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Coal miners' attitudes, knowledge, and perceptions of transitioning to renewable energy in South Africa

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A research report submitted to the Faculty of Commerce, Law, and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Supervisor:
Dr. Jacques Totowa

Johannesburg, 2023

Protocol number: WBS/BA305138/694

DECLARATION

I, **Thabo Brian Ramara**, declare that this research report is my own work except as indicated in the references and acknowledgments. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Thabo Brian Ramara 

Signed at Benoni, Ekurhuleni

On the 27th day of February 2023

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Abstract

The current state of load-shedding has sparked an interesting debate about energy security in South Africa. Electricity interruptions, purposefully switching off electricity to save energy for a certain period during the day, have caused significant problems across the country, including low economic activity, closure of businesses, and loss of jobs. Coal miners have concerns about switching to renewable energy due to loss of employment. South Africa depends on coal, a non-renewable resource, to generate electricity and has been struggling to supply electricity effectively. This study investigated the knowledge, perception, and attitude of employees in the coal mining industry about diversifying energy sources and incorporating renewable energy. The process followed was a quantitative study approach conducted in the mining industry, Khutala Colliery.

A questionnaire generated from SurveyMonkey was used to recruit one hundred and fifty-four participants. Data analysis, visualization, and presentation were undertaken using SPSS version 29. Inferential statistics were used for this research with the P-values in the following tables. Results show that coal mining employees had a positive attitude towards renewable energy. Employees were overall knowledgeable about renewable energy as an alternative source. There was a positive perception of renewable energy as a source of energy to address the current energy problem. Lastly, the dataset shows a positive attitude towards using renewable energy in SA. There is a need to understand the level of knowledge, perception, attitude, and readiness to transition to renewable energy before implementing alternative energy.

Acronym

BRICS: Brazil, Russia, India, China, South Africa

CO2: Carbon Dioxide

CoP: Country Operation Plan
FDI: Foreign Direct Investment
IBM: International Business Machine
IEA: International Energy Agency
IPCC: International Panel on Climate Change
IPP: Independent Power Producers
NDP: National Development Plan
NGO: Non-Governmental Organization
OAPEC: Organization of Arab Petroleum Exporting Country
OECD: Organization of Economic Cooperation & Development
R&D: Research & Development
RAA: Reasoned Action Approach
RE: Renewable Energy
RET: Renewable Energy Technology
SDGs: Sustainable Development Goals
SPSS: Statistical Package for Social Scientist
SSA: Sub Sharan Africa
TPB: Theory of Planned Behavior
TRA: Theory of Reasoned Action
UN: United Nations

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CHAPTER ONE: INTRODUCTION

1.1 Introduction and Background

Fossil fuels drive the current global economy. Energy security is at the base of any business and therefore has a determining impact on the economy (Adedoyin et al., 2020; Saidi & Hammami, 2015). Although energy demand is increasing globally, emerging markets face challenges in satisfying their energy needs because of several factors like urbanization, industrialization, and population growth (Adedoyin et al., 2020; Saidi & Hammami, 2015). A gap exists in energy use amongst developed and developing countries and between affluent and poor households (Lin & Omoju, 2017). Globally, Asia Pacific tops the chart of energy consumption (44%), then North America (20%), and lastly Africa is at (3%) (BP, 2020a).

Energy consumption brings with it the problem of carbon emissions. The global energy needs across different countries are mainly satisfied by using fossil fuels with the contribution of renewable energy still minimal (Adebayo, Awosusi, Oladipupo, Agyekum, Jayakumar, & Kumar, 2021).

The introduction of renewable energy in the energy supply mix is urgent if we want to mitigate the effect of using fossil fuels on the environment. The imperative of sustainability enumerated by the Sustainable Development Goals (SDGs) combined with risks associated with climate change are pressing issues that humankind is grappling with (Devkota et al., 2020); Marahatta et al., 2022; Marahatta et al., 2021; Bogdanov et al., 2019; Bogdanov et al., 2021a). The oil embargo of the 1970s triggered events that pushed European countries to shift from fossil fuel dominance to renewables (Gasser (2020). Moreover, the war in Ukraine has reminded the world how urgent it is to transition to other forms of alternative energy (Welfens, 2022).

Renewable energy is critical in addressing the energy shortage in South Africa and promoting sustainable development because of global climate change concerns and sustainability (Guang-Wen et al., 2023). The power problem in South Africa has a long-term impact on economic growth and development (Udeagha & Breitenbach, 2023).

Moreover, several industries have been impacted by the slow response to tackling the problem (Ingram et al., 2023). The key drivers of renewable energy include the need to attain a carbon-neutral environment by 2030(Yu et al., 2023).

Several renewable energy sources, such as solar, wind, and biomass, must be implemented to reduce the significant impact of power generation issues that Eskom faces (Osman et al., 2023). Furthermore, the impact of renewable energy in the decarbonization process of the electricity industry is essential to achieve a clean and carbon-free environment and reduce fossil fuel use, especially in emerging economies (Yu et al., 2023).

Industry 4.0 is essential in the production of renewable energy in emerging countries such as South Africa, where research on the Internet of things, artificial intelligence, and real-time data analytics. In contrast, this technology has been deployed in China and Germany to augment sustainable energy production (Bhagwan & Evans,2023). Other industries 4.0 practices in renewable include the green finance model to finance renewable energy in emerging markets (Ng et al., 2021) and the digitization of renewable energy infrastructure (Ghobakhloo, 2020).

This study responds to the need for more research in renewable energy in emerging markets and how it can be used to innovate energy production and reduce the dependence on fossil fuels (Ukoba et al., 2023). There is potential in South Africa to produce renewable energy to fill the shortfall in the energy availability of the country (Panchenko et al., 2023), and renewable energy like solar can be efficiently used by households while fossil fuel can be deployed to industries where energy demand is much higher than domestic consumption.

The need to scale up the use of sustainable energy in South Africa is critical to a just energy transition which is also an important debate in the country. The stakeholder in the industry must collaborate to ensure the best approach to a just energy transition is adopted. Renewable energy can support a just energy transition (Mirzania et al., 2023).

1.2 Problem Statement

Electricity supply interruptions have become a common occurrence in South Africa. The considerable number of days businesses spend without power has severely impacted business continuity and efficiencies (Mbomvu, Hlongwane, Nxazonke, Qayi, & Bruwer, 2021). Such interruptions have affected the viability of business enterprises (Machivha, 2021). The energy problem in Southern Africa has ignited the debate about the move to a more environmentally friendly and cleaner electricity source, such as renewables. This study attempts to assess the attitudes, knowledge, and perceptions of workers in the coal mining sector, specifically the coal sector, towards a transition to renewable energy sources.

1.3 Research objective

- Examine the relationship between the employees and their knowledge towards renewable energy.
- Explain the relationship between employees' attitudes and knowledge towards renewable energy usage.
- Analyze the relationship between employees' attitudes and perceptions towards renewable energy.

1.4 Hypothesis

- H1. Employees in the coal mining environment have positive awareness of renewable energy.
- H2: Employees in the coal mining industry have positive knowledge of renewable energy usage.
- H3: Employees in the coal mining environment have a positive perception of renewable energy.

1.5 Significance of the Study

This research offers insights into the current energy problem by determining the attitudes, knowledge, and perception of employees in the mining industry toward renewable energy. The study postulates that the workforce within the sector should be the champions of the

transition to renewable energy such as windmills, and solar including other types of energy sources to alleviate some of the problems emanating from the coal industry. Furthermore, the research extends knowledge and understanding of renewable energy's impact in a modern economy such as South Africa, influenced by several fundamental systemic and structural problems like unemployment and low business productivity.

