context of a qualitative study, data collection refers to the systematic process of gathering information, often in the form of non-numerical data, to understand and interpret social phenomena. Qualitative data collection methods are designed to explore and comprehend the complexities of human experiences, perceptions, and behaviours. Qualitative data collection involves gathering data that is rich in detail, context, and nuance, aiming to provide a deeper understanding of the subject under investigation (Zhang & Wildemuth, 2005). Qualitative data collection holds distinct advantages in research. It brings depth and richness to the gathered information, allowing for a thorough exploration of the subject. The flexibility of qualitative methods is another key benefit, enabling researchers to adjust their approach as insights unfold. A crucial aspect is the emphasis on understanding the context and surroundings of the phenomenon under study. Moreover, qualitative approaches excel in unravelling complex social phenomena, offering a holistic perspective. Notably, these methods prioritise capturing the genuine perspectives of participants, ensuring an authentic representation of their experiences (Zhang & Wildemuth, 2005). In the present study, these advantages were harnessed to gain profound insights into the intricate dynamics of the just transition to renewable energy. The strategy used for the collection of secondary data was based on Kitchenham and Brereton's (2013) literature study. The review methodology is based on the method of systematic review that is frequently used in the field of

energy studies (Kitchenham *et al.,* 2009). The researcher combined a keyword-based search and a citation-based snowballing approach, resulting in thematically related publications. Snowballing is a search approach used for systematic literature studies. Snowballing refers to using the reference list of an article or the citations to an article with the intention of identifying additional articles. However, snowballing could benefit by not only reviewing the citations in the reference list but can be complemented with a systematic way of reviewing where the papers are actually referenced and where papers are cited (Kitchenham *et al.,* 2009). The publication search was limited to the latest information on the Department of Mineral Resource Energy database. The search keywords corresponded to the subject of this study and included the following words: 'just transition,' 'renewable energy', and 'Mpumalanga' (in English). First, the collected publications were checked for the word just transition. Secondly, citation-based snowballing searches followed for further publications if the publication described just transition. All positively evaluated publications were analysed in detail and provided information regarding the coal value chain in Mpumalanga. The publications selected were checked for relevance and analysed through an inductive approach to thematic analyses. A qualitative synthesis of the themes was conducted (Kitchenham *et al.,* 2009*).*

The researcher analyses 152 coal mines in Mpumalanga that supply coal for domestic and export markets. Data was gathered from the DMRE database for employee numbers in the mining and export/import activities. Additionally, the researcher accessed ESG reports from the mine's websites to understand the mines 'climate strategies '. Integrated Reporting reports from these mines were also analysed, covering financial and non-financial, including ESG concerns and environmental indicators like wastewater, energy, and carbon emissions (Kitchenham *et al.,* 2009*).*

3.10.1 The application of content analysis

The following steps were followed during the data collection process:

Zhang & Wildemuth (2005) advised that content analyses have been an underused yet powerful approach for qualitative research. He advised that this approach can be used to analyse pre-existing texts, and it also allows the researcher to conduct studies that might not be able to be completed. In the context of the just transition, where intricacies and subtleties are integral, this approach enables the systematic examination of a variety of textual sources. Given the diverse stakeholders and perspectives involved in the transition process, qualitative content analysis facilitates a nuanced understanding of the challenges and opportunities embedded in the

narrative, policies, and discourses surrounding the just transition in Mpumalanga Field (Zhang & Wildemuth, 2005). Some researchers may not have the resources and time needed to do fieldwork (Zhang & Wildemuth, 2005).

The study collects a diverse array of texts, including policy documents and media coverage related to the just transition in Mpumalanga (Miles & Huberman, 1994). These texts serve as windows into multifaceted dimensions of the transition, capturing the voices and viewpoints of various stakeholders such as government agencies, local communities, environmental groups, and industry representatives.

The data collected was textual and visual, including written articles, databases, reports, and previous dissertations related to the transition from coal to renewable energy in Mpumalanga.

3.10.2 Data preparation

The different sources were organised for systematic examination, focusing on articles and documents pertinent to the transition in Mpumalanga (Zhang & Wildemuth, 2005).

3.10.2.1 Data familiarisation

It was important to read the articles in order to obtain a clearer understanding of the information, identify potential patterns and develop an initial sense of the data themes and meanings.

3.10.2.2 Coding and analysis

Applying a coding framework that was inspired by Zhang and Wildermuth, the researcher Identified key themes and patterns and labelled specific segments of the data (e.g., sentences, paragraphs) with codes that capture key concepts or ideas related to challenges, opportunities, and stakeholder perspectives(Zhang & Wildemuth, 2005). This process involved the systematic categorisation of the textual elements that shed light on challenges and opportunities associated with the just transition. The repetitive nature of content analysis allows for a detailed exploration of data, ensuring a comprehensive examination that considers both explicit and implied content, known as manifest and latent content, respectively (Miles & Huberman, 1994).

3.10.2.3 Emerging themes and developing categories

Through qualitative content analysis, several themes begin to emerge. During this step, the researcher grouped related codes into categories or themes that represent recurring ideas or patterns specific to the just transition in Mpumalanga((Miles & Huberman, 1994). Challenges may include issues related to job displacement, economic restructuring, and community adaptation. On the other side, opportunities may manifest in the form of substantial development initiatives, renewable energy projects, and community empowerment strategies. The analysis has to go beyond the surface-level observation, delving into the underlying meanings and implications embedded in the text (Zhang & Wildemuth, 2005).

3.10.2.4 Constant comparison of a sample text

The data was continuously compared to newly coded data segments with previously coded ones and emerging categories and themes to refine and adjust as new insights emerged (Miles & Huberman, 1994).

3.10.2.5 Saturation

Continuing the coding and analysis process until reaching saturation, ensuring a comprehensive exploration of the data specific to the Mpumalanga transition. The researcher continuously reviewed the existing literature on the just transition with the intent to see if there were any new themes that would emerge from the existing themes; at point, the researcher reached a point where no new codes could be defined, and the researcher concluded on the relevant codes that will be used in chapter 5.

3.10.2.6 Assess coding for consistency

After coding the entire data set, the researcher needs to recheck the consistency of the coding. This is a control process to ensure that all codes are consistent. If done manually, human codes are subject to fatigue and are likely prone to errors and mistakes (Miles & Huberman, 1994; Weber, 1990)

3.10.2.7 Draw conclusions from coded data

This step entails making sense of established categories and themes and drawing conclusions about the identified challenges, opportunities, and dynamics of the just transition in Mpumalanga (Bradley, 1993).

3.10.2.8 Interpretation

Once categories and themes are established, researchers interpret the meaning and significance of these findings. This involves reflecting on what the data reveals about the research question or topic of interest and considering their implications for the broader understanding of the transition.

3.10.2.9 Reporting

The results of qualitative content analysis are typically reported in research papers, reports, or presentations. Researchers describe the categories and themes, provide illustrative examples from the data, and offer interpretations and insights (Patton, 2002, p.503-504). For qualitative content analyses, the researcher must report their decisions and practices concerning the coding process, as well as the methods they used to establish trustworthiness. The insights gleaned from

the qualitative content analysis contributes to a more profound understanding of the just transition in Mpumalanga. By identifying challenges and opportunities through the voices of various stakeholders, policymakers can make informed decisions that address the community's concerns, ensure a fair and equitable transition, and capitalise on the opportunities for sustainable development.

3.10.2.10 Computer support for qualitative content analysis

The utilisation of computer programs such as ATLAS.ti assists in organising, managing, and coding qualitative data. The study used diverse textual sources such as policy documents, published dissertations, and data from the Department of Minerals Resources. The researcher created one single depository from which all coding processes were applied. ATLAS.ti could be used to assist with the manual process. As mentioned above, it serves as u to epic data depository software, providing a centralised platform for storing and accessing the data (Zhang & Wildemuth, 2005).

3.11 DATA ANALYSIS

Bryman and Bell (2014:342) advocate the three most frequently used data analysis strategies as analytical induction, thematic analysis, and grounded theory. In addition, these are flexible methods that do not necessarily follow a specific philosophical orientation. A popular technique for assessing qualitative data in psychological and other fields is thematic analysis (Clarke, 2012). Joffe (2012), a TA practitioner, attributes the origins of TA to a science philosopher, Gerald Holton, who wrote on “themata” in scientific cognition (Holton, 1975). However, the term appears to have

existed before Holton's work. The term "thematic analysis" has been used since the early 1900s, if not before and has been used to describe a variety of topics, including but not limited to social science data analysis methods (Van den Berg, 2001). Some older applications of TA, a technique for finding themes in qualitative data, are comparable to those in use today. Additionally, the term has been used synonymously with content analysis to refer to both qualitative and quantitative content analysis (Christ, 1970; Baxter, 1991). Some have even suggested that TA originated with content analysis (Joffe, 2012). The 1990s saw the publication of procedures for using TA as a qualitative technique (Aronson, 1994). However, qualitative researchers have referred to their approach to analysis as thematic, without specifically citing a developed method, both before and after specific procedural advice was published (Stemler, 2000). According to (Zhang & Wildemuth, 2005), six phases in the thematic analysis method are suggested.

Table 3.1 describes these phases and how they were incorporated into the study.

Table 3.1: Phases of thematic analysis

Stages	**Explanation of the process**
Familiarising oneself with the data	Raw data were extracted from the Department of Mineral Resources database (DMRE) and various mining websites and were, thereafter, transcribed. The data were read and re-read while the researcher took note of initial ideas. The data collected were transformed into text before analysing the research onion.
nerating initial codes	The stage involved logically coding interesting characteristics of the data and collecting data relevant to each code. In addition, it included Identifying and labelling specific sections of the data (e.g., sentences, paragraphs) with codes that capture key concepts or ideas relating to challenges, opportunities, and stakeholder perspectives.
Searching for themes	Categorise codes into possible themes and gather all relevant data for each theme.
Reviewing themes	Checking whether the themes work in relation to the coded extracts and the entire dataset, then creating a thematic map of the analysis
Defining and naming themes	Refining the specifics of each theme. Naming and defining each theme. This involved reflecting on what the data revealed about the research

Stages	Explanation of the process
	question or topic of interest and considering the implications for the broader understanding of the transitioning stage
Producing the report	Producing a scholarly report of the analysis by selecting vivid, compelling extracted examples that relate to the research question and the literature

Source: Braun and Clarke (2006:87)

3.12 RELIABILITY AND VALIDITY (TRUSTWORTHINESS)

All research studies must consider issues of validity and dependability. To make qualitative findings high-quality and practically useful, validity and reliability difficulties need to be taken into account (Noble & Smith, 2017:34). In qualitative research, issues of validity and reliability are linked to trustworthiness (Rolfe, 2006:304). In qualitative research, trustworthiness (or rigour of a study) refers to confidence in the data that ensures the quality of the investigation (Connelly, 2016:435). It refers to an authentic and consistent interpretation of findings based on data (Yeh & Inman, 2007:386). Credibility, reliability, transferability, and confirmability make up the four components of trustworthiness (Sinkovics *et al*., 2008:699, Forero *et al*., 2018:2). Data collection for the study should be conducted in a systematic and ethical manner, ensuring that the data are reliable and valid. It is important to implement consistent and rigorous coding procedures during content analysis, as well as to use a standardised approach and, if applicable, computer-assisted tools like ATLAS.ti are leveraged to enhance the reliability of the coding process. This study undertook a manual approach.

