Consumer perceptions of the transition from coal to renewable energy in South Africa:

Consumer perception toward the transition from fossil fuel to renewable energy technology for electricity generation in South Africa

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DECLARATION

I, Captain Sebothoma, declare that this research article is my own work except as indicated in the references and acknowledgements. 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.

(Captain Sebothoma)

Signed at University of Witwatersrand

On the 24th day of January 2023

DEDICATION

This study is dedicated to my ancestors and God for giving me the opportunity to take part in it, as well as to my family, supervisors, research participants, and fellow South Africans who are currently experiencing the devastation brought on by loadshedding.

ACKNOWLEDGEMENTS

The patience and unwavering support of my supervisors, Dr's. Bruce Young and Diane Hildebrandt, during the research study is much appreciated. The time and information I have shared with my fellow research candidates Juanita Kapp, Mahlatse Maraba, Rowenta Jainarain, Nathalie Katumba, and Cecil Ouma is also something I value. A particular thank you to my wife Ivy Sebothoma, daughters Lethabo and Relebogile Sebothoma, and son Potego Sebothoma for their unwavering support during the course of my studies. The most essential thing is that I prostrate before God and my ancestor to thank them for their love and support throughout my time here on earth and in everything I have done. Further acknowledgements are extended to Puleng Mohapi and Pumza Mgolombane for their support and time.

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ABSTRACT

The South African government has announced investments in renewable energy technology initiatives to address the electricity supply gap created by loadshedding and inefficiencies at Eskom, the country's power utility. However, a few studies on public acceptance on renewable energy technology have been undertaken in many countries, including one conducted in Nigeria by Rosemary Nike Wojuola, which found that the public always has some opposing thoughts on the deployment of such technologies.

The purpose of the study was to understand the consumer's perceptions on the transition from fossil fuel to renewable energy technology for electricity generation in South Africa, and it will assist to improve policies that encourage consumers to embrace and learn about electricity generated by renewable energy sources. The “technology acceptance model’ and ‘theory of reasoned action” are used to evaluate the beliefs, attitudes, and perceptions concerning renewable energy technology in relation to sustainable behaviour. A quantitative approach (survey) was employed in this study to investigate South African electricity consumers' awareness of sustainable development (including knowledge, beliefs, perceptions, and attitudes). Statistical software (IBM SPSS Statistics version 28) was used to conduct inferential and descriptive statistical analysis on the collected data, allowing the researcher to derive predictions (or "inferences") from the data.

The majority of participants, according to the data, had high levels of education (at least a graduate degree), which means that the sample does not represent the South African population as a whole. Based on the study findings, participant’s generally have an average level of knowledge regarding renewable energy technology, with females scoring lower than males. The results of a regression study between attitude calculated and behavioural intention of the consumers to adopt renewable energy technology were $F=15.378$ and $p=0.001$. This means that the research model fit the data and there was a positive association between the two variables (attitude calculated and behavioural intention). Lack of information, affordability, and unknown benefits of renewable energy technologies were the main barriers to participants' willingness to install renewables in their homes. Additionally, the study revealed that consumers depend on the government to speed up the development of renewable

energy technologies for the production of electricity; however, there is evidence that the current administration is failing to maintain the existing fossil fuel infrastructure to ensure that the public has access to reliable electricity. The findings also show that the consumer's perception or attitude toward renewable energy technology is influenced by the perceived usefulness and ease of use, as well as the participants knowledge and beliefs about the technology. Thus, there is a need for renewable energy technology education that is sufficient to foster a favourable impression of renewable energy technologies among the general public. To foster a sustainable culture driven by the adoption of renewable energy technology for electricity generation across the country, sustainability should also be covered in education programs at all educational levels.

Keywords: consumer, perception, sustainable development, renewable energy technology, awareness, behavioural intention, knowledge, belief, attitude.

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CHAPTER 1. INTRODUCTION

1.1. PURPOSE OF THE STUDY

This quantitative study evaluates consumer perceptions on the transition from fossil fuel to renewable energy technology for electricity generation in South Africa using a combination of theories, such as the technology acceptance model and theory of reasoned action. The data collected can contribute to the development and enhancement of policies to help South Africans in adopting and learning about electricity generated from renewable energy technology for personal and commercial use. Furthermore, this research can help in understanding South African electricity consumer's awareness on climate change.

1.2. CONTEXT OF THE STUDY

According to Akinbami et al. (2021), coal is South Africa's most important source of electrical energy, accounting for more than 85% of the country's electricity generation. While coal has helped South Africa create electricity, it has also placed it among the world's top ten greenhouse gas emitters (Akinbami et al., 2021). President Cyril Ramaphosa stated during his state of the country speech on the 10th of February 2022 that load shedding remains to have a significant impact on the social lives of all South Africans, affecting commercial activity and putting additional stress on communities and families (South African Government, 2022). In addition, the president highlighted that our country faces a 4000 MW electrical gap due to policy mistakes, inadequate maintenance, the destructive impacts of state capture and old power plants.

Based on Winkler (2022), in the last decade, South Africa's electricity infrastructure has deteriorated, with both unscheduled and scheduled electricity outages on the rise. Despite the slowing economy caused by the Covid-19 pandemic, the country saw 1130 hours of planned electricity outages in 2021, and according to Reuters (2023), the nation experienced more than 200 days of electricity outages in 2022, the greatest in a single calendar year, and conditions could become worse in 2023. Martins (2019) agrees with most research that renewable energy sources can play a significant role in reducing energy-related environmental impacts, beginning with local issues and concerns. The South Africa government has announced its plan to have 600MW of

CSP (concentrated solar power), 11.5GW of onshore wind, and 8GW of solar PV by 2030 (Minnock, 2018).

According to Africanews (2021), to reduce the energy gap and deal with environmental impacts of coal energy generation, South Africa, the continent's most industrialized nation, is increasingly relying on solar power to replace coal. Furthermore, to lessen the country's excessive reliance on coal, the South African government has given twenty-five contracts totalling fifty billion rand ($2.8 billion) for renewable energy projects.