1.6 Limitations of the Study

This research is limited due to the following; firstly, the study is quantitative, and there are some concepts which are better examined a qualitative or mixed method research to capture the nuance of the problem. Secondly, the theoretical framework used to examine the problem has some things that could be improved. Therefore, other theoretical frameworks, such as RBV and Institutional theory, would better explicate the problem because the nature of the problem is complex, and there are several stakeholders. Thirdly, the literature on renewable energy in emerging markets needs to be better developed, and there are conflicting results about the impact of renewable energy on the economy and how it can lead to energy sustainability in the long run. Therefore, the solution to the energy crisis emerging in South Africa must adopt a multiprong approach rather than reliance on renewable energy as the only solution.

1.7 Conclusion

This chapter tenders the introduction to the research and background to the research, the problem statement, the research aims and objectives, the research hypotheses, the study's significance, the study, the limitations of the study and the conclusion. The proceeding chapter delves into the literature view to fill the knowledge gap regarding renewable energy in South Africa and how it can alleviate the current energy crisis in South Africa.

CHAPTER TWO: LITERATURE REVIEW

2. Introduction

This chapter presents the landscape of renewable energy and transition in South Africa. The current state of knowledge shows that several scholars and policymakers advocate for a change to clean energy. Renewables are considered a viable option for the current energy sources.

2.1 Theoretical Framework

The theory of planned behaviour (TPB) developed by Icek Ajzen (1985, 1991), expands on the theory of reasoned action (TRA; Fishbein & Ajzen, 1975; which also modeled behavioural change. Past literature positioned the theory of plan acts as a solution to the problem of attitude-behaviour correspondence (Attitude–Behavior Consistency). Moreover, the theory of planned behaviour has been deployed by researchers to examine the change in behaviours of the research participants or respondents. The theory explores the conduct of the target subject of the study, their actions, context, and time frame (Ajzen & Kruglanski 2019). The theory has four elements that are grounded in the principle of compatibility. The key antecedent in the theory of planned behaviour is the intention to act on the behaviour under study (Ajzen, 2020).

The theory argues that personal norms influence the respondents' intentions and subjective criteria are classified as injective and descriptive (Fishbein & Ajzen, 2010). Injective normative belief is where a reference group or individual positively or negatively influences behaviour performance (Ajzen 2020). Furthermore, attitudes are derived concerning a behavioural faith about the consequences of the action. In contrast, behavioural control refers to the factors such as skills, abilities, time, money, and cooperation, among others, that influence the respondent's intention. The theory aims to examine the attitude and behaviour of research participants. A link exists between the theory and present research in that the attitude of workers towards the transition to renewable energy in South Africa is essential. Theoretical constructs were captured in the study and were significant in determining the response of workers in the coal industry toward renewable energy transition. This is the appropriate theory to study this problem because it deals with factors that could influence workers' behavior (Ajzen, 2020).

Moreover, limited research in South Africa has examined the attitudes of employees and coal production toward a just energy transition. Therefore, the theory of change behaviour highlights the attitudes and perceptions of employees and producers towards renewable energy.

2.2 Coal-dependent energy in South Africa

Research from the Council of Scientific and Industrial research indicates that Coal is still the most dominant source of energy, accounting for 80% of electrical capacity (Mandaha, 2022). Furthermore, the Department of Energy has estimated that South Africa contributes approximately 450 million tons to wards CO2 emissions annually (Nembahe & Ratshomo, 2016). The current predicament is that the National Development Plan (NDP) places coal production at the forefront of energy generation and overall industrialization. On the other hand, the drive for net zero emissions continues to become a global discussion, with an expectation that South Africa, like other coal-producing countries, will discontinue investment in coal-related technology despite the vast of coal reserves.

South Africa being a participant in the “United Nations Framework Convention on Climate Change” (UNFCCC) as it champions the objective of minimizing and mitigating the impact of global warming due to the use of fossil fuels, needs to align all its initiatives to meet the global target of achieving a net zero effect on the climate. The White Paper on Renewable Energy (REWP 2003) developed by the Department of Minerals and Energy set a target for increasing renewable energy contribution by drafting a practical strategy application framework looking at the cost-effectiveness of renewables (Aliyu, Modu, & Tan, 2018). The South African coal mining sector employs approximately 92 000 people in production, management, and processing plants.

The drive to attain a 'just transition' in needs to consider the impact not only on jobs, as the country faces an unemployment crisis, but also on coal-sector dependent communities. The focus must be on prosperity, collective agency, and economic equality **(**Makgetla, 2021). Social partners such as unions and other community-based organizations will likely oppose a transition that will not address their concerns (Ward,

Sharma, & Searight, 2020). The 'transition' must be flexible to allow the employees and another stakeholder to transition their lives and social well-being orderly (Kalt, 2021). Research, development, and technology implementation are direct outcomes of policy investment and are plausible ways to switch to greener energy efficiently and promptly. Developed countries have led the transition to renewable energy, while the global south is far behind. Various issues affect the transition to greener energy. Employment, the standard of living, and migration affect the transition to greener energy (Bohlmann, Horridge, Inglesi-Lotz, Roos, & Stander, 2019).

A bottom-up approach in implementing the transition to renewable energy could be more beneficial in the South African context as it could promote the localization of the industry (Bhattarai, Maraseni, & Apan, 2022). Therefore, to mitigate resistance by the stakeholders, namely coal mining employees, in-depth impact measures in determining a successful transition should include skills comparison, upskilling employees, and employment opportunities for the surrounding communities.

2.3 Climate Change and Renewable Energy

There is a global effort to mitigate the consequences of climate change that calls for a fundamental energy transition. In South Africa, changing coal to other renewable energy sources is essential. SA has a high CO^2 emission because of coal-generated electricity. Reducing this to a zero-carbon strategy with renewable energies is vital because of the abundant solar resources and wind (Bellelli, Aftab, & Scarpa, 2023). In addition, the transition will take several decades. Some newer coal-fired power plants will remain operational for several more decades. Their carbon dioxide may be captured before emission and recycled into economically valuable renewable liquid fuels for mobile applications (Bhagwan & Evans, 2023).

2.4 Perception towards Renewable Energy

The move towards renewable energy significantly impacts the coal industry globally, and most coal producers resist this move (Essex & de Groot, 2019). It is a historical and legacy attachment to coal mining in South Africa which has traditionally employed hundreds of thousands of local and migrant labourers from neighboring countries. (Strambo, Burton,

& Atteridge, 2019). Supporting the transition was localised among the business executives and climate change activists, not the general coal mining industry employee (Annecke & Wolpe, 2022). Moreover, the incentive for transition in South Africa is less attractive compared to other countries to allow coal miners, producers, and employees to shut down their coal mining plants and for municipalities to rely solely on renewable energy and support the transition (Carley, & Konisky, 2020; Heffron, Körner, Wagner, Weibelzahl, & Fridgen, 2020).

Cha et al. (2017) studied America as the country rolling out its just transition strategy from fossil fuels to clean energy. Several factors considered would ensure a just transition is achieved or hindered by workers likely to be negatively impacted by its evolution. A key consideration required was the economic impact especially felt by workers and their communities, many of whom are already struggling due to the high cost of living and financial hardships (Newell & Mulvaney, 2013). The plea made by stakeholders and employees was that resources and attention need to be directed toward ensuring the employees adapt to the transition in a fair and just manner without creating joblessness and adding to the existing inequality (Cock, 2019; Swilling, Musango, & Wakeford, 2016).

Similarly, South African trade unions, speaking on behalf of their affiliates, have raised concerns about the “just transition” process, stating that not just alternative but decent job opportunities need to be created for the coal mining workers and their communities, with emphasis made on establishing a transparent and credible plan which would ensure unions, coal mining workers and their communities are part of the transition and not simply left behind (Strambo, Atteridge, & Burton, 2019).

Burton, Marquard, & McCall (2019) discuss factors that negatively impact the support of a just transition in South Africa. They highlight that the unemployment challenge in the country results from various structural failures in the economy, which do not support the development agenda of SA. These factors are an education and skills deficit rooted in the flawed education system. Minimal skills development and poorly integrated industrial

policy led to de-industrialization and low growth in the labour-intensive sectors, such as coal mining.