3.12.1 Credibility

Credibility refers to the degree of confidence the researcher has in the study's findings. It is parallel to internal validity in quantitative research (Sinkovics *et al*., 2008:699; Rolfe, 2006:305). Additionally, it describes the techniques and resources used to ensure consistency between participant replies and the researcher's corresponding interpretation (Given, 2008:138). One way to ensure that the data are credible is to ensure that the data collection methods, such as content analysis and the integrative literature review, are systematic and aligned with the research questions. Using triangulation assists in the credibility of the study.

3.12.2 Dependability

Dependability refers to the extent to which the research could be replicated. It relates to reliability in quantitative research (Rolfe, 2006:305). It motivates researchers to be aware of changing study circumstances, which is why keeping track of research nuances is necessary (Given 2008:209).

3.12.3 Transferability

Transferability parallels generalisability or external validity in quantitative research. It refers to applying the research findings to different contexts (Finfgeld-Connett, 2010:248). Using a combination of sampling techniques improves representativeness, thus improving transferability (Forero, 2018:7).

3.12.4 Confirmability

Finally, confirmability refers to the degree of neutrality in the findings, namely, the degree to which the researcher believes that the findings have been confirmed or corroborated by other researchers. Bias-free responses are anticipated (Connelly, 2016:435 - 436). Triangulation, confirmability audits, audit trails and reflexivity are used to establish confirmability (Amankwaa, 2016; Forero *et al.,* 2018). An audit trail was maintained, detailing decisions made during the research process. The researcher's role in potential biases was clearly articulated, ensuring that the interpretations were grounded in the data and to minimise personal biases.

3.13 ETHICAL CONSIDERATIONS

The researchers are bound by their ethical responsibility to ensure that their research is conducted in an ethical and responsible manner. Ethical considerations must be integrated throughout the entire research process, from the research design and implementation of the research to the dissemination of the research results (Creswell & Creswell, 2017. (Bashir *et al.*, 2016) discussed the importance of online ethical implications in the study of online illness narratives, whether it is in online articles or conferences. He tested the validity of information on qualitative reviews and tested the credibility of authors, ensuring that participants' information that comes up in studies is safe and correctly stated in accordance with the intended study. Raising concerns about online information that is available for usage emphasises the importance of only using credible sources and authors. (Pietilä *et al.,* 2020) also mentioned the importance of ethical considerations in the application of content analyses in nursing research. Gajjar (2013:1-2) states that ethical standards in research are particularly important.

Fair use and attribution will be taken into consideration regarding copyright laws and giving proper attribution to the sources being analysed. Ethical guidance will be followed when citing and referencing, giving credit to the original authors or creators of the literature used.

In this study, the principal researcher was not in contact with any participants. The publications that were used in this study were retrieved from the Trade and Industry Policy Strategies as well as publicly available information from the Department of Minerals Resources and Energy. Therefore, it was not necessary for the researcher to obtain any prior permission. In addition, this study was also evaluated by the Economic and Management Sciences Research and Ethics Committee of the North-West University. This committee determines the level of risk for the study as a whole and it was anticipated that the level of risk for the current study will be perceived as low risk. By incorporating these ethical considerations into the study, the researcher strived to maintain the integrity of the research process and contribute to the ethical advancement of knowledge in the field of the just transition to renewable energy.

3.14 SUMMARY

From the abovementioned information, it is evident that research methods play an important role in conducting any type of study. It is necessary to understand the different elements which form part of research in order to choose the correct methodology and design for the completion of the study. Chapter 3 provides essential information regarding the research design, research methodologies, population and sampling, validity and reliability of the content analysis (including ethical considerations) and the manner in which these methods were used in conducting this study.

This study made use of purposive sampling method where a specific technique was used to obtain the necessary data. All the information that was provided in Chapter 3 was used in the processing of the secondary data gathered by means of the aforementioned content analysis. The data were analysed and presented in the form of tables in Chapter 4, where the results and findings determine the outcome of this study. The results and findings also determine whether the correct method was chosen for obtaining the data.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

In Chapter 3, the research design and methodology were highlighted as it forms part of the process of acquiring the data needed in this chapter. Content analysis was used for inductive reasoning. The inductive approach provides a framework for new theories and concepts based on observations, subjective interpretation, systematic classification process, coding and identifying patterns (Stemler, 2000).

The study focused on 152 mines operating within the study area. These mines represented a diverse range of operations across the value chain, including exploration, development, extraction, processing, and distribution. A total sample of 152 coal mines in Mpumalanga, which mine coal for domestic and export internal markets, was analysed. The data were extracted from the DMRE database that is on the website, which indicates the number of employees in mining and export and import activities. Furthermore, the researcher used internet sites to access the mines' ESG reports, with the intention of understanding the climate strategy. The researcher additionally analysed the latest Integrated Reporting reports of the selected mines; included in the report is financial and non-financial information. This report generally indicates ESG concerns and includes reporting on core environmental indicators such as waste, water, energy and carbon emissions for the mines concerned (Stubbs & Higgins, 2014).

The purpose was to explore the impact of the just transition away from coal mining on the coal value chain and the emergence of the energy transition. Chapter 4 focused on the analysis of the data collected. The purpose of analysing the data (Saunders *et al.*, 2009) is to complete a jigsaw puzzle in which the pieces represent data. These pieces of data and the relationships between them assist the researcher in forming a comprehensive picture or pictures to understand what they are conveying.

This chapter provides the results and findings based on the information acquired. Qualitative content analyses aim to identify common words, phrases, or themes that enhance the researcher's comprehension and interpretation of the phenomenon under investigation. The content analyses revealed themes and subthemes by using thematic analyses.

4.2 CONTENT ANALYSIS

According to Stemler (2001), content analysis allows researchers to analyse large volumes of data with greater ease by using a systematic approach. Qualitative content analyses aim to

identify common words, phrases, or themes that will enhance the researcher's comprehension and interpretation of the phenomenon under investigation. Content analyses assisted in revealing themes and subthemes by using thematic analyses (Zhang & Wildemuth, 2005).

4.2.1 Process of content analysis

Kaid (1989) lists seven key core activities that form part of qualitative content analyses.

1. Developing the research question that will be answered in the study
2. Choosing the samples to be analysed
3. Stating the categories to be applied
4. Defining the coding process
5. Coder training
6. Applying the coder process
7. Examining the results of the coding process (Weber, 1990)

The steps that were followed in this study are illustrated in Figure 4.1.

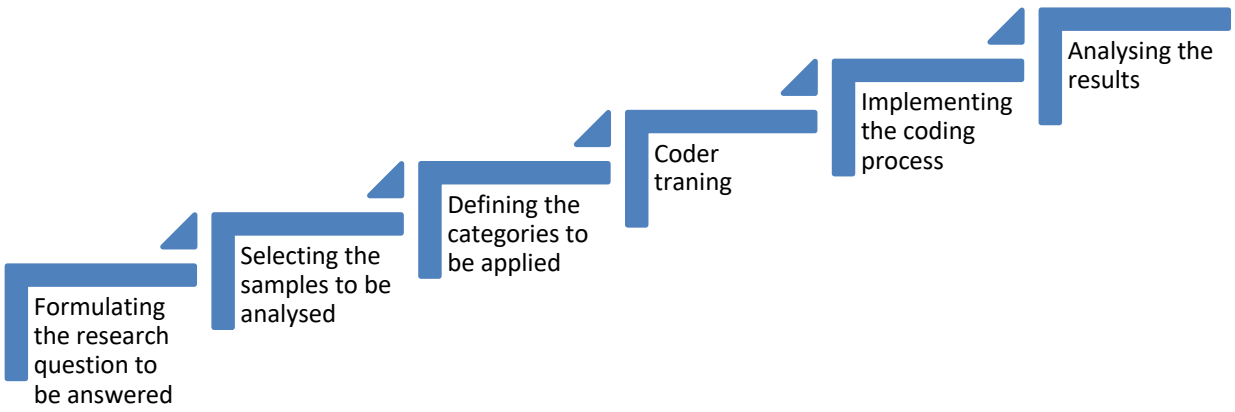

Figure 4.1: Content analysis steps

Source: Author's creation

4.3 DATA COLLECTION

Document analysis is a systematic procedure for reviewing and interpreting documents to elicit meaning, gain understanding and develop empirical knowledge. This method is particularly

valuable in qualitative research as it provides a rich data source offering a historical context. It can be used with other research methods to provide a multi-dimensional perspective. This approach was used to create the different themes from the different literature (Love, 2013:99-112).

4.3.1 Document selection

The documents used for the study relating to the 152 mines were retrieved from the (DMRE) database and the Integrated Resource (IR) reports from the various mining companies' websites to determine the number of employees, their ESG contribution and climate strategy (Stubbs & Higgins, 2014).

In addition, the following documents were used for the literature review:

- Government Gazette
- Statistics South Africa (Stats SA)
- South African Audience Research Foundation (SAARF),
- Department of Mineral Resources and Energy (DMRE)
- Trade & Industrial Policy Strategies (TIPS)
- Electronic academic journals
- Newspaper articles and:
- Published thesis and dissertations.

4.3.2 Search strategy

A sample of 152 coal mines located in Mpumalanga that mine coal for domestic and export internal markets were used for this study. The reason for choosing this database was to get an understanding of the total amount of active mines that are operating in Mpumalanga with the intent of getting an understanding of the impact of the just transition away from coal mining on the coal value chain and the emergence of the energy transition. The transition away from coal will significantly impact the viability of coal for mine owners. The exportation of coal to international markets is the viability of many mines and many of these companies are multinationals; profitability depends on it. Domestic use of coal in the local economy is for electricity generation and the use for chemical usage in Sasol and the use for cement.

4.3.3 Unit of analysis

The unit of analysis for this study is coal extracting mines in Mpumalanga. Details of a total of 152 active coal mines in Mpumalanga were obtained from the DMR website. The shortlisting criterion

was whether the mine owner owned more than one coal mine in Mpumalanga. Of the 152 coal mines, 16 legal entities owned more than one colliery and were referred to as the critical coal players in the Mpumalanga province. An analysis of the information extracted from the Department of Minerals and Energy database is provided in Section 4.4.4.

4.3.4 Synthesis

Furthermore, the researcher used internet searches to obtain the supplementary data as shown in Table (established date, year in operation, number of employees, market, target sectors, JSE listing and climate strategy). The top twenty mines were included in the sample for analyses and to understand the key role players.