In his state of the nation address the president mentioned the various new renewable energy generation projects which will be coming online in the upcoming years: This includes:

- 2 600 MW from the renewable energy program's Bid Window 5, for which selected bidders were named in the year 2021.
- The remaining projects which amount to 500 MW in the renewable energy program's Bid Window 4, are nearly completed.
- Additional 2 600 MW of the renewable energy program in the upcoming Bid Window 6.
- 800 MW from ready-to-go risk mitigation electricity projects.
- Requests for proposals for 500 MW of battery storage and 3,000 MW of gas power will be posted in the year 2022.
- Estimated 4 000 MW from mining integrated generating projects, with another 1 400 MW already being acquired by a number of municipalities.

According to South African Government (2022), 19 of the 25 projects that were announced under Bid Window 5 are already completed, adding a total of 1 759MW of renewable capacity to the national grid. In addition, the preferred bidders for Bid Window 6 were announced on the 08 December 2022.

The Integrated Resource Plan (IRP), Renewable Energy Independent Power Producer Procurement Program (REIPPPP), the government's plans to unbundle Eskom, the Integrated Energy Plan (IEP), the Vision, Strategic Direction, and Framework for Climate Policy, the Green Fund and the Local Content Requirement (LCR) are some of the major policies in the South African renewable energy market (Globaldata, 2022).

Renewable Energy Independent Power Producer Procurement Program (REIPPPP) in South Africa

FiT was launched in 2009 and was superseded by REIPPPP in 2011. It covers technologies including, biogas, onshore wind, solar thermal power, solar thermal power, landfill gas, photovoltaic (PV), and small hydropower.

Integrated Energy Plan (IEP) in South Africa

According to Globaldata (2022), the IEP's goal is to offer a blueprint for South Africa's future energy environment that will direct future energy infrastructure investments and policy development. In addition, the IEP must have a planning horizon of at least 20 years under the National Energy Act. Further, the creation of the IEP is thus an ongoing process because it must be constantly revised to take into account, among other things, changes in the macroeconomic environment, the advancement of new technologies, and adjustments in national goals and imperatives.

Integrated Resource Plan (IRP) in South Africa

The IRP is South Africa's strategy for developing electricity at the lowest possible cost through to 2030. It was initially presented in 2010, and it was intended to be revised every two years. However, two proposed drafts from 2013 and 2016 were rejected. The IRP 2019 was finally approved by the government in October 2019. The country will continue to rely primarily on coal, despite IRP 2019's promotion of a varied energy mix that includes coal, renewables, and nuclear power.

Government plans to unbundle Eskom in South Africa

Unbundling Eskom has been announced by the South African government as a novel response to the utility's financial crisis (Globaldata, 2022). Based on the information provided by Globaldata (2022), the utility's assets will also include its peak power plants, the grid, any related substations, the national control centre, and the system operator. The supply agreements and supply contracts between the transmission and distribution entities are what the transmission entity will base its decisions on. IPPs and residential rooftop solar PV would integrate generation to relieve Eskom demand.

Vision, Strategic Direction, and Framework for Climate Policy in South Africa

On July 28, 2008, the government released the Vision, Strategy Direction, and Framework for Climatic Policy (Globaldata, 2022). According to Globaldata (2022), the Vision, Strategy Direction, and Framework for Climatic Policy goal is to keep the rise in global temperature to 2°C or less above pre-industrial levels, and it makes the following recommendations: reducing GHG emissions; creating new initiatives or expanding existing ones; raising public awareness; and encouraging pro-environmental public behaviour. In addition, alignment, co-ordination, and cooperation: this includes defining the roles and responsibilities of all the stakeholders and aligning climate change response policies with the current system.

The impact of electricity on society is both positive and negative. Humans benefit from having access to abundant, secure, affordable, clean, and safe electricity. South Africa has an extensive resource of renewable energy such as solar energy which can be converted to electricity; nonetheless, most households and businesses are still reliant on fossil fuel electricity. This reliance on fossil fuels may be due to consumer's financial restraints and knowledge about the existing renewable energy technology for electricity generation. Furthermore, it has been suggested by Wojuola and Alant (2017, p.3) that consumer adoption of renewable energy technology is linked to people's perceptions, attitudes, and beliefs about the technology. To make large advancements in the adoption of renewable energy technology practice, consumer attitudes and perception must change (Devine-Wright 2007 as cited by Wojuola and Alant, 2017, p.3).

The purpose of this research is to determine how electrical energy consumers feel about the transition from fossil fuel to renewable energy. Furthermore, to assess consumer awareness of sustainable development and climate change, and the link between consumer perception to sustainable lifestyle or development.

1.3. RESEARCH PROBLEM

The view of political participation is to support and encourage opposition to dominant practices, which are harmful to the global climate and silence dissenting voices Whitmarsh et al. (2013). Public engagement is frequently seen as a helpful tool in implementing the governmental programs. However, approximately 41% of South Africans are familiar with the concept of climate change (Edem E. Selormey, 2019),

and the majority is content or concerned about having electricity in their homes or business. According to Whitmarsh et al. (2013) the various activities that comparatively contribute to climate change are not well known by the residents, therefore these residents do not engage enough in discussions about the effects of greenhouse gas emissions from fossil fuel or new energy sources that will supply reliable and safe electricity. Climate change and greenhouse gas emissions from carbon-generated electricity is affecting citizens' lives, however, (Deena Ganvir, 2016) it is observed that most citizens are not concerned with how electricity is generated.

In addition, elevated levels of loadshedding in the country disrupt citizens' social lives and have an influence on small business productivity. Although the country's president has stated that the country is focused on the transition from fossil fuel toward renewable energy for electricity generation, there is a widespread perception that electricity generated from renewable energy is expensive as compared to fossil fuel (Elmustapha et al., 2018), and that most South Africans will be unable to afford it.