A political consideration highlighted by Strambo et al. (2019) is understanding the consequences a declining coal mining workforce entails the labour unions. The United Kingdom in the 1980s and 1990s saw labour unions weaken due to closing of coal mines. In the case of South Africa, this could result in a weakened labour movement threatening the relevance of labour unions in the coal mining sector which form part of the space for the training and personal development of South Africa's political class. Organized labour in South Africa has a powerful political voice; therefore, the transition from coal to renewable is unlikely to be smooth (Swilling, Musango, & Wakeford, 2016). Furthermore, a poorly managed transition process could fail to provide opportunities for potentially affected employees and communities.

2.5 Barrier to Renewable Energy Transition from an employee perspective

Looking at the Canadian example in their transition program, phasing out coal-fired power, the government is investing 21 billion Canadian dollars over 11 years for green infrastructure and commercially viable clean energy (Smith, 2017). The commitment made was made to ensure a "just transition" program. It was designed for employees to be impacted by the phase-out process. It will secure employee income, training, and re-employment opportunities and create regional economic initiatives to support communities that bear the transition process's brunt (Smith, 2017).

In the case of South Africa (Swilling, Wakeford, & Kaviti Musango, 2005) highlight that for the desired structural transformations to prevail, there needs to be an understanding of local conditions that is dominated by rampant unemployment and poverty. The government could use the "just transition 'process to assist in stimulating the economy to achieve its broader objectives. There are fundamental and long-term considerations that need to be made by the government and the private sector in the "just transition" process (Consoli et al., 20).

Researchers have warned that the implications of an unmanaged "just transition" may have undesired outcomes for the workforce, considering a rise of new job roles, extinction

of traditional jobs, and significant changes in the job content. Therefore, clear articulation to the stakeholders is necessary for locating, helping describe, and weighing the effects and impact of the “just transition” on employment to enable buy-in, development, and preparation for transition.

There should be openness and planning together with consideration for the longevity of the coal mining workforce as we plan the transition process. Governmental institutions often under-classify job impact in their nature and form. The nature of governments' obsession with targets for job creation, focusing mainly on the primary sector, namely the construction and operations phases, without looking at their future sustainability post-project and operations stages, creates a false sense of security for the future. Bohlmann et al. (2019) note that renewables are often high-level, cognitive skills-based jobs requiring formal training, work experience, and higher education levels. Managers in coal mines and skilled labour with formal education may be easily transitioned and upskilled on the uptake of the new jobs created, where a majority of the lesser and uneducated employees will be left impacted.

Consoli et al. (2015, p. 3) equally draw attention to understanding the capability and capacity of a positive, minimal-impact transition of the coal mining employees as we compare current and future employment. Key considerations include the job-specific levels of formal education, work experience, and on-the-job training differences between the coal mining and renewable energy jobs. They involve the task profile difference and similarity of the coal mining and renewable energy jobs and the coal mining jobs and skills transferrable to the renewables sector. Another barrier to job security may be the age of the workforce. For example, coal mining workers over 50 years may be vulnerable due to their impending health issues, and many perceived lower adaptability capabilities and declining productivity (Hanto et al., 2021).

Beutel et al. (2022) stated that this could be true when there is a lack of support in training and structured upskilling programs, along with poor management of employee health issues due to inadequate medical surveillance programs in the workplace. They advise that the transition must include vulnerable groups that often get overlooked due to lack of formal education and state that there should be recognition of prior learning and

certification skills, informal internships, dual-type apprentice programs merging on-the-job and classroom training, community-based training initiatives for labour sending areas to ensure inclusivity of all impacted and affected groups.

2.6 Policy and Regulatory Framework

Efforts to foster a well-structured “Just Transition”, in the case of South Africa, involves a social dialogue that may be bipartite between the unions and employers or a tripartite approach that includes the government. Beutel et al. (2022) advise that despite the prevailing governance context (centralized, decentralized, private, or public), political leadership has proven indispensable to leading change and creating a policy framework coupled with decision-making processes to clarify the roles and responsibilities of multiparty stakeholders. Research findings by (Stanley et al., 2018) on managing coal mine closures and the ‘just transition” indicates that policies and strategy development are imperative in driving political, institutional, regulatory, and fiscal/budget planning. The impact needs assessing along with its multiplier effect. The regulatory framework needs to take cognizance of the labour market programs required to address the needs of redundant workers and potential impacts on workers in related and dependent industries.

South Africa’s National Development Plan (NDP) states that by 2030, South Africa should create an energy sector to promote economic growth and development by investing in additional energy infrastructure. Work done by (Nembahe & Ratshomo, 2016) highlights the commitment and direction taken by the Department of Energy to the National Energy Act, 2008 (Act 34 of 2008) in that the policy seeks to create diverse energy sources that are made available and affordable. The Act aims to diversify the economy beyond the reliance on traditional energy sources and commodities. The drive is to create labour-intensive industrialization, a knowledge economy, and foster industrial development.

2.7 Renewable Energy Investment

Almost all renewable energy development projects are capital-intensive and require a high capital outlay. Therefore, developers in the sector need to be incentivized by the government as they assist in this just transition (Murshed, 2018). The interest rate should be low to encourage investment in renewable energy. The dataset shows that citizens'

beliefs regarding renewable energy costs harm their chance of adoption. There is a need for national governments in developing countries to introduce subsidies to fund scale-up and domestic usage of renewables to encourage domestic consumption in developing economies (Kruger & Eberhard, 2018).

Moreover, research and development (R&D) is an key value-adding component of the renewable sector. R&D would improve the delivery of renewable energy and have a positive impact on cost, this will further encourage communities to adopt renewable energy (Hashemizadeh et al., 2021). In addition, research results indicate that influencing factors such as attitude, subjective norms, and perceived behavioural control positively moderate the relationship between consumers' intention and willingness to purchase renewable energy. Belief about renewable energy cost has a negative effect. At the same time, environmental concerns did not have a significant impact.

2.8 Summary

The principal goal was to share a thematic review of the literature regarding renewable energy and look at the need for an energy transition to alleviate the current power crisis. The key was to compare the change in Europe and Asia and see how South Africa could learn from their process. Stakeholder management, regulatory frameworks, and employee job security are at the forefront of a “just transition”. This can be achieved by investing in private and public sectors, acceptance by employees and their communities, and policies to support the transition.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the research design and methodology applied to investigate the phenomena. It covers the design, target population of the study, research strategy , pilot study, questionnaire construction sampling, data collection technique, validity and reliability data analysis, and research ethics.

3.2. Research Methodology

There are two broader research methodologies, i.e., quantitative, and qualitative. The current study is positioned on the quantitative axis of the research paradigm. In contrast, research methods are technically the data collection and analysis procedures aligned to either of the two-axis, i.e., quantitative or qualitative. This study adopts the quantitative research methodology, data collection methods, analysis, and interpretation (Saunders et al., 2016).

3.3 Research Philosophy

Developed by Saunders, research philosophy has been defined as the researcher's view of the world. There are three broad philosophical worldviews: interpretivism, positivism, and realism. Each worldview was aligned to a particular research methodological paradigm, i.e., quantitative, or qualitative. The present study adopts the positivist worldview because of the need to predict and generalize the results from the dataset about the attitudes, knowledge, and perceptions of employees in the mining industry towards renewable energy in South Africa and the implication thereof (Saunders et al., 2012).

3.4 Research Strategy

From the research Onion explicated by Saunders et al. (2016), several research strategies exist to collect data: survey, experiment, grounded theory, archival research, case studies, action research, and ethnography. The research strategy adopted related to the methodological choice used in the study. Since this research is quantitative, the survey strategy was selected. The survey research strategy used a cross-sectional dataset that was collected through a Likert scale questionnaire during a single collection

cycle, one case at a single point in time to collect quantitative data about the knowledge and attitudes of employees towards renewable energy to analyze the association between the variables (Creswell, 2014). The justification for using the survey strategy is that it allows for a quick collection of data and the analysis of the dataset. Moreover, the research strategy describes how to develop, design, and use the collection instruments for the study. The study strategy is survey research using survey instruments (Saunders et al., 2009).