4.3.5 Data analysis

Thematic analysis was used to analyse different themes in the data find meaning, it is better described as a study of patterns of meaning (Crosley & Rautenbach, 2021). As indicated by Bryman *et al*. (2014), this approach is adaptable and not bound to a certain philosophical orientation. Thematic analysis was used for this study to identify, analyse, and describe the themes of a dataset (Bell *et al.*, 2022; Bryman et al., 2014). The researcher used the six-phase thematic analysis (Braun & Clark, 2020). The literature on Trade and Industrial Policy Strategies (TIPS) and various government policies, as well as published theses and dissertations on the coal value chain and just transition, were analysed with the main intention of finding linkages between the literature and answering the secondary objectives that were formulated in chapter 1 (refer to point 1.4.2, page 5). The researcher also observed and noted the different points observed in the just transition to renewable energy literature.

Table 3.1 illustrates the different phases involved in thematic analysis, which guided the researcher during the data analysis process.

4.4 RESULTS AND DISCUSSION

The analysis of the impact of South Africa's just transition strategy on the coal mining industry is based on a study of Mpumalanga's key colliery owners as it would be onerous, if not impossible, to study all the 152 collieries in Mpumalanga. Details of each one of the key coal miners were collected to assess the potential impact of South Africa's just transition. These details include the entity's annual coal production, number of employees and whether the miner has announced a climate strategy, among other characteristics, which can provide an indication of how each

company is adapting to this change. Table 4.2 illustrates a content analysis that was conducted from data that was extracted from a data set from the DMRE website.

Table 4.2: Top 16 mines in Mpumalanga

Number	Total Coal Mines in Mpumalanga	MINE OWNER	Established	Operating Years	Annual Production (Mt)	No of Employees	Market	Target Sectors	JSE listin	Climate Strategy
1	10	SASOL MINING (PTY) LTD	1955	68,00	40	31 270	domestic, Export	Chemical	Yes	Net zero 2050
2	5	EXXARO	2006	17,00	43,1	14 679	domestic, Export		Yes	Carbon Neutral by 2050
3	5	UMCEBO MINING (PTY) LTD	1994	29,00	12,5	500	domestic, Export	power, fuel	No	Unknown
4	3	EXXARO COAL CENTRAL (PTY) LTD	1998	25,00	5	5 000	domestic, Export	Metallurgy	No	Carbon Neutral by 2050
5	3	EYETHU COAL (PTY) LTD	2004	19,00	4	2 000	domestic, Export	petroleum, energy	No	Unknown
6	5	GLENCORE OPERATIONS SA	1974	49,00	16,4	16 700	domestic, Export	power	Yes	Net zero 2050
7	3	MSOBO COAL (PTY) LTD	2004	19,00	2,4	2 400	domestic, Export	power, agriculture	No	Unknown
8	3	SUDOR COAL (PTY) LTD	2017	6,00	20,9	1 974	domestic, Export	power	No	Unknown
9	2	ANGLO COAL	1917	106,00	14	23 000	Export	Metallurgy	Yes	Net zero 2050
10	2	CANYON RESOURCES (PTY) LTD	2006	17,00	6,98	1 290	Export	power	No	Unknown
11	2	COAL SOUTH32 SA	2015	8,00	13,3	9 074	Export	Metallugy	No	Net zero 2050
12	2	IYANGA MINING (PTY) LTD	2006	17,00	6	1 050	Domestic	power	No	Unknown
13	2	MBUYELO COAL (PTY) LTD	2006	17,00	6	916	Domestic	Power	No	Unknown
Total	47				190,58	109 853				

Source: Researchers own

The export market will not be impacted by the Energy transition; the loss of production will only affect the domestic market.

4.4.1 Data evaluation and analysis

Average lifespan of coal mines

Table 4.2 offers insights into the top 16 coal mines, collectively owned by 51 mine owners, including multinational corporations and local coal mining companies. The establishment year of each mine is also provided. Notably, Anglo Coal stands out as the oldest operating mine, having been in operation for an impressive 106 years since its establishment in 1917. This data raises an intriguing question: What is the average lifespan of a coal mine? Anglo Coal's remarkable longevity, tracing back to the Industrial Revolution (Montagna, 1981), is particularly noteworthy. The mine, with 106 years under its belt, continues to be a significant player, with an annual production of 14 million tons. The table underscores the enduring importance of coal, aligning with findings in the literature review that highlight its crucial role in contributing to the GDP of Mpumalanga. However, amidst this recognition, crucial questions emerge. As countries contemplate transitioning from fossil fuels to green energy sources, what fate awaits these mines that have stood for over 160 years? Furthermore, in the face of declining production trends observed over time, sustaining operations' viability becomes a pressing concern. These considerations emphasise the dynamic landscape of the energy sector, prompting a reassessment of the future trajectory for long-standing coal mines in the wake of changing energy paradigms.

Impact on the employment

The 16 mines collectively contribute significantly to the coal industry, boasting a combined annual production of 190.58 million tonnes. During the study period, the workforce associated with these mines amounted to 109,853 individuals. Notably, Sasol, a key player, employed 31,270 people. This data is pivotal in understanding the broader implications, particularly in the chemical sector. The substantial workforce engaged in coal-related activities, highlighted by the employment figures from Sasol and the collective mining operations, underscores the potential impacts on employment as industries transition from coal. This analysis aligns seamlessly with the existing literature discussing the tangible consequences of employment in the wake of the shift away from coal. The numbers presented here offer a glimpse into the real jobs at stake, emphasising the need for comprehensive strategies to address the workforce challenges associated with this transition.

Domestic and international exportation of coal

The coal market is divided into international exports and domestic consumption. The pie chart clearly illustrates that the primary utilisation of coal production is directed towards both domestic consumption and export markets. This observation aligns seamlessly with existing literature, emphasising the enduring significance of coal in contributing to the country's GDP. The literature consistently underscores the pivotal role of coal, and the pie chart reinforces this narrative by highlighting its dual-purpose allocation for domestic use and export. This dual usage echoes the findings in the literature emphasising the multifaceted contributions of coal to the economy.

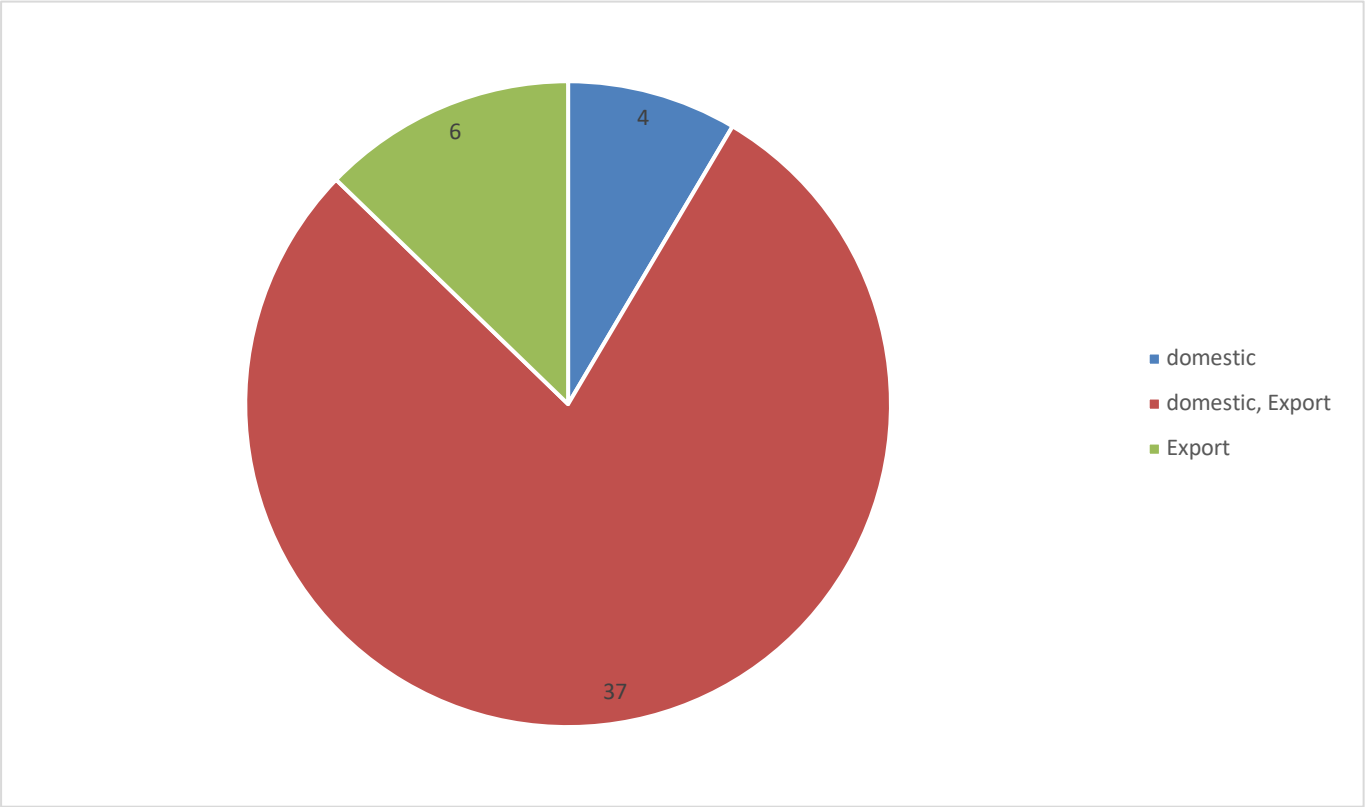

Figure 4.2: Total coal usage

Source: Researchers own

Target sector and the number of mines

As indicated by our research sample, coal serves diverse markets and sectors. The identified coal market sectors include power generation and agriculture, power generation and fuel and power generation. These insights are derived from the data presented in the researcher's table. This

information provides a comprehensive view of the coal value chain in South Africa, acknowledging the existing challenges. As noted in the literature (Wright *et al*., 2019), the coal value chain has consistently declined globally. Despite this, the data emphasises coal's continued importance in various sectors, highlighting the complex dynamics of the coal industry and its integral role in the broader economy.