1.4. RESEARCH OBJECTIVES

The study conducted by Wojuola and Alant (2017) in Nigeria served as a guide for this investigation to understand the South African electricity consumer perception on the transition from fossil fuel to renewable energy technology and use the data to help in developing awareness and policies that will guide electricity consumers on adopting the use of renewable energy technology. The objective is sub-divided into the following goals:

- To investigate South Africans' consumer perception of renewable energy technology to determine what influences this perception.
- Determine the relationship between consumer perception of renewable energy technology and sustainable development and their understanding of it.

1.5. RESEARCH QUESTIONS

The research questions that guide this study are, as inspired by Rosemary Nike Wojuola (2017) research:

1. What is the general consumer's perception of renewable energy technologies in South Africa (including attitudes, and beliefs)?

2. Is there a link between the consumer's perception and awareness of sustainable development and renewable energy technology in South Africa?

   If true,

   - What is the nature of it, and?
   - What implications does this have for renewable energy technology and sustainable development awareness in South Africa?

   If false,

   - What implications does this have for renewable energy technology and sustainable development awareness in South Africa?

1.6. RESEARCH HYPOTHESIS

Similar to Rosemary Nike Wojuola (2017) research, the two hypotheses are:

- *Hypothesis(H) 1:* Consumer attitude calculated is positively related to attitude observed.
- *Hypothesis(H) 2*: Consumer attitude calculated is positively related to "behavioural intention".

1.7. SIGNIFICANCE OF THE STUDY

According to Edem E. Selormey (2019), nearly six out of ten Africans have heard of climate change, with more than three-quarters of Malawians, Ugandans, and Mauritians. South Africa is one of only five countries where less than half of the population is aware of climate change. In addition, women, rural residents, the less educated, and the poor, as well as those who work in agriculture, are among those who are less familiar with the concept of climate change. About two-thirds identify the phrase with unfavourable changes in weather patterns, compared to about one-third and other who relate it with positive or other changes. Furthermore, around two-thirds attribute climate change to human activity or human activity mixed with natural processes. More than a quarter believe that natural processes alone are to blame for climate change. As a result, the focus of this research is to contribute to the evaluation and collection of data on consumer or public knowledge and understanding of climate change in South Africa.

1.8. DELIMITATIONS AND ASSUMPTIONS OF THE STUDY

The study was used to evaluate how consumers feel about renewable energy technology being used to generate electricity for usage in businesses and homes. The "technology acceptance model" and "theory of reasoned action" was integrated to provide direction on how to assess human behaviour toward technology through a quantitative data analysis. According to Li (2010) the “theory of reasoned action” is founded on the premise that people are rational decision makers who constantly quantify and analyse relevant behaviour and beliefs while constructing their perception toward that behaviour.

In addition, the study has provided an insight at how customers perceive climate change and sustainable development when they use renewable or fossil-fuel-based electricity. The assumption in this study is that a consumer's understanding of a product influences how they behave toward it, hence the use of renewable energy technology was evaluated based on the consumer's knowledge of the technology. Furthermore, due to the elevated levels of loadshedding in South Africa, it was assumed that some of the businesses or households that adopted renewable energy technology for generating electricity did so to have access to an alternative energy source during electricity outages, rather than to contribute to sustainable development.

1.9. DEFINITIONS OF TERMS

Table 1: Definitions of terms

Term	Definition
Consumer	is a person who buys goods or services for their personal use; in this study, the term "consumer" refers to a person who buys electricity for industrial or residential use.
Perception	this term describes how the consumer, or the general public perceives, understands, or interprets the utilization of electricity produced by renewable energy technologies.
Sustainable development	"Sustainable development" is known as a development that meets current demands without jeopardizing the capacity of the future generations to meet their demands. In this study this term is concentrating particularly on the

	consumers understanding of the many electricity-generating methods that can provide a sustainable development.
Renewable energy technology	a broad term known as "renewable energy technology" refers to energy generation using a renewable energy source, such as wind, solar, water (tidal or hydro), geothermal heat, and biomass (wastes and biofuels).
Awareness	awareness refers to a state or an ability of being cognizant of events, objects, or sensory patterns. When awareness is at this level, an observer can confirm sense data without necessarily assuming understanding.
Behavioural intention	this is referring to the motivational elements that influence a certain behaviour. The more strongly one intends to engage in an action, the more likely that behaviour will actually be carried out. This study focuses on consumers' intentions to purchase or use electricity produced from renewable energy sources.
Knowledge	in this study knowledge is a consumer's familiarity with, consciousness of, or understanding of renewable energy or sustainable development, this include facts, information, descriptions, or skills, which is obtained by experience or education through perceiving, discovering, or learning. A subject's theoretical or practical comprehension is referred to as knowledge.
Belief	is an acceptance that something is real or genuine, especially one without evidence.
Attitude	refers to a perspective on a reality or event, a useful mindset, a mindset or sentiment toward a reality or a circumstance, which can either be a bad frame of mind or a positive frame of mind.

1.10. STRUCTURE OF THE REPORT

Chapter 1: Introduction

Introduced the purpose of the topic, provided context for the study, and clearly articulated the research problem and objectives. In this chapter, a broad overview of the significance and limitations of this study is presented.

Chapter 2: Literature review

This chapter reviews prior research in the field and evaluates the literature already in publication to demonstrate understanding of the topic. The chapter also covers the theoretical framework that directs the study, as well as the technological foundation of the renewable energy technologies currently used in South Africa.

Chapter 3: Research Methodology

The methodology and research design used to address the research questions posed for this paper are presented in this chapter. Additionally, it includes information on how the data was gathered, how ethics were taken into account, and how the data was analysed, along with an explanation of why preferred methods were selected.

Chapter 4: Quantitative Analysis of Consumer Perception toward Renewable Energy

The quantitative data's findings and results are discussed and interpreted in this chapter. These results are contrasted with earlier research on the topic to highlight any similarities or differences, and any discrepancies are discussed along with potential explanations.

Chapter 5: Discussions and Ramifications

This chapter provides an overview of the major findings and discusses their implications for consumer education and knowledge on sustainable development, and renewable energy technology.