3.5. Research Procedure and Methods

3.5.1 Target Population

The target population is a universe of available research respondents. The population for the quantitative is a more significant collection of individuals or objects that are the focus of the scientific query. Because it is impossible to use everyone in the population, it is necessary to target a specific subset. Furthermore, because of the large population sizes, researchers only use part of the individual in the population because it is too expensive and time-consuming (Creswell, 2014). The key characteristics of the population include age, gender, educational level, professional qualifications, and others. In the present research, the population comprises employees in the coal mining sector. In selecting this population, the researcher examined the current literature on the phenomenon and concluded that this is the right population to study. The pilot study involved 30 respondents, and the final population was approximately 200 (Sekaran & Bougie, 2013). The population entails the entire group of people, events, and things of interest that the study wishes to investigate (Sekaran & Bougie, 2013). It is usually this group that the researcher wants to make inferences based on sample statics, and a sample is a subset of a population.

3.5.2 Sampling Methods

Several sampling methods are employed in research, such as probability and nonprobability. Because this research endorsed the quantitative methodology, we used the probability sampling technique (Creswell, 2014). The probability sampling method utilizes some form of random selection to draw out respondents for the research. However, to ensure the credibility of the random selection method, there is a need to set

up a process or procedures that represent the population (Saunders et al., 2016). Moreover, sampling frame design randomly selected respondents from the Seriti mining houses. The sampling frame was obtained from the human resources division (HR), the simplest totality of the list of prospective respondents (Creswell, 2014). In addition, other types of probability sampling used in quantitative research include systematic and stratified random to accomplish the aim of their investigation. Moreover, the sample can be defined as a subset of a population. It is cumbersome to collect data and test every single element of the population (Sekaran & Bougie, 2019).

3.5.3 Data Collection Procedures

The dataset was collected using the cross-sectional survey from a random sample population of employees in the mining industry after the pilot study had been conducted. The 7-point Likert scale questionnaire was created via SurveyMonkey. The link to the questionnaire was made accessible online. Participants were given minutes, allowing for a high response rate. The questionnaire was divided into six main sections:

- demographic profile of respondents,
- attitude towards renewable energy,
- knowledge of renewable energy,
- perceptions towards renewable energy,
- readiness for transition and
- Intention

Web-based questionnaires are an easily accessible, fast, and effective data collection method. They do not require any financial input, and the participants can access the questionnaire at their convenience.

3.5.4 Data Collection

The Likert scale nominal scale questionnaire was used since it allows respondents to indicate their agreeableness with the statements in the instrument (Saunders et al., 2009), which is proposed for data collection from the population. This method was selected based on previous studies conducted to check the attitudes and perceptions of the

population toward renewables. The significance of using the Likert scale questionnaires is the simplicity and use, and time respondents require completing the questionnaire. It requires a few minutes if conducted online than face-to-face questions (Creswell, 2014). Moreover, other advantages of the Likert scale questionnaires are that it allows for easy analysis of the datasets because the variables are controlled. SurveyMonkey provides a preliminary analysis of the data (Sekaran & Bougie, 2014).

The Likert scale questionnaires were used for data collection from participants. The list of questions can be found in Appendix A, with questions emanating from the literature review conclusion and findings (Creswell, 2016). The advantages of the closed-ended Linkert questionnaires are that they allow easy coding, tabulation, and comparison (Saunders et al., 2016). The disadvantage of a closed-ended Likert-type scale questionnaire is that data needs to be more balanced because it is challenging to rate the scales.

3.5.5 Questionnaire Construction

The questionnaire was designed to collect respondents' attitudes, perceptions, and knowledge data. The questionnaire was administered to the respondent after the researcher conducted a pilot study (Saunders et al., 2016). The questionnaire was a closed-ended Likert-type question that allowed for collecting specific data.

The Likert scale questionnaire is an interval scale using five anchors from strongly disagree, disagree, neither disagree nor agree, agree, and strongly agree (Sekaran & Bougie, 2019). Moreover, there is popularity with the Likert scale used by scholars in survey research design because of the ease with which the questionnaire can be administered, completed, analyzed, and results presented and interpreted. The scale questionnaire was inspired by the literature reviewed to further understand employees' perceptions, knowledge, and attitudes.

3.6 Administration of Instruments

The questionnaire administration was essential in this survey research to obtain responses from the population necessary to collect sufficient data (Sekaran & Bougie, 2014). The four primary formats of instrument administration include self-administered,

in-person or telephonic interiews, and computer-based administered surveys. Due to time constraints, the pilot and the main study questionnaire were web-based via survey monkey (Saunders et al., 2009).

3.7. Pilot Study

In this research, a pilot study was undertaken with a small group of respondents, 30 in total, to determine the suitability of the research methods including instruments. The pilot results were analyzed and provided a basis for refining the questionnaires and study design (Creswell, 2014). The pilot serves to refine the research instrument used in data collection so that the data collection is usable for the study. In addition, the pilot study provided the researcher with insights to correct the type of errors and follow the questionnaire. The population must understand the questionnaire and ensure that the data is authentic. Data analysis was done on the pilot study to deduce the study's outcome. A pilot study with 30 managers and departmental heads from the coal mining industry and the preliminary questionnaire analysis was tested before collecting data. The questionnaire was emailed to over 50 respondents, and thirty returned the questionnaire. This was done to ensure the reproducibility and accuracy of the questionnaire method.

3.8. Data Analysis

The survey data collected from respondents were analyzed via Statistical Package for Social Scientists (SPSS) software. The data analysis output will be descriptive and inferential statistics for the study. Inferential statistics were applied to test the hypotheses stated and developed in the research. The inferential output from SPSS was presented in tables. Spearman's Rho was used to test the correlation among the variables (Creswell, 2014).

The data analysis procedure applied Statistical Package for the Social Sciences Incorporated (SPPS Inc) version 23 to analyze quantitative data (Saunders et al., 2009, p. 497). In the data reduction stage, the transcripts from the survey will be coded and compressed to a summary for analysis, and the differences along with inconsistencies presented. The excel software was used for tabulation before being transferred to SPSS for analysis (Mishra, Pandey, Singh, Keshri, & Sabaratnam, 2019). The data was presented both in descriptive and inferential statistics format.

The completed were then captured onto Microsoft Excel. The questions ranging from one to twenty were entered horizontally on the spreadsheet, while the number of respondents went vertically. The data was captured instantly and exported into SPSS for analysis. The frequencies command to obtain the frequencies were analyzed. The percentages for the questions were generated. The means and standard deviations analysis and descriptive statistics buttons were applied was used. Though the percentages have different categories, the study used only good percentages for interpretations and discussions in chapter four of this study.

3.8.1 Unit of Data Analysis

The unit of analysis is an essential component of quantitative research, and it examines the level at which data is aggregated and analyzed (Ruppar, 2022). There are three primary levels of analysis: individuals, groups, and organizations (Saunders et al., 2019). In the present research, the unit of analysis is individual respondents. The rationale for this choice is that the study seeks to establish the individual employee in the coal sector's perception, knowledge, and attitudes toward adopting renewable energy.

3.9. Validity and Reliability

3.9.1 Validity

The validity and reliability of research are essential concepts in quantitative research methodology. The instrument used to collect data must be credible and measures what it purports to measure (Saunders et al., 2016). Content, face, construct, concurrent, and criterion validity were assessed. Robust checks include data collection from a representative sample, the research instrument was designed to collect the correct type of data, and face validity will be ensured insofar as the statements and face value of the questionnaire are well organized. Since the instrument was adapted from previous studies, criterion validity has been assessed in the previous research.

The questionnaire had 37 statements that improved the validity of the research since the critical variables of succession planning were articulated and captured in the study. In addition to content validity, face validity was considered in some fundamental and minimum content validity indices. Face reasonableness indicates that the items identified

to assess a concept resemble the measure of the concept. Researchers must see fit to treat face validity as a valid component of content validity (Saunders et al., 2016).