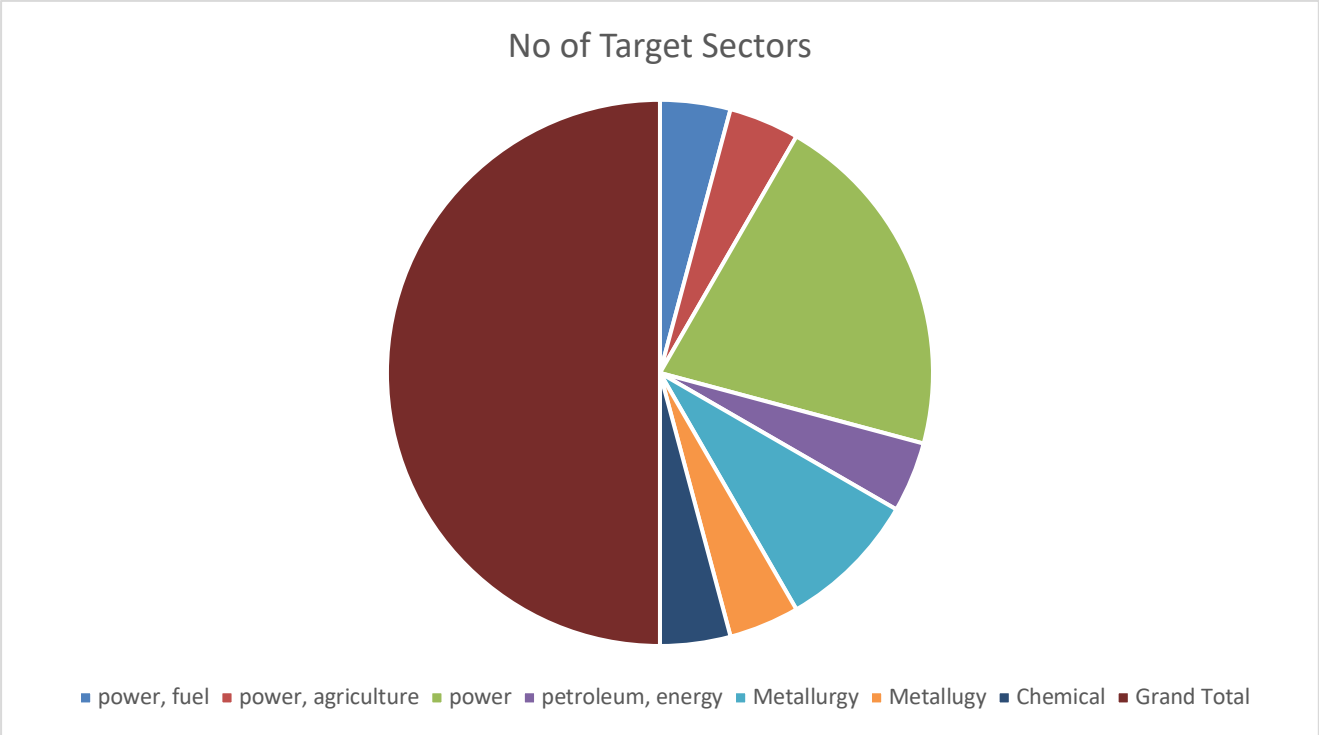

Figure 4.3: Number of Target Sectors

Source: Researchers own

JSE listing and climate strategy

The table includes the number of mines publicly and non-publicly traded on the Johannesburg Stock Exchange (JSE) listing. When a company is listed on the JSE, its shares are publicly traded. There are three mines trading on the JSE, and 11 mines are not listed on the JSE. The table further expands on whether the mines had a climate strategy. Six mines had a climate strategy, and the remaining did not.

4.5 CODING

The basic action of the coding process is to organise large quantities of text into fewer categories of content (Caunt *et al.*, 2013). These categories can be directly taken from the text or derived from the text through analysis. Relationships can then be identified among these categories. After these relationships have been identified, a coding scheme is developed to guide coders to make decisions during the analysis of the content. The coding scheme is a device that organises data

into the identified categories. This coding scheme also includes the process and pre-set rules of the content analysis and is set up in a systematic and logical way to give a scientific result (Hsieh & Shannon, 2005). The researcher identified and labelled specific segments of the data (e.g., sentences and paragraphs) with codes. Codes can be descriptive or interpretive labels that capture the essence of the content. Several themes were identified from the various sources. Thematic analyses were used to produce the different themes. Information was from the literature review used in Chapter 2. The intention was to produce recommendations to add to the study.

4.6 THEMES AND SUB-THEMES

These potential themes reflect the diverse aspects of the transition from coal to renewable energy in South Africa and its impact on various stakeholders, particularly mine workers and local communities. From coding the data, eight codes were derived, and this study will unpack three themes, namely:

- Theme 1: Social-Economic Impacts on Mine Workers
- Theme 2: Energy Transition
- Theme 3: Challenges and Opportunities in the Transition

Themes that were identified

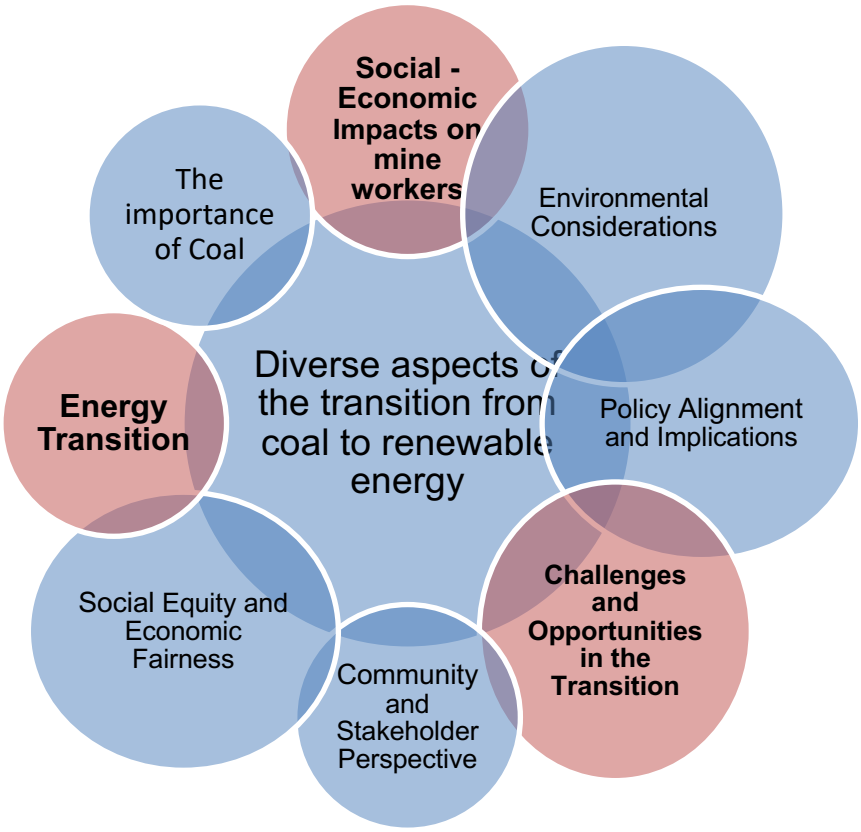

Figure 4.4: Themes that were identified

Source: Authors own

Table 4.3: Themes and subthemes - Theme 1 Socio-economic impacts

Themes	Subthemes	Document	Author
Socio-Economic Impacts on Mine Workers	• Job Displacement and Security • Economic Resilience:	Eight papers	8 Authors (Funds, 2020)/ (Timmons *et al*., 2014) Bodansky, 2016) Marais *et al*., 2022). (Timmons *et al*., 2014) Montmasson-Clair, 2021) (Fourie, 2018, (Burton & Winkler, 2014). (Marais *et al*., 2022).

			(Deichmann *et al*., 2011).

Source: Authors own

4.6.1 Theme 1: Socio-Economic Impacts on Mine Workers

Table 4.4 takes a look on the Social -Economic impacts that the transition will have on mine workers .

Table 4.4: Social-economic impacts

Author	Coding	Theme	Sub Theme	Interpretation
Funds, 2020/(Timmons et al., (2014)	"*Coal currently powers the majority of South Africa's electrical generation capacity. In 2021, the sector had about 93 000 workers*" (Minerals Council South Africa,2022). "*Over 26,000 people worked at Sasol in South Africa*" (Sasol, 2018).	Job Displacement ,looking at the number of jobs that stand to be affected and the significance.		Socio-Economic Impacts on Mine Workers/The importance of coal
Bodansky, (2016)	"*Reducing coal-generated electricity will have severe implications for places such as Emahleni, where such generation occurs*" (Bodansky, 2016). Many coal miners and people working in coal-generated power stations will likely lose their jobs. Most of Eskom's coal plants are in the province of Mpumalanga; therefore, the effects of closures will be intensely concentrated(Bodansky, 2016).	Because of the implementation this the effects of the just transition .		Socio-Economic Impacts on Mine Workers/The importance of coal.
Marais et al., (2022).	"*However, job losses in coal mines, power plants, and the transportation industry are potential consequences, along with a decline in municipal government revenue and a knock-on effect on local economies*"(Marais et al., 2022). As the economy goes greener, due to the Economic Social governance (ESG) responsibilities, there will be direct, consequential effects on the coal value chain and the societies directly linked to it and everyone that is directly linked to it (Marais et al., 2022).			Social Equity and Economic Fairness.
Burton & Winkler, 2014; Strambo *et al.*, (2019).	"*The coal industry in South Africa has a significant impact on local economies and communities, providing employment and contributing to government revenue*"(Burton & Winkler, 2014) . "*This industry faces numerous challenges related to labour, social responsibility, and community engagement*"(Burton & Winkler, 2014; Strambo et al., 2019).			Socio-Economic Impacts on Mine Workers.

World bank ,(2018)	"*Due to inadequate support for these vulnerable people, former coal mining cities lag economically and socially in other nations, such as the United Kingdom and Poland, which have restructured the coal sector. The affected mining towns suffer catastrophic economic repercussions compared to areas with more diverse local economies since they have few viable economic alternatives to coal mining*" (World Bank, 2018).	Concentrated on the vulnerable groups and the transition to renewable energy.	Vulnerable Groups	Socio-Economic Impacts on Mine Workers.
Winkler, (2005)	However, health will improve as a result of lower air pollution, more access to clean energy, and community ownership models in renewable project type.	**Social Considerations**	**Social Considerations**	Socio-Economic Impacts on Mine Workers
Funds, 2020; Strambo et al., (2019)	*To achieve a just transition to cleaner and more sustainable energy sources while taking into account the economic and social ramifications for all stakeholders, it is challenging to navigate these complex dynamics" (Funds, 2020; Strambo et al., 2019)*	**Social Considerations**	**Social Considerations**	Socio-Economic Impacts on Mine Workers
Deichmann *et al.*, (2011).	Economic Diversification: - Efforts to diversify the local economy in coal-dependent regions have been undertaken. This includes investments in new industries, skills development, and job creation, which are crucial for successful transitions.	Economic Diversification/1. Socio-Economic Impacts on Mine Workers.		Socio-Economic Impacts on Mine Workers.

Source: Authors own

Explanation of Table 4.4

The table titled "Social-economic impacts" offers insights into the effects of transitioning from coal to cleaner energy sources in South Africa's coal industry. It highlights the industry's economic significance in terms of employment and government revenue, alongside challenges like labour issues and community engagement. Additionally, it underscores the economic and social repercussions faced by former coal mining cities, emphasising the need for proactive measures to address these challenges. The table also acknowledges the potential health benefits of transitioning to cleaner energy and the complexity of achieving a just transition. Lastly, it recognises efforts toward economic diversification in coal-dependent regions to promote resilience and sustainability. Overall, Table 4.4 provides a comprehensive overview of the multifaceted impacts of transitioning from coal, emphasising the importance of considering economic, social, and environmental factors in energy transition strategies.