Chapter 6: Conclusion

1.11. LIMITATIONS OF THE STUDY

Although the "theory of reasoned action" model will be utilized to assess human behaviour in the study, it should be stressed that this theory should not be taken seriously as a tool for predicting and understanding human behaviour (Sarver, 1983). The demographic and sample were limited to all people residing in South Africa who were 20 years of age or older given the nature of the study and the timeframe, and the participants were randomly chosen, however, the results show that the sample is biased toward people with at least a graduate degree in terms of education level.

CHAPTER 2. LITERATURE REVIEW

2.1. INTRODUCTION

The adoption of renewable energy technologies in South Africa is influenced by a number of factors which includes consumer perceptions of the technology, climate change, affordability, reliability and the existence of legislation that would direct consumers towards such technologies. The usage of renewable energy technologies to generate electricity is becoming more widespread throughout the world as a substitute for the burning of fossil fuels in order to achieve sustainable development or living.

According to IPCC Report 2022, a code red has been issued for humanity by the IPCC Working Group 1 Report. There is unquestionable proof that burning fossil fuels and deforestation are causing greenhouse gas emissions that are suffocating our planet and putting billions of people at immediate risk. Therefore, to understand how consumers would behave toward electricity produced by renewable energy technologies, it is crucial to understand the concept of consumer perception, renewable energy technologies, sustainable development and awareness, “the theory of reasoned action”, and “the technological adoption model”.

2.2. CONSUMER PERCEPTION

In the life of the consumer, perception is crucial (Agyekum et al., 2015), and perception is the process by which a person organizes, interprets, and chooses data to construct a meaningful picture of the world. We are then able to respond when we interpret a situation or circumstances. Perception is a series of processes by which a human becomes aware of and interprets information about the world (Gregory,1995 as cited in Agyekum et al., 2015). According to Agyekum et al., 2015, things would be a lot easier if everyone saw things the same way. Of course, the opposite is also true. however, many individuals believe that reality is objective, and that we all see things in the same way (Agyekum et al., 2015).

Perception is an individual's first impression from which they pick and interpret information to construct a meaningful picture of the world (MUNNUKKA, 2008 as cited by Kazmi, 2012). As a result, it is thought that customer perception influences

customer satisfaction and thus their purchasing and usage decisions.

2.3. RENEWABLE ENERGY TECHNOLOGIES

The Renewable Energy Independent Power Producers Procurement Programme in South Africa focuses on renewable energy generation capacity such as wind, solar, biomass, and hydroelectric (Walwyn, David; Brent, Alan, 2015).

2.3.1. SOLAR ENERGY

Solar energy is the most abundant energy resource available to human society (Chen, 2011). In addition, the increase in global warming has pushed the earth's average temperature above its safe limit. Solar energy has gotten a lot of attention from notable experts in this century to avoid this environmental catastrophe (Wahab et al., 2019). Photovoltaic cells or concentrated solar power systems that convert solar energy directly to electricity or thermal energy are emerging as key contenders for next-generation green power generation (Ginley et al., 2008). (Energy.Gov, 2022b) Photovoltaic panels or mirrors that concentrate solar radiation are used in solar technologies to convert sunlight into electrical energy. This energy can be used to produce electricity, or it can be stored in batteries or thermal storage.

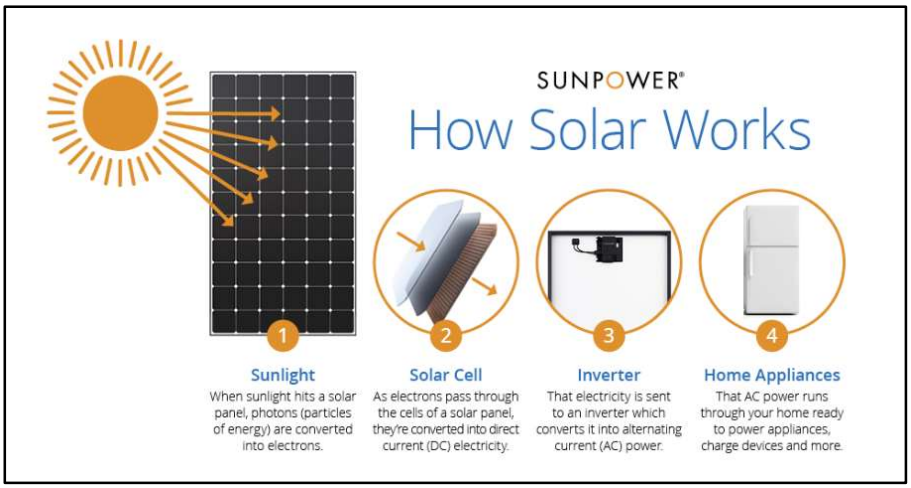

Figure 1: Solar energy conversion to electricity (source: SUNPOWER (2022))

According to ElProCus (2021) solar panels, charge controllers, batteries, and inverters are used to convert solar energy into electrical energy, which is referred to as Solar Power Energy.

2.3.2. WIND ENERGY

Both "wind energy" and "wind power" refer to the process of utilising the wind to generate electrical power or mechanical (Energy.Gov, 2022a). According to Energy Government (2022a), this mechanical energy can be put to use for specific tasks like pumping water or grinding grain, or it can be used to generate electricity. In addition, wind energy is converted into electricity in a wind turbine by the rotor blades' force in aerodynamics, which work the same as the helicopter rotor blade or an airplane wing. As the wind flows across one side of the blade, the air pressure on that side drops. Lift and drag are caused by the variation in air pressure between the two sides of the blade. The rotor spins because the lift force is greater than the drag force. The rotor is connected to the generator either directly (in the case of a direct drive turbine) or through a shaft and a set of gears (in the case of a gearbox), which speeds up spinning and enables the generator to be physically smaller. Electricity is generated by converting aerodynamic force into generator rotation.