3.9.2 Reliability

Reliability is a critical element of a quantitative research instrument, ensuring that the instrument can produce consistent results in different research settings. Moreover, the types of reliability include test, split-half test, and parrel reliability, among others. In addition, the primary form of reliability used is Cronbach's alpha, which can detect the instrument's reliability by analyzing the correlations between variables (Creswell, 2014).

3.10 Independent and Dependent Variables

The independent variable is the casual or predictor variable, whilst the dependent variable is the effect or result of manipulating the independent variable (Bloomfield & Fisher, 2019). This study's independent variables were age, educational level, experience, and firm experience. Moreover, the dependent variables are the respondents' perceptions, knowledge, and attitudes toward renewable energy. In addition, it was essential to understand how age, level of education, and industry experience influence respondents' attitudes, knowledge, and perceptions toward renewable energy. The hypotheses were tested by regressing the independent variable against the dependent variables.

3.11 Research Ethics

Research ethics is critical to scholarship, and the study will follow the ethical guidelines and policies published by the university. The research eliminated any unethical practices that would influence the validity and reliability of the study. The ethical application was assessed by the Wits ethics committee and approved before the commencement of the study (Saunders et al., 2016). Furthermore, research ethics entails that a researcher avoids plagiarism, and therefore, the final research was submitted via Turnitin to obtain the similarity report to prevent plagiarism. Moreover, other key ethical issues to address include ensuring that respondents get informed consent before administering the instrument. In addition, the research procedure and data collection will ensure no unethical behaviour during the data collection process. Besides, the respondents were not coerced into participating in the study. Moreover, the information about the

respondents was kept confidential, and the reason for the study was described to the respondents. Furthermore, the respondents' recruitment was unpaid (Creswell, 2014; Lewis & Thornhill, 2014).

Moreover, this study certifies the confidentiality and anonymity of respondents. No personal information was disclosed to third parties, and respondents' identities were according to the appropriate South African legislation, such as the Protection of Personal Information Act (PoPI)). Besides, the secondary data sources obtained from companies remain anonymous, and the dataset collected from research was used for academic contributions only. Furthermore, in ensuring that no harm occurred to respondents during this research, especially during the data collection phase, the researcher avoided the detrimental effect of this research, either physical or psychological. Also, no cause social disadvantages to the respondent and any financial harm, such as losing one's job because of participation and invasion of privacy, will be mitigated during the research design process (Creswell, 2014).

3.12 Conclusion

This chapter discussed the research methodology, which was quantitative, and the survey was sent to the population of interest in the mining industry. The informed consent was presented to the respondents, and the confidentiality and anonymity of the respondent were considered to mitigate any negative impact of the research. The dataset was analyzed using SPPS v29, and the results were presented in a tabular format to examine the relationship between the variables in the hypothesis.

CHAPTER FOUR: RESULTS

4.1 Introduction

This study's primary aim was to analyze the attitude, knowledge, perception, readiness for transition, and intention. Data was collected from SurveyMonkey and recorded on SPSS. There were 118 participants: 72 males and 80 females, 46,6% and 51,9%, respectively. Table 4.1 below represents the study population.

4.1.1 Gender Demographics

Table 4.1: Gender

Variables	**Frequency**	**Percent**
	(n)	**(%)**
Gender		
Male	72	46.6%
Female	80	51.9%
Others	2	1.71%
Total	**118**	**100**

4.1.2 Education

The level of education was investigated in the coal mining workers. Table 4.2 shows that 21% (32) of the respondents had Matric qualifications, whereas 16.2% (25) of the respondents had national diploma qualifications, and 46.8% (72) of the respondents held bachelor's degree qualifications. Moreover, 8.4% (13) of the respondents have honours qualifications, while 7.8% (12) had a master's degree. Finding out the level of education affects the attitude and perception of transitioning to renewable energy.

Table 4.2: Education

Variables	Frequency (n)	Percent (%)
Level of Education		
Matric	32	20.8%
National Diploma	25	16.2%
Bachelor	72	46.8%
Honours	13	8.4%
Master's	12	7.8%
Total	**154**	**100**

4.1.3 Level of Experience

Table 4.3 represents data on the level of experience among the participants. 16% (24) of the respondents had less than four years of industry experience, whilst 26.6% (46) had industry experience of between 5-9 years whilst 29% (46) of the respondents had between 10-14 years of industry experience and 17% (25) of the respondents had between 15-19 years. Lastly, 11.7% (18) of the respondents had over 20 years of industry experience. The level of expertise is an essential factor in determining one's interest in exploring the use of alternative energy.

Table 4.3: Level of Experience

Variables	Frequency (n)	Percent (%)
Level of Experience		
<4	24	15.6%
5-9	41	26.6%
10-14	46	29.9%
15-19	25	16.2%
20+	18	11.7%
Total	**154**	**100**

4.1.4 Position in the company

The positions held by the coal mining workers were investigated. Table 4.4 shows that 0.8(1) respondents held executive management positions, whereas 3.6% (4) were senior managers. In addition, 23.4% (36) of the respondents were middle managers, and 66% (78) were junior managers. However, 3.9% (6) of the respondents did not state their position or role within the company. The position held by individuals will impact their perception of the transition to renewable energy.

Table 4.4: Position in the company

Variables	Frequency (n)	Percent (%)
Position		
Executive Management	1	0.8%
Senior Management	4	2.6%
Middle Manager	36	23.4%
Junior Management	107	69.5%
Others	6	3.9%
Total	**118**	**100**

4.2 Hypothesis Testing & Results

The section provides the results from the hypothesis presented in chapter one. Data analysis involved data capture in an excel spreadsheet and verifying missing data. After that, the data was entered into IBM SPSS, and to test the hypothesis, Spearman Rho was used to running the correlation analysis. The dataset shows a significant correlation between the four variables (attitude, perception, knowledge, transition, and intention).

4.2.1 Employee Attitude and Intention

H1: The attitude of employees in the coal mining industry towards renewable energy was positively correlated to the intention to transition to renewable energy in South Africa. Spearman's rank correlation was calculated to test the correlation between the attitude of employees,

And there will transition to renewable energy. The results show a moderate positive significant correlation between the attitude and intention variables (152 = .554, p<0.001).

4.2.2 Perception and Intention

H2: The perception of employees in the coal mining industry towards renewable energy is positively correlated to the intention to transition to renewable energy in South Africa. Spearman's rank correlation was calculated to test the correlation between the perception of employees in the coal mining industry and their intention to transition to renewable energy. They show a moderate positive significant correlation between the perception and intention variables; (152) =0 .645, p<0.001.

4.2.3 Knowledge and Intention

H3: The Knowledge of coal mining employees about renewable energy positively correlates to the intention to transition to renewable energy in South Africa. Spearman's rank correlation was calculated to test the correlation between the knowledge of employees and their will to transition to renewable energy. The results show a moderate positive significant correlation between the knowledge and intention variables; Rs (152) = .486, p<0.001

4.3 Readiness /Transition and Intention

H4: The coal mining industry's employees' readiness to transition to renewable energy positively correlated to the intention to transition to renewable energy in South Africa. Spearman's rank correlation was calculated to test the correlation between the readiness to transition of coal mining firms and their intention to transition to renewable energy. The results Rs (152) = .777, p<0.001, show a strong positive significant correlation between the readiness to transition and intention variables.

4.4 Knowledge and Attitude

H5: The Knowledge and attitude of employees in the coal mining industry towards renewable energy are positively correlated. Spearman's rank correlation was calculated to test the correlation between the knowledge and attitude of employees in the coal mining industry towards renewable energy. The results Rs (152 = 0.584, p<0.001) show a

moderate positive significant correlation between the readiness to transition and intention variables.