Subtheme - Job Displacement and Security and Economic Resilience

In the current sample (refer to Table 4.4), 109,853 employees will be affected by the transition to renewable energy. The researcher also looked at several papers on the just transition and produced the themes mentioned earlier on the just transition and the impact that it will have on vulnerable groups, that is, the mine workers.

This sample used eight authors and their related papers. Several authors (Bodansky, 2016 and Marais *et al.*, 2022) mention the just transition to renewable energy when coal production is reduced, critical mention of job displacement and the economic impacts it will have on the local economies.

"*Job Losses and Economic Impact: As South Africa's economy shifts towards cleaner energy sources, there is a potential for job losses in coal-related sectors such as mining, power generation, and transportation. This can also impact municipal government revenue and local economies (*Marais et al., 2022).

"*Reducing coal-generated electricity will have severe implications for places such as Emahleni, where such generation occurs. Many coal miners and people working in coal-generated power stations will likely lose their jobs" (Bodansky, 2016). Most of Eskom's coal plants are in the province of Mpumalanga; therefore, the effects of closures will be intensely concentrated.*

Coal currently powers the majority of South Africa's electrical generation capacity. In 2021, the sector had about 93,000 workers (Minerals Council South Africa,2022). Over 26,000 people worked at Sasol in South Africa (Sasol, 2018).

In this sample, Sasol employs around 31,270 employees that will be affected by the energy transition. Sasol owns ten mines, and they operate in the Chemical sector.

Coal Industry Significance: The coal sector is crucial in South Africa's energy generation, employing many workers. However, the industry is significantly transforming due to the shift towards cleaner energy sources (Marais *et al*., 2022).

4.6.2 Theme 2: Energy transition

The researcher then looked at the second theme that emerged, the energy transition and looked for standard views that would emerge from the eight authors used for the sample. From these views, five subthemes were created:

1. Interconnectedness of the South African Mines and International Coal Markets
2. Forces Driving the Decline in the South African Coal Value Chain
3. The 21st Century Energy Transition towards renewables
4. Diverse Sources of Renewable Energy
5. Government -Led Employment Sustainability.

A sequence of events and themes was created from the literature. What is emerging is that South African energy systems and international coal mines are interlinked. “Forces are driving the decline in the South African Coal Value Chain. These driving forces are steadily moving the country towards the 21st century”. Energy transition “towards renewable energy. Renewable energy encompasses diverse renewable energy sources like solar, wind, hydro, biomass, and geothermal energy. The government of South Africa is also leading by creating employment sustainability initiatives that are aiding and driving the country towards the just transition and Energy Transition “(Timmons *et al*., 2014 & Deichmann *et al.*, 2011).

Table 4.5: Energy transition

Author	Coding	Theme	Sub Theme	Interpretation
McWilliams *et al.*, (2022)	*"Governments across the globe have had to come up with alternative resources for energy production. This has strengthened the case for the just transition to alternative energy* "(McWilliams *et al.*, 2022).	Case for the Transition to Renewable Energy /Alternative sources for energy -Renewable or wind solar and Hydro	Impacts of the just transition Just transition	Energy Transition
Business Tech ,(2023).	"*South Africa has also been affected by overall energy shortages to meet supply and demand(Term used as loadshedding). As a result, this has also strengthened the course to transition to renewable energy or alternative energy mix*" (business tech,2023).	Case for the Transition to Renewable Energy /Alternative sources for energy -Renewable or wind solar and Hydro	Impacts of the just transition Just transition	Energy Transition
Burton and Winkler (2014), SACRM (2011).Huxham et al. forthcoming(update citation .	*"Changes in the South African energy system and international coal markets are interlinked. Many of South Africa's mines are commercially viable because they can sell a portion of their product to the international markets at higher prices*" (Burton and Winkler 2014, SACRM 2011).	Demand and supply being interlinked. , We have a big dependency on the export of coal, whether we transition or not, and the supply side is decreasing. Energy transition will happen whether we get on board or not. Sa is partakers	The interconnectedness of South African mines and international coal markets.	Energy Transition

		in the Global economy, Open market.		
Wright *et al.*,(2019)	By the early 2020s, the value chain in South Africa was already on a steady decline, and the inevitable was experienced worldwide. Two variables that contributed to the decline. One, the use of coal for power generation quickly became outdated, disintegrating the value chain due to cleaner energy being marketed internationally. Two, due to climate change and the problem worsening, there was more pressure both internationally and locally to restrict the use of coal-based products ((Wright *et al.*, 2019)	We are part of the world economy ,Coal Generation becoming outdated and due to Climate change .	Forces driving the decline in South African coal value chain .	Energy Transition
Timmons et al., (2014)	*"In the twenty-first century, we are already seeing the next great transition in energy sources, moving away from fossil fuels and moving towards renewable energy sources. The transition to renewable energy can be motivated by several factors: environmental impacts (climate change)limits on fossil fuel supplies, technology changes and prices*" (Timmons et al., 2014).	This text just reinforces the preseason for the transition ,H also looks at the policies and how indicatives that we can put in place as a country (Pigovian taxes)	The 21st century energy transition towards renewables	Energy Transition
Deichmann *et al.*, (2011).	"*Renewable energy encompasses various sources such as solar, wind, hydro, biomass, and geothermal energy. Solar energy harnesses the power of sunlight, while wind energy utilises wind*	Just explains renewable energy.	Diverse sources of renewable energy	Energy Transition

	turbines to generate electricity" (Deichmann et al., 2011).			
Timmons *et al.*, (2014)	"*The government is actively promoting a just transition to a low-carbon economy in South Africa through two key initiatives: National Employment Vulnerability Assessment (NEVA): NEVA aims to assess the impact of climate change and climate change responses on jobs, both by sector and location. It seeks to understand the potential effects on employment and determine what job-related interventions may be necessary and where they should be implemented* "(Timmons et al., 2014)	Government led initiatives that drive for an equitable transition to renewable energy.	Government-Led employment sustainability.	Energy Transition /policies
Arndt *et al.*, 2019; He *et al.*, (2020).	"*Adaptability in response to changing energy market dynamics and technology advancements has been a common feature. These countries have adjusted their energy transition plans when needed, which South Africa may also need to do to remain flexible and responsive*" (Arndt *et al.*, 2019; He *et al.*, 2020)	Adaptability and Flexibility		Energy Transition

Source: Authors own

Explanation of Table 4.5

The table titled "Energy Transition" provides a condensed overview of the global shift towards alternative energy sources and its implications for South Africa's coal industry. It highlights factors driving this transition, such as energy shortages, climate change concerns, and evolving international coal markets. The table underscores the declining viability of coal-based products and the increasing pressure to restrict their use, as well as the promotion of a just transition to a low-carbon economy by the South African government. Additionally, it acknowledges the need for adaptability in response to changing energy market dynamics and technological advancements. Overall, the table offers valuable insights into the multifaceted challenges and opportunities associated with the transition to renewable energy in South Africa.

Figure 4.5 represents a diagram highlighting the sequence of events to the energy transition and the five subthemes.

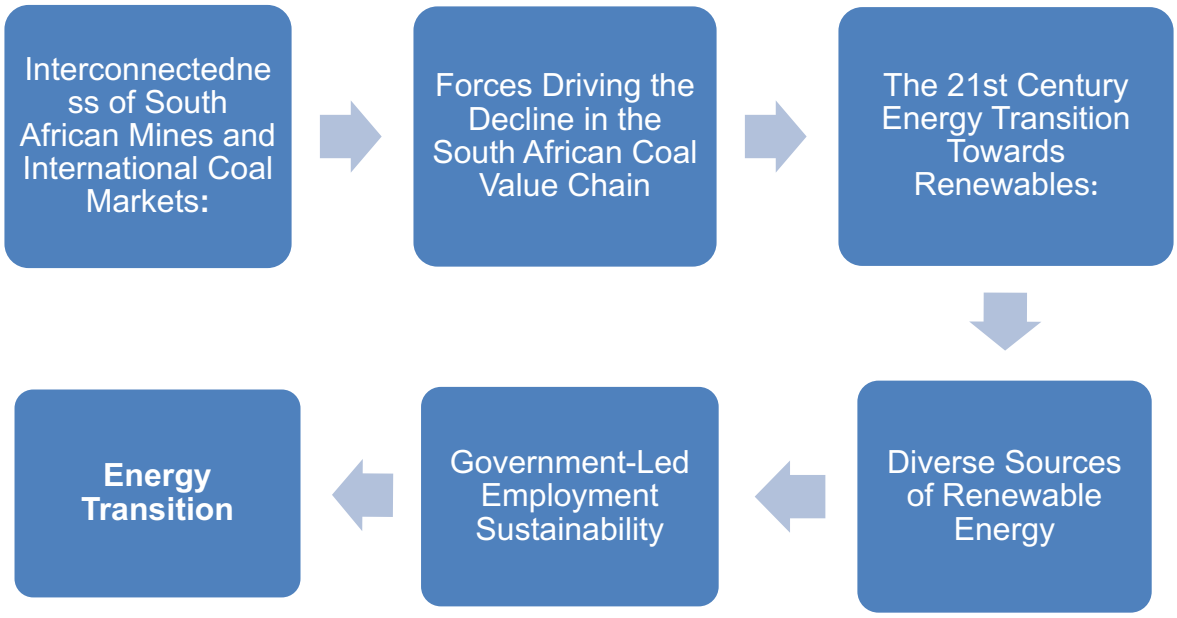

Figure 4.5: Sequence of events to the energy transition and five subthemes.

Source: Authors own

Sub Theme 1: The Interconnectedness of South African Mines and International Coal Markets

This theme highlights the significant interdependency between the South African coal mining industry and global coal markets. The ability of South African mines to sell coal internationally at higher prices plays a crucial role in the commercial viability of these mines. This linkage underscores the global implications of changes in South Africa's energy system and the need to consider international market dynamics when planning to transition from coal to renewable energy (Strambo *et al.*, 2019).

Sub Theme 2: Forces Driving the Decline in the South African Coal Value Chain

This theme emphasises the two critical factors that contributed to the decline of the South African coal value chain in the early 2020s. The first factor is the rapid obsolescence of coal as a source of power generation, leading to a shift towards cleaner energy sources and subsequent disintegration of the coal value chain. The second factor is the growing international and local pressure to limit the use of coal-based products due to concerns about climate change, further undermining the coal value chain. These forces represent significant challenges and drivers of change in the South African energy landscape (Wright *et al.*, 2019).

Sub Theme 3: The 21st Century Energy Transition Towards Renewables

This theme encapsulates the ongoing major energy transition characterised by a shift from fossil fuels and a growing emphasis on renewable energy sources. The transition is motivated by various factors, including concerns about environmental impacts, particularly climate change, limitations on fossil fuel supplies, technological advancements, and evolving energy prices. These dynamics collectively drive the global move towards more sustainable and renewable energy solutions (Timmons *et al.*, 2014).

Sub Theme 4: Diverse Sources of Renewable Energy

This theme highlights the multifaceted nature of renewable energy, encompassing various sources like solar, wind, hydro, biomass, and geothermal energy. These sources leverage natural processes and elements, such as sunlight and wind, to generate sustainable electricity, contributing to a cleaner and more diverse energy landscape (Deichmann *et al.*, 2011).