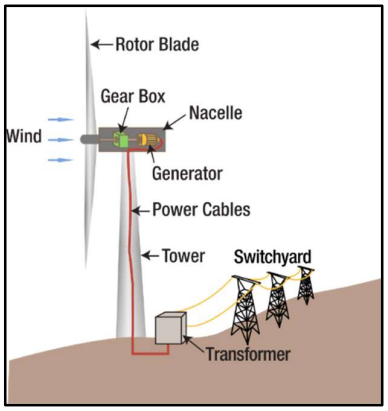

Figure 2: Wind energy conversion to electricity (source: Valley (2013))

The wind has long been a significant source of power for sailing ships, and since at least three hundred years ago, windmills have mostly been used to grind grain or pump water (Jenkins et al., 2021). Wind energy generation is subject to fluctuations as a result of changing weather conditions, necessitating the use of a storage system for the excess energy generated (Almutairi et al., 2021). Horizontal axis windmills have been a feature of the rural economy since medieval times and fell out of favour during the introduction of affordable fossil-fuelled engines and the growth of rural electricity that followed (Musgrove, 2010 as cited in Jenkins et al., 2021).

2.3.3. HYDROELECTRIC

According to Alvarez et al. (2020), the pre-industrial revolution gave birth to hydropower, also known as hydroelectric power, this is made by extracting energy generated when water travels across a vertical distance. In addition, hydropower electricity generating is the most clean and traditional renewable energy source, and it is also one of the most cost-effective technologies in terms of electricity generation costs. Further, hydropower facilities can adapt to changes in energy demand faster than other systems, and they can transform direct mechanical force into electricity, which maximizes the efficiency of this technology. Hydropower is the most common renewable energy source, and it accounts for 70% of global output. Despite the environmental benefits of hydropower, it can also have severe repercussions and consequences, such as disruption of river ecology, deforestation, terrestrial biodiversity and loss of aquatic, and water quality issues.

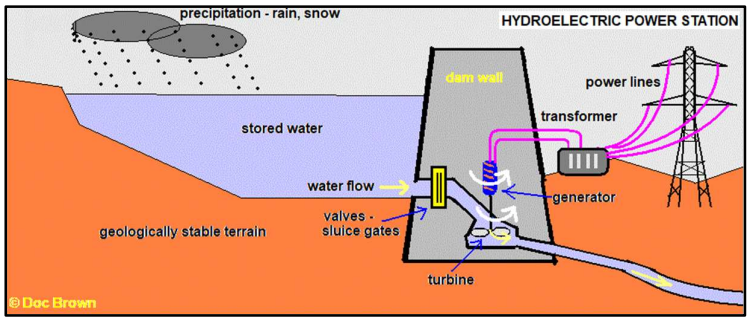

Figure 3: Hydropower conversion to electricity process flow (source: Sage (2022))

2.3.4. BIOMASS ENERGY

Forest biomass provided more than 80% of the biomass for bioenergy systems globally, behind coal, oil, and natural gas (Malik et al., 2021). This is because bioenergy, or energy derived from biomass, is regarded as a readily available renewable source of energy.

Martins et al., 2019 argues that while bioenergy can help with issues such as, unemployment and greenhouse gas emissions, biomass use, distribution, harvesting and planting can have a few negative consequences. These consequences must be considered when evaluating the option's long-term viability, particularly considering political, population growth, natural disasters, organizational factors, and economic

uncertainty that will influence future competition between biomass demand for bioplastics, energy, and food. As a result, designing a reliable and sustainable supply chain is essential for a transition to a sustainable energy system (Salimi & Vandani, 2018 as cited in Martins et al., 2019).

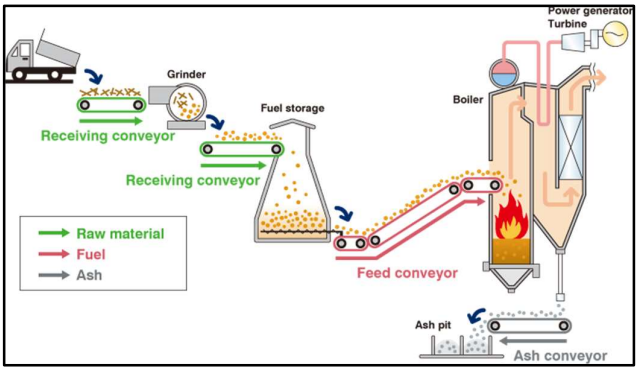

Figure 4: Biomass energy conversion to electricity process flow (source: FAVPNG (2019))

Biomass can be utilized to generate renewable energy at home, mainly because biomass energy comes from agricultural waste like corncobs and fruit pits, organic matter, and wood, and it can be utilized to generate electricity.

2.4. SUSTAINABLE DEVELOPMENT

Over the last few decades, human development has resulted in natural disasters and climatic change that is becoming increasingly unfavourable, as well as socio-economic and political instability and wars (Tomislav, 2018). In addition, humans have a detrimental effect on the environment because of their actions, putting the humanity's survival and that of future generations at risk. Further, these circumstances have resulted in behavioural adjustments intended at a more effective and sustainable resource management, resulting in less environmental impact and stress.

Based on Tomislav (2018, p.2) study, the concept of sustainable development, considered ethical behaviour that will guarantee the long-term use of resources without endangering future generations. Tomislav (2018, p.2) suggests that the notion of sustainable development is built on three concepts: development (socio-economic development within ecological boundaries), future generations (the ability to use resources in the long run to ensure future generations have the appropriate quality of life) and needs (resource redistribution to assure everyone's quality of life). According

to Tomislav (2018, p.2), The Triple Bottom Line concept, which entails a balance between three pillars of sustainability:

- *Environmental sustainability* which focuses on sustaining the environmental standards required for carrying out economic activities and raising people's standards of living.
- *Social sustainability* which aspires to uphold human rights, equality, cultural preservation, respect for diversity in terms of culture, religion, and race.
- *Economic sustainability* is essential to preserve the human, social, and natural capital required for income and living standards.