4.5 Knowledge and Readiness/Transition

H6: The Knowledge and readiness to transition to renewable energy of employees in the coal mining industry towards renewable energy are positively correlated. Spearman's rank correlation was calculated to test the correlation between knowledge and the readiness to transition to renewable energy employees in the coal mining industry. The results Rs (152 = .610, $p<0.001$) show a moderate positive significant correlation between knowledge and the readiness to transition to renewable energy.

4.6 Knowledge and Perception

H7: The Knowledge and perception of employees in the coal mining industry towards renewable energy are positively correlated. Spearman's rank correlation was calculated to test the correlation between the knowledge and the perception of employees in the coal mining industry toward renewable energy. The results Rs (152) = .650, $p<0.001$, show a moderate positive significant correlation between knowledge and employees' perception of renewable energy.

4.7 Perception and Readiness to Transition

H8: The perception and readiness to transition to renewable energy are positively correlated among employees in the coal mining industry in South Africa. Spearman's rank correlation was calculated to test the correlation between the knowledge and the perception of employees in the coal mining industry toward renewable energy. The results Rs (152) = .794, $p<0.001$, show a strong positive significant correlation between perception and readiness to transition to renewable energy among employees in the coal mining industry.

4.8 Perception and Attitude

H9: The perception and attitude of employees in the coal mining industry in South Africa towards renewable energy are positively correlated. Spearman's rank correlation was calculated to test the correlation between the knowledge and the perception of employees in the coal mining industry toward renewable energy. The results Rs (152) = .729,

$p<0.001$, show a strong positive significant correlation between the perception and attitude of employees in the coal mining industry towards renewable energy.

4.9 Conclusion

Energy transition has gained traction, and all stakeholders must commit to developing and implementing a sustainable energy strategy for South Africa. This chapter presented the findings from the study and shows that there is a need to diversify the energy solution to tackle the problem of loading shedding. Overall, the results show a positive attitude, knowledge, perception, readiness to transition, and intention to transition toward renewable energy employment opportunities.

CHAPTER FIVE: DISCUSSION

5. Summary

There is a need for a just energy transition and diversification from coal to other alternative energy sources to address the present energy crisis plaguing South Africa. Nevertheless, to embark on this goal, scholars and policymakers must consider the perception, attitude, knowledge, readiness to transition, and intention of all the stakeholders toward renewable energy. This study investigated the attitudes, knowledge, and perceptions of employees in the coal mining industry towards renewable energy and how the transition to clean energy can alleviate the energy problem in South Africa. The study had 118 participants recruited from an online questionnaire from SurveyMonkey. Demographic data, including gender, education, and position, were used to determine factors influencing the coal mine workers' perception and knowledge of renewable energy. The results show a positive attitude, knowledge, perception, readiness to transition, and intention to transition toward renewable energy. This study showed that SA coal mine workers know about renewable energy and have accepted the possibility of transitioning to alternative renewable energy sources for future employment.

5.1 Employee Attitude & Intention

The literature shows that employees in the coal mining industry depend on the industry for their living and career progression. A just energy transition must consider these factors (Ourahou et al., 2020; Sweeney et al., 2020). However, for just energy transition to happen, employees must support the intention to transition and have a positive attitude and the intention to transition to renewable energy in South Africa in the long and medium term (Proudlove, Finch, & Thomas, 2020).

In addition, this research is supported by evidence and studies from other jurisdiction has shown support and a positive attitude towards renewable energy that datasets about the attitude of employees and their intention to transition to renewable energy (Agyekum, Amjad, Mohsin, & Ansah, 2021).

5.2 Perception and Intention

The result from the study is constituent with the literature which shows that several factors such as age, skills, abilities, remuneration, motivations, and time of the transition impact employees' perception and intention to transition to renewable energy (Ajzen, 2020; Ferraro, Prussia, & Mehrotra, 2018). In addition, the idiosyncratic probability of workers supporting a just transition to renewable energy bearing in mind the negative and positive impact on employees (Pellegrini-Masini, Pirni, Maran, & Klöckner, 2020; García-Muros, Morris, & Paltsev, 2022). Moreover, policy consideration is essential for workers in the coal industry to support a just intention. It should look at reskilling the employees to use new technology in the sector to be absorbed in the new renewable industry to create new employment opportunities (Hägele, Iacobuţă, & Tops, 2022).

5.3 Knowledge and Intention

The knowledge of workers is the critical factor in ensuring a successful transition to renewable energy (Kusi-Appiah & Essandoh, 2023). Moreover, studies show that the knowledge base of workers' intention to transition to renewable energy employment in South Africa is significant as their buy-in makes it easy and manageable to ensure a smooth education and upskilling process (Kusi-Appiah, & Essandoh, 2023; Rugiero, 2019). There must be a dialogue between the union representative and the government to agree on the phased-out approach to the coal plant and a just energy transition (Cawood, 2004; Todd & McCauley, 2021).

The result from is study is supported by literature, which indicates that the knowledge base of workers and employees is significant in forming the intention to transition to renewable energy (Murombo, 2022). The dataset supports the argument that Knowledge and intent to transition to renewable energy technology are essential.

5.4 Readiness /Transition & Intention

There must be a readiness and intention to transition employees to support the transition to renewable energy and encourage renewables in South Africa and purchase renewable energy (Elahi, Khalid, & Zhang, 2022). In South Africa, the stakeholders, such as employees and owners of mining houses, must spearhead the readiness to transition to

renewable energy is positively correlated to the intention to transition to renewable energy in South Africa (Nhamo & Mukonza, 2016; Nhamo, 2013).

Moreover, the readiness and intention to transition to renewable energy must be supported by the labour movements such as NUMSA and workers' representatives and governments whose roles are significant in ensuring a smooth transition to other alternative sources (Nel, Marais, & Mqotyana, 2023). In addition, South Africa has relied on coal as an energy source for decades (Scholvin, 2014; Amusan & Olutola, 2017).

Furthermore, several resource constraints inhibit readiness and transition to renewable energy, such as foreign direct investment (FDI), technology, and human resources regulatory framework, which supports the readiness to transition coal as a source of energy to other alternative sources (Moreau, Dos Reis & Vuille, 2019; Jabeen, Ahmad, & Zhang, 2022).

5.5 Knowledge & Attitude

There is considerable debate about a just energy transition globally, particularly in South Africa. However, to move this debate along, there is a need to understand the level of Knowledge and attitude of employees in the coal mining industry toward renewable energy (Crowe & Li, 2020; Barnes, 2022). The result of this study is supported by evidence from other scholarly work, which shows that where the population of the study is located influences the perception of the energy transition. Moreover, respondents with ties to coal had a more favourable view of coal than those with abundant solar energy, significantly impacting the transition.

Furthermore, a just transition is complicated in a coal-dependent economy such as South Africa, and Knowledge about energy-related and climate change policy is essential (Barnes, 2022). Moreover, there is considerable interest from the public to end load-shedding, and therefore the Knowledge and attitude toward renewable energy are positive. The benefits of the transition to renewable energy have a win-win for all stakeholders, especially around climate change and the reduction in carbon emissions (Karasmanaki & Tsantopoulos, 2021).

5.6 Knowledge & Readiness/Transition

The Knowledge and readiness to transition to renewable energy of employees in the coal mining industry towards renewable energy are positively correlated. There are several reasons for the transition to renewable energy besides addressing the shortfall in Eskom generation capacity, such as the need to tackle climate change, production of transparent energy, energy diversification, using renewable energy to secure energy security and deliver power to rural areas (Vainio, Varho, Tapio, Pulkka, & Paloniemi, 2019).

Moreover, several factors are essential to understand the readiness for to transition process. Employees and other stakeholders must be ready to implement transition, which includes acquiring the capacity and necessary skills to drive the transition agenda to renewable energy employees in the coal mining industry. The Knowledge and timeline for transition are critical and significantly impact the transition period and the time to alleviate the energy problem via alternative energy, such as renewables.