Sub Theme 5: Government-Led Employment Sustainability

This theme encapsulates the government's proactive approach towards ensuring a just transition to a low-carbon economy in South Africa. Key initiatives like the National Employment Vulnerability Assessment (NEVA) underline the commitment to assess and mitigate the impact of climate change on employment, enabling location-specific interventions to sustain jobs while transitioning to a low-carbon economy.

Conclusion on Theme 2

South Africa's Energy Landscape is evolving due to a combination of factors. International coal markets influence the country's value chain, declining due to outdated coal use and mounting climate change pressures. As part of a 21st-century energy transition, South Africa is shifting

towards renewable energy sources like solar, wind, hydro, biomass, and geothermal power. The government is actively involved in this transition, using initiatives such as the National Employment Vulnerability Assessment (NEVA) to assess climate change's impact on jobs and identify necessary interventions. This shift highlights global energy systems' interconnectedness and the importance of a sustainable transition.

Theme 2: Challenges and Opportunities in the Transition

The researcher then looked at the third theme that emerged, challenges and opportunities from the various publications on the just transition to renewable energy.

Common themes were gathered, and these are highlighted in Table 4.6.

Table 4.6 Challenges and Opportunities

Author	Coding	Theme	Sub Theme	Interpretation
Makgetla & Patel, (2021)	The coal value chain in South Africa has environmental concerns, including pollution, greenhouse gas emissions and habitat disruptions.		Environmental Considerations	Challenges and Opportunities in the Transition
Burton & Winkler, (2014)	Green job creation in areas like maintenance, installation, and grid integration.	Opportunities in the Green Economy .	SWOT Analysis	Challenges and Opportunities in the Transition
Makgetla & Patel, (2021)	Explains the coal value chain, The coal value chain in South Africa starts with exploration to find coal deposits, followed by mine development to prepare the site, and obtain permits.	Coal value chain that comprises the coal mining , extraction , transportation of coal and usage if the coal .	Coal Value Chain Explanation	Challenges and Opportunities in the Transition
Funds, (2020)	Employment in the coal mining sector is likely to decline due to economic (least cost trajectories), technological (increased automation) and environmental (including national-determined contributions of CO2 emissions and water scarcity) limits (Funds, 2020).	Impacts of the just transition.	Several factors drive the accelerated transition away from coal.	Challenges and Opportunities in the Transition

Timmons et al., (2014).	South Africa boasts some of the world's largest coal-fired power stations. Eskom, a prominent utility company, pioneered innovative methods for burning low-grade coal in these power stations. Notably, Eskom even financed privately owned coal mines, which provided low-grade coal for its operations, while the mines exported higher-quality coal, generating substantial profits for their owners (Timmons et al., 2014)	Impacts of the just transition.	Several factors drive the accelerated transition away from coal.	Several factors drive the accelerated transition away from coal.
Roser, (2020).	However, the landscape has evolved in recent years. Over the last decade, renewable energy technologies, such as solar and wind power, have become more cost-effective than coal (Roser, 2020).	Impacts of the just transition.	Several factors drive the accelerated transition away from coal.	Challenges and Opportunities in the Transition
Beveridge & Kern, 2013; He et al., (2020)	These countries have implemented coal phase-out plans with defined timelines. While the pace varies, the commitment to gradually reducing coal use and ultimately phasing it out is a common strategy (Beveridge & Kern, 2013; He *et al.*, 2020)	Phasing Out Coal		Challenges and Opportunities in the Transition

Source: Authors own

Explanation of Table 4.6

Table 4.6, titled “Challenges and Opportunities “, offered a concise overview of the environmental concerns and employment shifts and employment shifts within South Africa’s coal value chain. It outlines the process of the coal value chain, from exploration to mine development, highlighting potential declines in employment due to economic, technological, and environmental factors. The table underscores Eskom’s role in coal-fired power generation and the emergence of more cost-effective renewable energy technologies like solar and wind power. Additionally, it discussed global trends in the coal phase-out strategies, emphasising a common commitment among countries to reduce and eliminate coal use over defined timelines gradually.

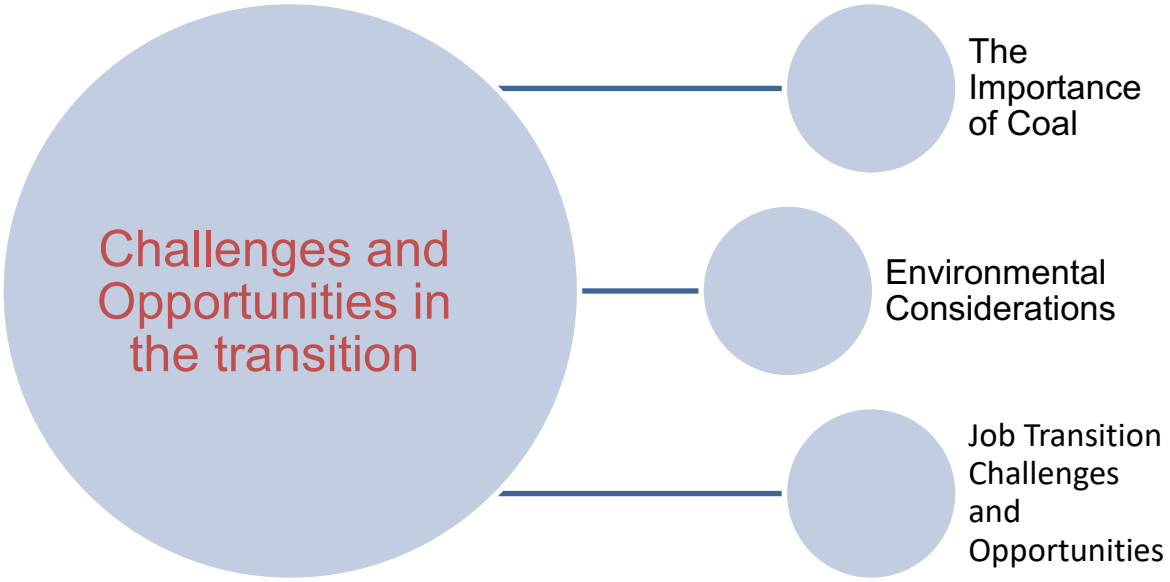

Figure 3.6: Unpacking the theme to the challenges and opportunities

Source: Authors own

Figure 3.6 is a sequence diagram unpacking the theme to the challenges and opportunities and looking at the three subthemes that emerged from the data: The importance of coal; environmental considerations; and job translation challenges and opportunities that will be unpacked below.

Sub-Theme: The Importance of Coal

Many authors highlight the importance of coal in the literature, especially in coal towns like Mpumalanga, which depend on coal mining activities that are pivotal to its local economy. However, if not carefully managed, it will impact the coal value chain, that is, the critical role players, mineworkers, local businesses, and mining communities (Makgetla & Patel, 2021).

"*Coal has been a critical part of the economy for over 100 years. Nonetheless, market and policy signals, coupled with targets to reduce greenhouse gas emissions, indicate that the decline of the coal sector will be inevitable. Therefore, the need to manage an accelerated transition to cleaner energy in a country facing extreme inequality, unemployment, and poverty makes it all more important for the just transition to be inclusive and just"* (Funds, 2020).

"*The exploitation of coal resources gained momentum in the early 20th century by establishing several mines and developing infrastructure to facilitate coal extraction and transportation. The coal extracted from the Mpumalanga mines serves the domestic market and contributes significantly to South Africa's export earnings. Coal is one of the country's largest exports by value, and 30% is exported" (du Venage, 2022).*

4.6.3 Environmental considerations

Although coal has been a critical driver in the local economy, it has had a negative effect on the environment and its surroundings. Considering the impact of coal mining on air pollution and the environment, considering its environmental impacts, look at the considerations.

"*However, despite its economic significance, the coal value chain in Mpumalanga has faced various challenges and criticisms over the years. The coal mining industry has been associated with environmental degradation, including water pollution, deforestation, and greenhouse gas emissions. Moreover, the extraction and burning of coal have contributed to air pollution and have been linked to adverse health effects for communities residing near mining and power plant sites"* (Strambo *et al.,* 2019).

The key benefits of transitioning to renewable energy are mentioned in the text below.

*“Improved public health: Reducing air pollution from fossil fuel combustion can significantly benefit South Africans, particularly those living near coal-fired power plants” (*Van den Berg*, 2023*).

Job Transition Challenges and Opportunities

A SWOT analysis was done in Chapter 2 (Table 2.1), illustrating the various strengths and weaknesses of coal miners, highlighting the key benefits and weaknesses of the transition to renewable energy.

A key mention from the authors is the transfer to the green economy.

“*Green job creation in areas like maintenance, installation, and grid integration. Green job creation in maintenance, installation, and grid integration” (*Strambo *et al.,* 2019*)*.

According to Montmasson-Clair (2021), distributive policies can assist mine workers with the just transition. These policies' main aim is to mitigate adverse impacts as well as generate counterbalancing and positive forces (Montmasson-Clair, 2021).

“*Achieving distributive justice, which is usually considered the core of just transition, hinges on addressing the direct negative impacts associated with the transition (such as loss of economic activity, employment and livelihood”* (Montmasson-Clair, 2021).

Distributive Policies - Active and Passive Labour Market Policies

Active labour market policies

“*An active labour market policy influences the entry and exit of people from the labour force. This can be done by providing Income support programmes. These programmes intend to ensure that employees can absorb the shock when transitioning to different employment opportunities or out of work”* (Carter *et al.*, 2019).

Alternative employment opportunities are retraining and re-skilling current mine workers. Linked to sub-placement schemes, the intention is to support workers in finding alternative employment. They provide small business subsidies, allowing mine workers to start their businesses. Voluntary packages, or early retirement packages, can be effectively managed by effective policies.

Passive labour market policies

The aim is to impact labour market conditions indirectly. It would include interventions of Creating minimum conditions for employment and conditions of work benefits. This can be achieved by setting a minimum wage; the positive impact of this is that it reduces the gap between poverty and inequality and in particular, the well-being of lower-paid workers. Evidence shows the existence of a “lighthouse effect” 4 as well, with a positive impact on wages in the informal sector (Mudronova 2016).

“*Labour market policies are critical and necessary to foster decent work. They are particularly important to improve working conditions as well as provide support and protection for workers. They also participate in establishing a safety net for workers falling out of employment” (*Montmasson-Clair, 2021).

The diagram indicates the different labour market policies: Active and Passive Labour market policies.