Tomislav (2018, p.2) urged that a balance between all of these pillars is necessary for fully sustainable growth, but this balance is challenging to attain because, in order to accomplish its objectives, each pillar of sustainability must take into account the interests of the other pillars in order to prevent an imbalance. Hence, while one pillar of sustainable development may become sustainable, others may not, especially in regards to ecological sustainability, which is essential to development's overall capacity.

2.5. SUSTAINABLE DEVELOPMENT AWARENESS

Through its role in society, the industrial sector has contributed to pollution and environmental exploitation, and climate change will provide a difficulty in the future to preserve a state's sustainability (Rahim & Musa, 2019). Green practices become a burden for industrial participants in order to preserve the long-term sustainability of social life. Several global corporations are investing in green product development, setting rules that limit the use of hazardous substances, and demanding suppliers to provide hazardous-material-free products at all stages of the supply chain.

According to Rahim and Musa (2019), the consumers' knowledge of green technology and related practices can be increased, and the negative influence on the environment reduced. The government should raise consumer knowledge of green initiatives so that they have a basic understanding. Green practices, on the other hand, may add to society's complexity and necessitate a significant amount of education and training. As a result, the success of government-sponsored training programs will increase green habits among consumers and providers. Furthermore, because of government legislation, government regulations are key drivers in achieving green practices in a

society. Governments, for example, stimulate the use of green technologies through legislation that establishes a low-carbon economy framework. Additionally, political issues have an impact on green practices, with government rules acting as a source of political pressure. Green practice knowledge has been an important aspect in putting green practices into action.

Environmental literacy has several components, one of which is environmental awareness (Amran et al., 2019), and it is defined as a mix of abilities, motivation, and knowledge. Perception, knowledge, involvement, behaviour, and awareness are the five dimensions of environmental literacy. The following are the Organisation for Economic Co-operation and Development's environmental awareness indicators:

- Environmental concerns awareness - this is a measure of how well-informed consumers are about current environmental issues.
- Environmental concern perception -. the degree to which consumers are worried about environmental issues.
- Environmental optimism - a measure of consumers' conviction that their or other people's activities can help to preserve and improve the environment.

Environmental awareness expanded in the second half of the twentieth century, and environmental awareness is essential to the movement's success. Consumers may start solving the problems that endanger the physical environment by informing communities that it is fragile and essential. According to Cortese (2003), imagine that every individual is aware of their relationships with the environment and other people. What if individuals actually understood the sources of goods and services, the destinations of trash, the effects they have on people and other living things, and how to reduce their ecological footprint (our impact on the Earth).

2.6. THEORY OF REASONED ACTION

In predicting social behaviour and understanding attitudes, Icek Ajzen and Martin Fishbein as cited in Sarver (1983) rely on a "theory of reasoned action," which proposes a causal sequence extending from beliefs, through attitude, the "social norm," and intention, to behaviour. The causal sequence is activated by the emergence of two types of beliefs: (1) beliefs about whether other people would disapprove or approve of a person exercising (or not exercising) a particular

behaviour, as well as a person's drive to accomplish what the person thinks the public would want them to exercise, and (2) beliefs about the effects of engaging in (or refraining from engaging in) a certain behaviour along with an assessment of those effects. According to Ajzen and Fishbein as cited in Sarver (1983, p.1), the initial form of belief forms a person's attitude toward a specific behaviour, whereas the second produces the person's "subjective norm" in relation to that behaviour. In this concept, "attitude" refers to a person's negative or positive evaluation of engaging in (or not engaging in) a particular behaviour. The "subjective norm" refers to the "impression that significant individuals expect either a specific behaviour to be performed or not to be performed." Both the "subjective norm" and the attitude influence the intention to exercising (or not exercising) a certain behaviour, though not necessarily in equal amount.

According to Ajzen and Fishbein as cited in Sarver (1983, p.2), the desire to undertake (or not undertake) a certain activity is the "immediate determinant" of that behaviour. "A person or people will normally act according to their intention, barring unanticipated occurrences," they continue, "although this does not guarantee total consistency between purpose and actions." The entire chain of events from beliefs to acts is depicted as a common process, predicated on the notion that "individuals make reasonable decisions depending on the information at hand." Ajzen and Fishbein as cited in Sarver (1983, p.2), assert that "each level in the sequence follows suitably from the previous stage"." A "theory of reasoned action" emerges when all the processes are considered. Even though one of the theory's key goals is to predict human behaviour, Ajzen and Fishbein as cited in Sarver (1983, p.2), commend it for its explanatory capacity, saying it is "designed to explain practically any human action."

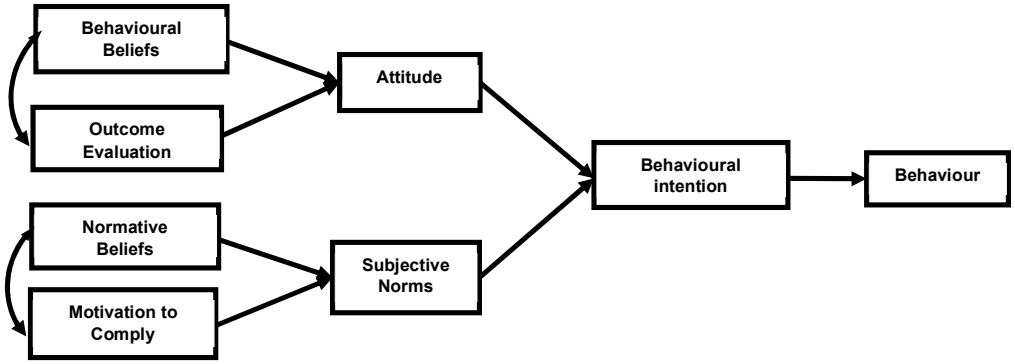

Figure 5: Theory of reasoned action model (Source: Sarver (1983))

2.7. TECHNOLOGY ACCEPTANCE MODEL

Actual system use is fundamentally a behaviour, and that the "theory of reasoned action" would be a good model to explain and forecast it (Granić & Marangunić, 2019. According to the "technology acceptance model," the user's motivation can be explained by three factors: perceived usefulness, perceived ease of use, and attitude toward using the technology. Davis as cited by Granić and Marangunić (2019) proposed that a user's attitude toward a system was a critical component in determining whether the system would be used. Perceived usefulness is described as a person or people's belief that using a given system will increase their job performance, whereas perceived ease of use is defined as a person's belief that using a specific system will be painless.