5.7 Knowledge & Perception

There is a big drive towards decarbonization, but the Knowledge and perception among the key stakeholders, such as employees, are critical enablers for a just energy transition in emerging market countries such as South Africa (Panarello & Gatto, 2023; Steg, Perlaviciute, & Van der Werff, 2015; Funder, Wlokas, Jhetam, & Olsen, 2021).

Moreover, the literature shows that Knowledge is connected to employees' willingness to gain new skills which can be used in renewable energy (Boamah & Rothfu, 2020).). Moreover, social norms and obligations also influence Knowledge and perception about renewable energy and drive employees to transition to renewable energy (Batel, 2020; Segreto, Principe, Desormeaux, Torre, Tomassetti, Tratzi, & Petracchini, 2020).

In addition, the different social and economic characteristics of the employees can determine the transition process and the Knowledge of stakeholders' working group, Knowledge of financial modeling and investment, how to reduce the barrier to scaling up renewable energy and training and development, and inequalities in society (Rosso-Cerón, & Kafarov, 2015; Carley, & Konisky, 2020; Gielen, Boshell, Saygin, Bazilian, Wagner, & Gorini, 2019).

5.8 Perception & Readiness to Transition

The dataset shows that South Africa still needs to be ready for the transition to renewable energy even though there is a high correlation between perception and readiness to transition to renewable energy (Neofytou, Nikas & Doukas, 2020). Moreover, stakeholders must be conscious of a multi-criteria transition readiness index, such as social, political, regulatory, economic, and technological factors (Neofytou, Nikas & Doukas, 2020).

The coal industry requires some time to develop the capacity to change from coal technology to renewable energy technology (RET) mining industry in South Africa. The perception and readiness to transition to sustainable sources of energy are vital, and workers must have a positive perception of the importance of renewable insofar as renewable energy is concerned (Eshiemogie, Ighalo, & Banji, 2022; Abbas, Khan, Bashir, Alemzero, Sun, Iram, & Iqbal, 2020).

5.9 Perception & Attitude

Extant literature shows that employees' perceptions and attitudes towards renewable energy are critical and significant, and several factors influence the perception and attitudes of employees regarding renewable energy (Hanke & Lowitzsch, 2020). Moreover, the primary drivers for adopting renewable energy include cost, belief regarding the benefits, the self-awareness and attitude of employees, and environmental concerns. All positively perceive renewables, especially early adopters (Wall et al., 2021; Fouad, Kanarachos, & Allam, 2022).

The relationship between consumer perception of sustainable renewable energy and attitude or willingness to purchase renewable energy is exceptionally significant. Most employees have a positive perception and attitude, which are drivers to adopting renewable energy such as solar, biomass, hydro, and wind (Ribeiro, Ferreira, Araújo, & Braga, 2018; Wojuola & Alant, 2017).

For a just transition from coal to renewable, the stakeholders in the coal mining industry in South Africa must be positive and supportive of the transition process (Baker, 2015; Ambole et al., 2021). In addition, strong institutions and regulatory frameworks are critical

to support a just energy transition in South Africa (Strambo, Burton, & Atteridge, 2019). The social impact assessment is necessary to support the renewable energy transition (Martinez & Komendantova, 2020).

Literature shows the relationship between perception and attitude in the renewable energy transition in the emerging market, primarily through renewable and circular economic principles (Patwa et al., 2021). However, there is a contradiction in the energy sector regarding a just transition because the coal industry remains an essential economic driver in South Africa. Therefore, some stakeholders have an indifferent attitude and perception about renewable, and there is significant resistance to the transition from coal to renewable energy in South Africa due to the impact and industry perils it would result in (Newell, 2019; Cock, 2019; Ting, & Byrne, 2020).

5.10 Conclusion

The South African power crisis continues unabated. This research aimed to study coal workers' attitudes, perceptions, Knowledge, transition, and intention to use renewable energy. The population of the study was employees of the coal mining firms who are also customers and stakeholders. The need for transition and energy diversification is urgent, but before this can be implemented, there is an to examine the attitude, perception, and Knowledge about renewable energy.

The chapter provides the discussion and evidence to support the results and the urgency of the transition and energy security in South Africa. Moreover, the literature shows that evolution and energy diversification is essential to tackling the power problem in South Africa in the short term. Overall, there is significant support for the results as seen from the extant literature that shows the need to understand the attitude, Knowledge, perception, readiness to transition, and intention to transition towards renewable energy.

CHAPTER SIX: CONCLUSION & RECOMMENDATIONS

6.1 Introduction

This study highlights the critical issue of transitioning from coal mining to renewables by examining the population's attitude, perception, knowledge, readiness to transition, and intention to work in the renewable energy sector. The research was carried out in the coal mining industry, which was imported in two ways; Firstly, employees are essential in the energy value chain as producers. Secondly, transitioning to other energy sources would negatively impact the coal mining industry.

6.2 Summary of Results

6.2.1 Attitude toward renewable energy

The results of the hypothesis showed a significant positive correlation between the attitude of employees and intention to use renewable among employees in the coal mining industry. This result is important because there can be resistance to the transition and use of renewable energy without a positive attitude about renewable energy.

6.2.2 Perception towards renewable energy

The perception of employees in the coal mining industry towards renewable energy is significant, and the result from the study shows that overall, the respondents had a positive perception of renewable energy and how it can provide employment. Moreover, extant studies give evidence to support the proposition that transitioning from renewable energy to renewable energy requires a positive perception to enable the implementation of renewable energy.

6.2.3 Knowledge and awareness about renewable energy

The result from the study indicates that overall, there is positive knowledge and understanding of employees in the coal mining industry about renewable energy. This was important because a lack of knowledge about the benefits of renewable energy can become a barrier to the transition and use of renewable energy. Moreover, scaling up renewable energy requires mass education of the public and employees to support the transition process.

6.2.4 Readiness to transition and intention

Although there is an urgency to transition to other alternative energy sources, this is not the end. However, a means to an end because before the transition can occur, the enabling framework must be in place. These are the regulatory framework, infrastructure, and supply chain to ensure sufficient materials.

6.3 Implication of the Study

The study has profound implications for academics, business, and other stakeholders. From the theoretical point of view, there is a need to generate a quality dataset to advance the discussion regarding renewable energy in South Africa. Firstly, this study provides an excellent quantitative dataset to promote the debate in this area. Moreover, the population of the study is significant because it highlights the perception, knowledge, and attitude of employees who are also customers of the power utility company. In addition, the research provides insights into theoretical constructs to understand consumer behaviour in the energy sector. Furthermore, it adds to the growing knowledge about the transition to renewable energy in Sub-Saharan Africa and South Africa.

Secondly, this study has implications for managers, the coal mining industry, the government, and other stakeholders grappling to find short- and medium-term solutions to the power crisis. It provides insight into what stakeholders must do to end the energy problem. The dataset shows that the energy transition from coal to other alternative energy sources is challenging, but all stakeholders must be involved. Moreover, the research provides the stakeholder with the opinion and understanding of the population towards renewable energy to support decision-making.

6.4 Recommendations from the study

Overall, the study recommends increasing awareness among the population about renewable energy and its impact on the current power crisis. Moreover, the results show a need to build consensus among the public and stakeholders to support the transition from coal to renewable energy. In addition, the study recommends that more studies be carried out in the public sector to collect more data about employees ' perceptions, attitudes, and knowledge about renewable energy and determine the level of support as

to whether renewable is the long-term solution to the power problem in South Africa. Furthermore, the study recommends the modification of the current infrastructure to accommodate renewable energy solutions and technology. Besides, there is a need for storage facilities and other infrastructure upstream and downstream to distribute renewable energy. Lastly, there needs to be an appropriate regulatory framework, which is urgent, and this is required to manage Eskom's current monopoly in the power sector.

6.5 Limitations of the study

There was a limitation due to time constraints on both the researcher and the managers, which caused the delay. In addition, there were challenges in obtaining secondary data from the various business units to corroborate the primary data collected from the respondents.