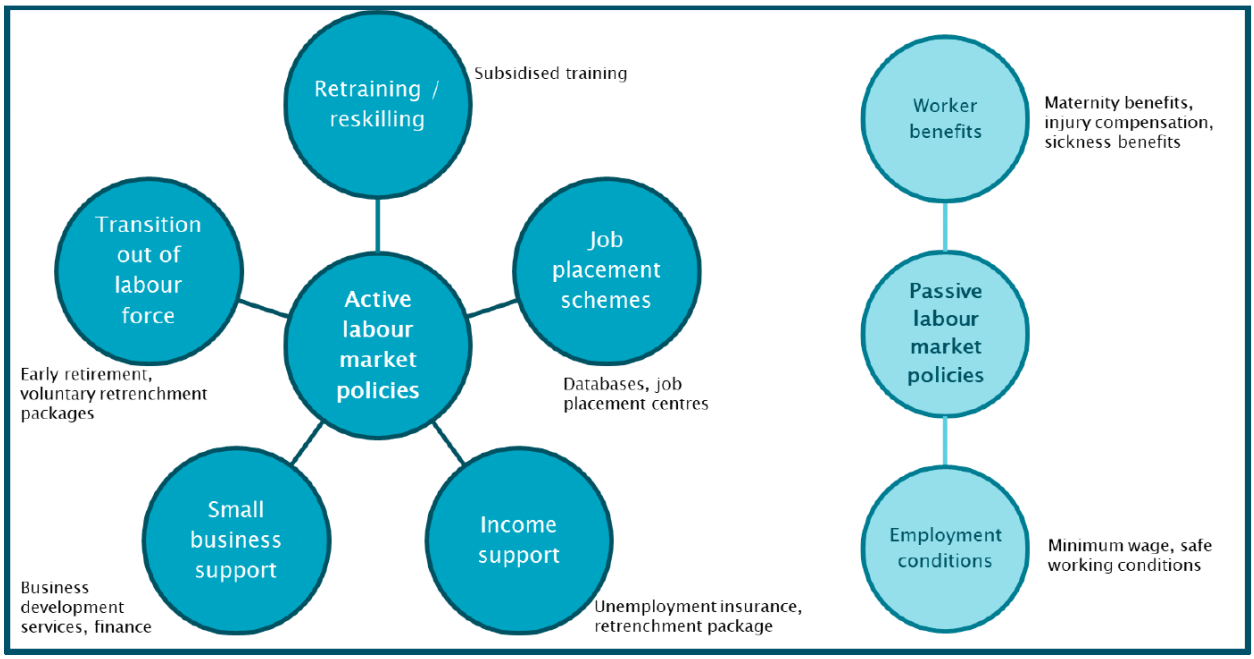

Figure 4.7: Unpacking the different labour market policies

Source: Montmasson-Clair (2021)

4.7 LIMITATIONS

The study encountered several limitations that warrant consideration. First, the limitation of limited generalisation is acknowledged. Given that the primary focus was on South Africa, specifically Mpumalanga, findings may not universally apply. Different contexts could present diverse challenges and opportunities in the transition away from coal.

Another notable limitation is temporal relevance. The literature reviews and information considered were primarily up to the early 2020s and the dynamic nature of the transition to renewable energy suggests that recent developments and shifts in the energy landscape might not be fully reflected. Furthermore, the presence of bias and perspective must be acknowledged. Depending on the sources and authors' viewpoints, a potential bias towards certain aspects of the energy transition could influence the comprehensiveness of the literature review.

The scope of the research question is another limitation. While the study effectively explores challenges and opportunities for specific stakeholder groups in the energy transition, there is recognition that broader research areas may exist and merit attention.

Lastly, the study confronts future uncertainties associated with the energy transition. Factors such as policy changes, technological advancements and market fluctuations introduce complexities that the literature review may need to more comprehensively capture, considering their potential implications.

To address these limitations, future research should aim for more up-to-date and comprehensive data, consider broader geographical contexts, and embrace an interdisciplinary approach to understand better and manage the complexities of energy transition.

4.8 CONCLUSION

The transition from coal to renewable energy in Mpumalanga represents a complex and multifaceted challenge. The primary objective of this transition is to reduce the region's reliance on coal and embrace renewable energy sources, such as solar, wind and hydroelectric power. This shift is not only environmentally imperative, as it mitigates adverse impacts on air quality and the environment, but also holds the potential to create new employment opportunities in the renewable energy sector.

The research question that guided this exploration was: "What are the potential challenges and opportunities for mineworkers, local communities, small-scale miners, suppliers and coal-dependent regions in Mpumalanga with the transition away from fossil fuel to renewable energy?" Through the analysis of the literature and data, several important themes emerged.

First, it became clear that the South African coal industry is linked with international coal markets. The profitability of South African mines is significantly influenced by their ability to access international markets, which often offer higher prices for coal products.

Secondly, it was evident that the coal value chain in South Africa was already on a decline in the early 2020s. This decline can be attributed to the growing obsolescence of coal for power generation, which has led to a global shift towards cleaner energy sources. Additionally, mounting pressure, both internationally and locally, to address climate change issues has put restrictions on the use of coal-based products.

Moreover, the literature points out that the 21st century is witnessing a pivotal energy transition globally. The move away from fossil fuels towards renewable energy sources is being motivated

by various factors, including concerns about environmental impacts, limitations on fossil fuel supplies, technological advancements and changing price dynamics.

The transition to renewable energy encompasses a range of sources, including solar, wind, hydro, biomass, and geothermal energy. These sources are instrumental in reducing environmental harm and addressing the challenges of climate change.

The government of South Africa is actively promoting a just transition to a low-carbon economy through initiatives like the National Employment Vulnerability Assessment (NEVA). These endeavours aim to assess the impact of climate change on jobs and explore interventions to ensure employment sustainability in the face of transitioning energy systems.

However, as with any substantial shift, there are limitations to the available data and the literature review. These limitations include data quality and availability, concerns about generalisability, the relevance of the data in a rapidly evolving field, the scope of the analysis, potential biases in the literature, a narrowly framed research question, uncertainties related to future developments, the need for a multidisciplinary approach and the necessity to consider the global context and diverse perspectives.

In addressing these limitations and recognising the interconnected themes of coal decline, renewable energy transition and employment sustainability, South Africa has the potential to navigate this transition with a just, sustainable, and equitable approach. While challenges are apparent, the opportunities for a greener, more prosperous future are within reach.

In essence, this study underscores the importance of understanding the intricate dynamics between energy transitions and the associated socioeconomic consequences. The path forward involves ensuring that as Mpumalanga shifts from coal to renewables, mineworkers, local communities, small-scale miners, suppliers, and the broader region all find opportunities to thrive in a changing energy landscape.

CHAPTER 5 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

The data centres on Mpumalanga, South Africa's transition from coal to renewable energy, prompted by global events and environmental concerns. The coal value chain, pivotal for South Africa's growth, was declining due to global trends and climate change pressures (Wright *et al.*, 2019). The primary objective was to reduce coal dependence, improve air quality, and create new jobs. This shift has socio-economic impacts, especially on vulnerable groups. Key findings were noted from the work that (Bodansky, 2016:2) did; he mentioned," *Reducing coal-generated electricity will have severe implications for places such as Emahleni, in South Africa*."

The primary objective of this study was to understand the potential challenges and opportunities of the just transition in Mpumalanga, considering the perspective of mineworkers, local communities, small-scale miners and suppliers, and coal-dependent regions that would impact the coal value chain in Mpumalanga. Chapter 5 contains a summary of the study, gives the limitations that were faced throughout this study, and provides recommendations for future studies as well as a conclusion. A summary of how the objectives of this study were achieved follows.

5.2 SUMMARY

The objectives that were formulated for the study were achieved in chapters 1 to 4. This study comprised a literature review (Chapter 2) and an empirical review (chapters 3 and 4). A summary of how the objectives were achieved is given below with reference to each chapter.

5.2.1 Chapter 1

In Chapter 1, the background to the study and problem statement were provided. The problem statement in respect of the study was to understand the potential challenges and opportunities of the just transition in Mpumalanga, considering the perspective of mineworkers, local communities, small-scale miners and suppliers and coal-dependent regions that would impact the coal value chain in Mpumalanga. In order to answer the problem statement, the following theoretical objectives were formulated for this study (Section 1.42):

- To conduct a literature review on renewable energy and its theoretical relevance
- To explore case studies or best practices from other regions or countries that have successfully transitioned from coal to renewable energy.

The following empirical objectives were also formulated in order to answer the problem statement (Section 1.4.2)

- To identify and present the chosen research methodology to be followed in order to address the set research objectives.
- To summarise the study with recommendations relevant to policymakers in the South African energy sector context.

Chapter 1 outlined the background to the study, the problem statement and the objectives that were set. The problem statement is addressed, and the objectives are achieved throughout the study (chapters 2 to 4).

5.2.2 Chapter 2

Chapter 2 contained a literature review on the pivotal role of the coal value chain in Mpumalanga, South Africa, which plays an important role in the region's economy, particularly in energy, petrochemical, and metal refineries. The review included a discussion of various components of the coal value chain. The environmental impact of these components was briefly discussed in Chapter 2, which led to environmental sustainability as one of the objectives of this study. The regulatory frameworks were explored in terms of their purpose and the overall effect that these have on consumers and the environment. Chapter 2 achieved the following research objectives as formulated in Chapter 1.

Conducting a literature review on renewable energy and its theoretical relevance.

The first secondary objective (Section 1.4.2) established that the South African coal industry has faced environmental challenges, leading to the need for a transition. The study emphasises the urgency for a just transition away from coal, aligning with global and national energy transition trends. Furthermore, in the study, the researcher examined the literature, and the following reasons were identified from the literature on the theoretical relevance of renewable energy:

Reasons for the transitioning away from fossil fuels to renewable energy:

Various environmental concerns have been raised as the coal value chain has been associated with environmental degradation, including water and air pollution, deforestation, and greenhouse gas emissions. This has led to adverse health effects on the surrounding communities (Strambo *et al.,* 2019).

Traction in the global and national energy trends are encompassed by changes in the South African energy system and international coal markets that has accelerated the deterioration of the coal value chain. Global pressure to restrict coal use due to climate change have also contributed to the shift towards greener energy sources (Strambo *et al.,* 2019).

Renewable Energy Transition

The transition to renewable energy is motivated by a number of factors, such as environmental impacts (climate change), constraints on fossil fuel supplies, and technological changes. Several renewable sources, including solar, wind, hydro, biomass, and geothermal energy, are being explored (Deichmann *et al.,* 2011).

Economic development and energy transition: As economies develop, there is a historical pattern of transitioning from one primary fuel source to another. In the twenty-first century, there is a global shift from fossil fuels to renewable energy sources. Economic factors, including decreasing costs of renewables, are driving this transition (Merven *et al.*, 2020).

Policies driving Transition

The Paris Agreement is an international treaty that aims to fight against climate change by limiting global warming. South Africa is heavily reliant on coal; however, it is slowly shifting towards the use of renewable energy to align with the Paris Agreement. A just transition strategy is critical in addressing social and economic impacts, especially in coal-dependent regions. First the Integrated Resource Plan (IRP) is an electricity infrastructure development plan for South Africa that emphasises diversifying the energy mix. Combining renewables such as solar, wind and hydropower aims to reduce dependence on a single energy source and enhance sustainability. Lastly, the Presidential Climate Change Policy (PCC) focuses on a just transition to a low-carbon economy. It aims to balance environmental sustainability with social equity and economic fairness, considering the well-being of vulnerable *populations* (Montmasson-Clair, 2021; Wright *et al.,* 2019).