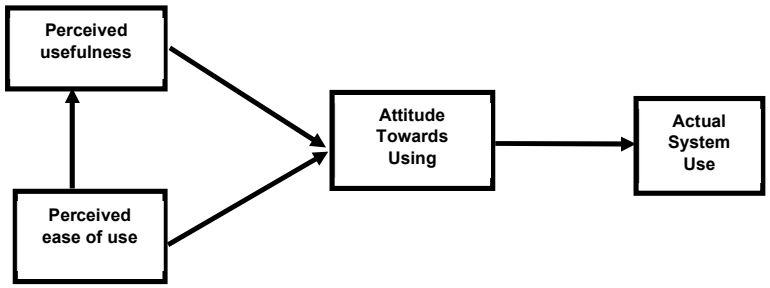

Figure 6: Technology acceptance model (Source: Granić and Marangunić (2019))

2.8. CONCLUSION: LITERATURE REVIEW

Consumers' perceptions influence how they interact with and adopt technology. Perception is shaped by how people interpret information and how much knowledge they have about a certain technology. One may argue that a consumer's ability to choose the optimal renewable energy technology for their personal or professional needs is related to the technology's complexity, personal motivation, and affordability.

A prominent level of understanding about sustainable development and climate change is required for an individual or a company to choose a technology or renewable energy technology that has a low environmental impact when generating electricity. As a result, achieving consumer perceptions influenced by the need for sustainable development and environmental protection necessitates a high degree of policies and awareness focused on educating consumers on sustainable development technology. Thus, it is possible to assess how a consumer's behaviour is influenced by their

perception or comprehension of both renewable energy technology and climate change by combining the theory of reasoned action with the technological acceptance model.

CHAPTER 3. RESEARCH METHODOLOGY

3.1. RESEARCH APPROACH

South Africans' perception and attitudes concerning renewable energy technology for electricity generation was investigated using a quantitative approach. The quantitative research allows variables like beliefs, perceptions, and attitudes to be evaluated to see how they correlate to the adoption of technology or sustainable development.

3.2. RESEARCH DESIGN

3.2.1. THEORETICAL FRAMEWORK

The technology acceptance model and the theory of reasoned action inform this research.

3.2.2. RESEARCH MODEL

The “Technology acceptance model” does not include the subjective norms seen in “theory of reasoned action” because it manages both emotive and cognitive judgments of beliefs (Wojuola & Alant, 2017, p.7). As a result, the “technology acceptance model” can be described as the evaluation of “theory of reasoned action” beliefs' implications. It is possible to combine the “technology acceptance model” and the “theory of reasoned action” as a study model when the "theory of reasoned action's" subjective norm component is not the primary focus but rather the relationship between actual behaviour, behavioural intentions, and attitude. In order to comprehend the phenomenon being studied more fully, it has been suggested that two or more models be combined in a study (Hesse-Biber, 2010 and Hussein, 2015 as cited in Wojuola and Alant, 2017, p.7). Similar to Wojuola and Alant (2017, p.7) research, this study concentrated solely on the link between beliefs, perceptions, knowledge, and behavioural intentions (in this case, the intention to use renewable energy technology). Knowledge refers to a person's understanding toward renewable energy and associated terms such as climate change, sustainable development, and global warming. The "technology acceptance model" and the knowledge portion of the "theory of reasoned action" were connected without the involvement of any outside

factors. The theory of reasoned action's subjective norms was not covered in the study."

According to Wojuola and Alant (2017, p.7), knowledge of renewable energy technology is linked to beliefs, and in the model, perceived usefulness and perceived ease of use indicate the appraisal of the beliefs' consequences (bi). Attitude and, by extension, behavioural intentions are determined when these two components are combined (BI). Knowledge denotes the consumer's understanding of renewable energy technology, whereas perceived usefulness denotes the consumer's belief that using renewable energy technology will promote sustainable development. In this study, perceived ease of use relates to the consumer's perception that employing renewable energy technology will be free of mental and physical effort, i.e., accessibility.

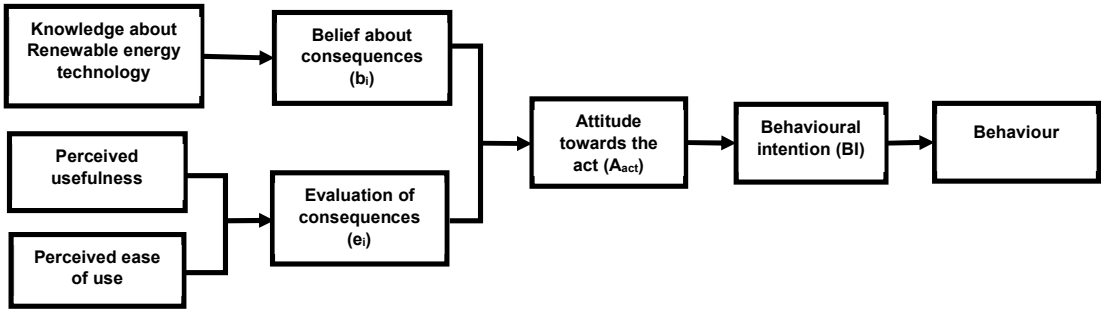

Figure 7: Research model (Wojuola and Alant (2017))

3.3. QUANTITATIVE RESEARCH METHOD

In this research, data was collected using quantitative methodology for primary data collection. According to (Sukamolson, 2007), the numerical representation and manipulation of observations with the purpose of describing and interpreting the phenomena those observations reflect is known as quantitative research. Additionally, quantitative research is described by Cohen (1980) as cited by Sukamolson (2007), as social research that makes use of empirical techniques and statements. Further, numerical data is gathered for quantitative research. In other words, social reality is primarily measured in quantitative research. Quantitative research and/or questions look for quantities in anything and use numbers to substantiate the research.