Moreover, the study design and scope were limited, and there needed to be more industry-specific literature. The study was quantitative, but some qualitative datasets would have enhanced the study. There was a need for mixed methods to gather qualitative data to cure some of the problems stated above. Moreover, some variables are attitude and behaviour, which cannot be quantitatively measured (Saunders et al., 2018).

6.6 Conclusion

This study examined employees' perceptions in the coal industry in South Africa towards using renewable energy and the transition to clean energy. This study showed a positive and significant correlation between attitude, knowledge, perception, transition, and intention to use renewable energy. Moreover, the study indicated that a just energy transition required the support of all the key stakeholders. Besides, to gain this support, there is a need to remove barriers to transition, and there must be a readiness to transition to renewable. Furthermore, the government must implement a regulatory and policy framework to support the transition program.

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Appendix 1: Research Instrument

SECTION A: Biodata

Instruction:

1) Please kindly indicate your gender (mark with X inside the box)

Male (1)	Female (2)	Others (3)

2) Please kindly indicate your highest level of education (mark with an X inside the box)

Matric	National Diploma	Bachelor's Degree	Honour's Degree	Master's Degree	PhD	Professional Certification	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	

3) Please kindly indicate the level of your experience in the mining industry

<4 years	5-9 years	10-14 years	15-19 years	20+ years
(1)	(2)	(3)	(4)	(5)

4) Please kindly indicate your position with the organisation (mark with an x inside the box)

Executive Management	Senior Management	Middle Management	Junior Management
(1)	(2)	(3)	(5)

5) Please indicate the age of your company (mark x inside the box)

<4 years	5<10 years	10<15 years	10<20 years	20 years +
(1)	(2)	(3)	(4)	(5)

Instructions: Please mark x inside the box to indicate the level of agreement with the statement

A	These statements probe your Attitude, Knowledge, & Perception toward renewable energy in South Africa	(1)	(2)	(3)	(4)	(5)	(6)	(7)
K1	Solar energy could be an alternative power source in South Africa.							

K2	The South population is aware of the advantages of renewable energy in South Africa.							
K3	There are renewable energy-based solutions available in the South African market to use by employees.							
K4	There is essential knowledge about renewable energy sources in South Africa							
T1	Most households in South Africa have complete control over utilizing renewable energy sources in their homes							
T2	Most households have the required disposable income to buy renewable energy for their households.							
T3	Most households/stakeholders are concerned about pollution because of coal power stations in South Africa							
T4	There are concerns regarding environmental sustainability issues in South Africa							
T5	There are concerns about climate change and its impact on South Africa.							
T6	The transition to renewable energy utilization would solve the power problem in South Africa							
T7	The cost of renewable energy is high in South Africa.							
T8	Renewable energy requires high investment in South Africa.							
T8	The consumer actions of purchasing renewable energy inspire others to utilize solar energy.							
P1	The utilization of renewable energy minimizes carbon footprints in South Africa.							

P2	The utilization of renewable energy improves the environment in South Africa.							
P3	The utilization of renewable energy will strengthen energy security in South Africa.							
P4	New renewable energy programs will increase green opportunities in South Africa.							
P5	There is enthusiasm about utilizing renewable energy because of its affordability.							
P6	There is enthusiasm about utilizing renewable energy due to its energy-saving behaviour.							
P7	There is enthusiasm about spending more on renewable energy compared to conventional energy.							
A1	There is enthusiasm about utilizing renewable energy due to its clean nature.							
P8	There is credible information, capital, and technical skills to use renewable energy power facilities in South Africa							
A2	The utilization of renewable energy power technology is entirely under my control.							
P9	There are opportunities to utilize renewable energy power technology in the future.							
P10	There is a recommendation to use renewable energy by my peers							
P12	Most households would utilize renewable energy technology if persuaded by colleagues to suggest I do so.							
P13	Households will utilize renewable energy power technology if people in my social circle (relatives, friends, neighbors) do the same.							

T8	There is a moral duty to protect the environment through a reduction in the consumption of fossil fuels.							
P14	It's cheaper to use renewable energy power technology compared to other sources of energy.							
A3	Renewable Energy Technology is more user-friendly than the old technology.							
T9	Most households are thinking about transitioning to renewable energy power technology because of load-shedding in South Africa.							
I1	Renewable Energy is the best alternative source of energy in remote areas in South Africa.							
I2	There are opportunities to implement renewable energy power technology in remote areas in South Africa is good.							
I3	There is the intention to utilize renewable energy power technology-based facilities by households in the future.							
I4	Households have plans to spend more on renewable energy power technology than on non-renewable energy.							

Appendix 2: Summary of hypothesis and correlations

Table 4.5 below shows the correlation between attitude, perceptions, knowledge, attitude, transition, and intention regarding renewable energy. The results show that these factors do influence.

Table 4.5 Correlations Table

			Knowledge	Attitude	Perception	Transition	Intention
Spearman's rho	K2	Correlation Coefficient	1.000	.584**	.650**	.610**	.486**
		Sig. (2-tailed)	.	<.001	<.001	<.001	<.001
		N	154	154	154	154	154
	A2	Correlation Coefficient	.584**	1.000	.729**	.700**	.554**
		Sig. (2-tailed)	<.001	.	<.001	<.001	<.001
		N	154	154	154	154	154
	P2	Correlation Coefficient	.650**	.729**	1.000	.794**	.645**
		Sig. (2-tailed)	<.001	<.001	.	<.001	<.001

		N	154	154	154	154	154
	T2	Correlation Coefficient	.610**	.700**	.794**	1.000	.777**
		Sig. (2-tailed)	<.001	<.001	<.001	.	<.001
		N	154	154	154	154	154
	I2	Correlation Coefficient	.486**	.554**	.645**	.777**	1.000
		Sig. (2-tailed)	<.001	<.001	<.001	<.001	.
		N	154	154	154	154	154

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.6 shows that all the hypotheses were significant and supported. The *p* was less than 0.001 in two tail test. The Spearman Rho value was above 0.5 except for one variable.

Table 4.6: Summary of Hypothesis

Hypothesis	**Degree of Freedom(df)**	**Rs**	**n**	***p-value***	**Hypothesis supported**
H1	152	.554	154	<0.001	Yes
H2	152	.645	154	<0.001	Yes
H3	152	.486	154	<0.001	Yes
H4	152	.777	154	<0.001	Yes
H5	152	.584	154	<0.001	Yes

H6	152	.610	154	<0.001	Yes
H7	152	.650	154	<0.001	Yes
H8	152	.794	154	<0.001	Yes
H9	152	.729	154	<0.001	Yes

Appendix 3: Ethics clearance letter

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/BA305138/694
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	Coal miners' attitudes, knowledge and perceptions of transitioning to renewable energy in South Africa
Investigator / Researcher	Mr Thabo Ramara
Nature of Project	MBA (Research Article)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed anonymity and confidentiality.
Issue Date of Certificate	2022-10-07
Expiry date	Date of submission of the project / research report
Chairperson	Prof Anthony Stacey ☎ +27 11 717 3587 +27 82 880 4531 anthony.stacey@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

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

Signature

14/10/2022
Date:

Appendix 4: Approval Letter

SERITI Power

08 July 2022

To: Mr Raymond Makgota - General Manager
Seriti Power Pty Ltd
Khutala Colliery
P O Box 440
Ogies
2230

Khutala Colliery
34 IS District
Farm Cologne, Ogies
South Africa
P.O. Box 440
Ogies, 2230
Tel: +27 13 648 5000

Dear Mr RM Makgota

MBA RESEARCH SURVEY

I would like to conduct an audit in form of a questionnaire / survey using the Seriti Power, Khutala Colliery employees for my MBA research project. The research will be based on understanding ***"The Attitudes, Knowledge & Perceptions from Producing Coal to Renewable Energy: A case study of coal miners in South Africa".*** The research to be undertaken will be kept anonymous and information including responses will be confidential.

Your approval for the survey will be appreciated.

Regards

THABO RAMARA
Mine Manager Underground

RAYMOND MAKGOTA
General Manager