Challenges and Recommendations

The transition poses challenges such as job losses, economic decline in mining towns and revenue reduction for municipalities. To address this, comprehensive strategies should include reskilling programmes, support for affected communities and economic diversification plans. Policies and initiatives need to be implemented during the transitioning stage and must ensure social equity and avoid inconsistent impacts on vulnerable groups. Community engagement and inclusivity are essential for a just transition. Effective implementation of policies, such as those

outlined in the Paris Agreement and the PCC are critical. These include investment in research and development, setting renewable milestones and providing financial incentives for renewable projects.

In summary, moving from coal to renewable energy in Mpumalanga is imperative, driven by environmental concerns, global energy trends and policy imperatives. A just transition strategy, informed by international agreements and national policies, is crucial to navigate challenges and ensure a sustainable and equitable future for affected communities and industries.

5.2.3 Chapter 3

Chapter 3 formed part of the empirical review of this study and provided a brief overview of the research design, research methodology, research paradigm, research approach, methodological choice, research strategy, time horizon, study population, sampling and sampling size, and data collection.

The empirical part of this study employed a content analysis which involved selecting diverse documents from the Department of Mineral Resources and several mining companies' websites. The nature of the documents varied from formal reports to informal written materials, offering a rich data source. The researcher further applied a content analyses review search of existing literature and came up with key themes as illustration (Figure 4.4). A thematic analysis was applied in five phases, namely familiarisation, generation of initial codes, searching for themes, reviewing, and defining or naming themes.

Chapter 3 focused on the research design and research methodology, which contributed towards the achievement of the empirical objective of identifying and presenting the chosen research methodology to be followed in order to address the set research objectives of this study. The results and findings of this study were discussed and illustrated (by means of tables and figures) in Chapter 4.

5.2.4 Chapter 4

Chapter 4 discussed and illustrated the results and findings of this study. The purpose of this chapter was to uncover challenges and opportunities for key stakeholders in the coal value chain, as mentioned in Chapter 1 (Section 1.5.1) and formulate recommendations that are in line with the research objectives, as mentioned in Chapter 1 (Section 1.4.2).

This study delves into the transition from coal to renewable energy in Mpumalanga, focusing on its impact on the coal value chain. Emphasising economic, social, and regional aspects, the

research seeks to uncover challenges and opportunities for stakeholders like mineworkers, local communities, small-scale miners, and suppliers. The study's significance lies in its comprehensive analysis, providing valuable insights for policymakers, communities, and stakeholders. It aspires to facilitate a smooth and equitable shift towards a sustainable energy future, benefitting both the local population and the global environment.

5.3 LIMITATIONS OF THE STUDY

Throughout the study, several limitations were identified, such as:

- **Data limitations**: The validity and accessibility of data pertaining to Mpumalanga's socioeconomic indices, renewable energy projects, and the coal value chain were necessary for the study to be reliable. Only completed or updated data allowed for a comprehensive analysis.
- **Challenges in generalisation**: The findings may need help in generalising beyond the specific context of Mpumalanga, as variations in socio-economic dynamics, policy frameworks and industrial structures can limit the broader applicability of the results.
- **Temporal dynamics**: The transition from coal to renewable energy is a dynamic process influenced by evolving policies, market conditions and societal attitudes. The study's snapshot nature may not capture the ongoing changes and their impacts.
- **Limited focus on mineworkers**: Although the study discusses the effects on mineworkers, it might not be able to provide a more thorough examination of their struggles and experiences. This restriction can ignore subtleties in their changes in socioeconomic status.
- **Single geographical focus**: The study concentrates on the province of Mpumalanga; South Africa and its conclusions and findings may not be universally applicable to other regions facing similar transitions. Differential regional settings could require different approaches.

Understanding these limitations is crucial for accurately interpreting the study's findings and acknowledging its scope's boundaries.

5.4 RECOMMENDATIONS

Resulting from this study, certain recommendations could be implemented regarding the just transition dialogue to renewable energy and encourage and facilitate investments in renewable energy infrastructure, encompassing solar, wind, hydro, and other sustainable sources, to diversify the energy mix in Mpumalanga.

The researcher, through reviewing the literature, as mentioned in Chapter 2 and by doing content analyses (refer to Chapter 4), made the following recommendations based on the research question that was referred to at the outset of the study (Section 4.1).

- There is a need to develop and implement policies with a specific focus on mineworkers, addressing their employment security, reskilling opportunities, and overall well-being during the transition.
- South Africa should take learnings from successful transitions in other regions or countries
- and integrate best practices into the Mpumalanga context, adapting strategies that have proven effective in mitigating challenges and maximising opportunities. These learnings can further be incorporated into policies like the updated version of the IRP 2019 (Integrated Resource Plan in South Africa) or the PPC (Presidential Climate Change Policy).
- For South Africa and specifically Mpumalanga, to transition to renewable energy requires continuous and transparent dialogue among the various government bodies, industries, local communities, and small-scale miners to enhance collaboration, information sharing and the collective development of sustainable transition strategies.
- The Presidential Climate Committee (PCCC) should advocate for and contribute to the development of supportive policy frameworks and regulations that encourage a just transition, aligning with national and international commitments such as the Paris Agreement.
- The updated IRP 2019 should encourage and facilitate investments in renewable energy infrastructure, encompassing solar, wind, hydro, and other sustainable sources, to diversify the energy mix in Mpumalanga. This can be achieved through programmes like the South African Renewable Energy Independent Power Producer Programme (REIPPPP). The REIPPPP involves a competitive tender process designed to facilitate private sector investment in grid-connected renewable energy generation in South Africa. The successful implementation of this programme has resulted in South Africa attracting more investment through independent power producers (IPPs) in the past four years than the rest of sub-Saharan Africa has seen over the past decades. (Eberhard *et al.*, 2014).
- The government can explore opportunities for economic diversification in communities heavily reliant on the coal value chain. Support initiatives that promote diverse economic activities beyond coal-related industries.
- The Presidential Climate Committee (PCC) can implement targeted skills development programmes to equip workers, especially mineworkers, with the skills needed for employment in emerging sectors related to renewable energy. This can be done through the NEVA program.

- Conduct public awareness campaigns to inform local communities, businesses, and individuals about the benefits of the transition, fostering understanding and cooperation.

South Africa can collaborate and have input into the UN Climate Conference (COP27-UNEP) where international partners, organisations and governments has access to knowledge, resources, and support for a smoother transition.

Implementing these recommendations holistically can contribute to a just and sustainable energy transition in Mpumalanga, fostering economic resilience and environmental sustainability.

5.5 AREAS FOR FURTHER RESEARCH

Furthermore, a single geographical focus was highlighted as a limitation. Future research could extend its scope to include other regions, such as the Eastern Cape and specifically investigate the impact of wind farm projects on the local communities in that area. The learnings from this research could be compared to the outcomes from that research as both studies try to explore the impacts on the vulnerable groups; in that study, it will be the community members that have given up land for windfarm development.

However, while the study identified potential challenges and opportunities in the short term, further research can explore the long-term socio-economic impacts of the transition. This could include tracking the evolution of employment patterns, economic diversification, and community resilience over several decades.

These areas for further research could build on the insights provided by the current study, contributing to a more comprehensive understanding of the complexities associated with energy transitions and sustainable development.

5.6 CONCLUSION

In conclusion, this study delved into the complex landscape of transitioning from fossil fuels to renewable energy in Mpumalanga, South Africa, with a particular focus on the coal value chain. The research aimed to address the primary question: What are the potential challenges and opportunities of the just transitioning in Mpumalanga? Key role players are the vulnerable groups and the impact that the transition will have on the coal value chain. The shift is not only imperative, as it mitigates adverse impacts on air quality and the environment, but it also holds the potential to create new employment opportunities in the renewable energy sector. What the study also explored was that the coal industry is closely linked to the international coal markets. The coal value chain in South AFRC has been on a constant decline since the early 2020s due to two main

variables: the promotion of cleaner energy by the international markets due to the climate change dilemma worsening, which has resulted in more pressure from internationally and locally to restrict the use of coal-based products. These two main variables have caused the disintegration of the coal value chain in South Africa. The just transition narrative has become important and has to be correctly implemented to ensure that vulnerable groups are not negatively affected and that they can benefit or be absorbed in the energy transition.

In essence, this study serves as a valuable resource for policymakers, communities and stakeholders involved in the energy transition in Mpumalanga. By acknowledging the challenges, identifying opportunities, and offering strategic recommendations, it contributes to the ongoing dialogue on achieving a just and sustainable future for the region, balancing economic development with environmental considerations.

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APPENDIX 1:

ETHICAL CERTIFICATE APPROVAL LETTER

07 July 2023

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Economic and Management Sciences Research Ethics Committee (EMS-REC)** on, 30/06/2023 the Economic and Management Sciences Research Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-REC) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: An exploration of the just transition to renewable energy on the coal value chain in Mpumalanga

Study Leader/Supervisor (Principal Investigator)/Researcher): Mrs J Manyaapelo

Student: B Summers (44715838)

N	W	U	-	0	0	7	1	1	-	2	3	-	A	4
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type:
Commencement date: 07/07/2023 **Risk:** Minimal
Expiry date: 07/07/2024
Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

•

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the EMS-REC:*
  - *annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the EMS-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *Annually a number of studies may be randomly selected for an external audit.*

1

- *The date of approval indicates the first date that the study may be started.*

n the interest of ethical responsibility, the NWU-SCRE and EMS-REC reserves the right to:

- *request access to any information or data at any time during the course or after completion of the study;*
- *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
- *withdraw or postpone approval if:*
  - *any unethical principles or practices of the study are revealed or suspected;*
  - *it becomes apparent that any relevant information was withheld from the EMS-REC or that*

APPENDIX 2:

LANGUAGE EDITOR LETTER

LINDA SCOTT DEVELOPMENTS
PROMOTING LINGUISTIC & CULTURAL INCLUSIVITY

Dr Linda Scott
083 654 4156
lindascott1984@gmail.com
www.justedit.co.za

15 Shannon Close
The Circus
Three Rivers
1929

English language editing
SATI membership number: 1002595

26 November 2023

To whom it may concern

This is to confirm that I, the undersigned, have language edited the **dissertation** of

B SUMMERS

for the degree

Master in Business Administration

entitled

An exploration of the just transition to renewable energy on the coal value chain in Mpumalanga

The responsibility of implementing the recommended language changes rests with the author of the document.

Yours truly,

Dr Linda Scott

SATI membership number: 1002595
SACE membership number: 1096643
ORCID ID.: 0000-0003-2049-0732
ETDP SETA Assessor/Moderator: SOR number: 468097

PhD: Language Practice
MA: Intercultural Communication
BA (Hons): Language Practice
NPDE and ACE