Sukamolson (2007) continues to explain that to determine how the entire population feels about a certain subject, quantitative research is also valuable for quantifying

opinions, attitudes, and behaviours. Furthermore, audience segmentation can be done with the help of quantitative research. The population is divided into groups that are both similar to one another and different from other groups.

A survey is a type of research study in which people are asked to provide information about their interests, opinions, beliefs, behaviours, or personal traits (Navarro-Rivera & Kosmin, 2013). Surveys questionnaires are an effective investigative technique for doing evidence-based research and gathering data on social issues. Statistical tools are used to examine survey data, allowing us to evaluate and confirm (or disprove) hypotheses. The fundamental component of a survey is a questionnaire, and it includes questions or a set of questions that the researcher(s) want the sample to answer in order to learn about the target universe's traits, behaviour, and attitudes. A questionnaire must include questions that are easy enough for most, if not all, respondents to understand.

In order to better understand characteristics, attributes, attitudes, or beliefs in a community, researchers use surveys to investigate large numbers of individuals (samples) and extrapolate from these to populations (universe) (e.g., group). Surveys are used to create a statistical foundation for social knowledge. The information and responses gathered generate social facts that can be turned into metrics and figures that are subject to probability laws. Survey questionnaires are included in the appendices.

3.3.1. LIMITATIONS OF THE SURVEY AND QUESTIONNAIRE

Respondents' capacity to understand a question may be impaired by cognitive and linguistic issues, which can lead to ambiguous or incorrect interpretations (Martin, 2006). To address this issue, the survey questionnaire was developed with the goal of creating standardized questions and response options that respondents understand and that create comparable and relevant responses.

Delva, Kirby, Knapper, and Birtwhistle (2002) as cited by (Simon & Goes, 2013) identified time-limited surveys as problematic because persons who face actual or perceived time constraints are less likely to answer to surveys because they are overworked – they just do not have the time to complete the survey. In addition, surveys frequently have the drawback of pushing respondents into specific response groups, so limiting the range of responses. Unlike an interview, when respondents can

ask clarifying questions, respondents are usually limited to the survey's text for instructions on how to fill it out and where to answer.

3.3.2. POPULATION AND SAMPLE

According to Stats SA (2021) as illustrated in Table 2, the entire population of South Africa was predicted to be 60 million people in the mid-year population census of 2021, and econometric models predicted that the population was trending around 60 million in 2022.

Table 2: Mid-year population estimates for South Africa by population group and sex, 2021 (Source: Stats SA (2021))

Population group	Male		Female		Total	
	% Distribution of males	Number	% Distribution of females	Number	% Distribution of total	Number
Indian/Asian	2,7	790 412	2,5	754 810	2,6	1 545 222
White	7,7	2 257 654	7,8	2 404 805	7,8	4 662 459
Coloured	8,8	2 578 930	8,8	2 716 038	8,8	5 294 968
Black African	80,9	23 761 051	80,9	24 879 278	80,9	48 640 329
Total	**100**	**29 388 047**	**100**	**30 754 931**	**100**	**60 142 978**

The population of South Africa was also assessed considering the various age groups and the data shown in Figure 8. According to Figure 8, the sample size for the age group starting at 20 years and older is 38.5 million people.

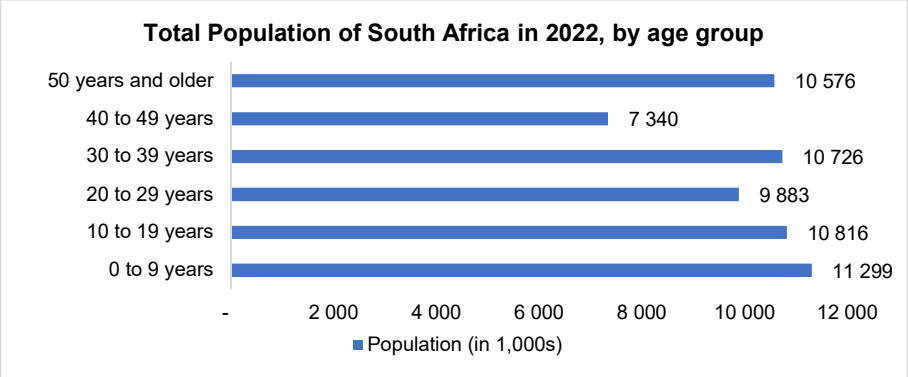

Figure 8: Total population of South Africa in 2022, by age group (source: Statista, (2022))

Random sampling was used based on the population information provided, however, the results showed that the sample is skewed toward people who have at least a graduate degree. The sample size is determined using a sample size formula as follows:

$$s = \frac{X^2 . NP\,(1-P)}{d^2\,(N-1)+X^2 P\,(1-P)}$$

Source: https://youtu.be/VZd2zZy5T2E

Where,

S – Sample Size

X – t-value at a confidence interval of 95% (1.96)

N – Population Size (38.5 million)

P – Population portion (63.5%)

d – degree of accuracy (0.05)

The current sample size has been determined at 357 people to represent the entire population of South Africa in the survey, taking into account the age group (20 years and older) of the participants or individuals who are considered to be old enough to run a household, commercial business, or are exposed to renewable energy technology. Additionally, according to the sample size calculator on the research advisor, a sample size of 357 is adequate for a population of 38.5 million people with a 5% margin of error and a 95% confidence level. However, most statisticians concur that a sample size of 100 is required in order to obtain any form of significant results (Tools4dve, 2022). A survey link was created and disseminated via email and social media (WhatsApp) as it is an easy and effective approach to collect survey responses. All participants within the stipulated age group were treated equally as the population sample was picked randomly regardless of their location, level of education, or familiarity with renewable energy technologies.

3.4. DATA ANALYSIS

SPSS statistical software (IBM SPSS Statistics version 28) was used to analyse the quantitative data (survey). The data from surveys was coded and given variable names prior to being loaded into the statistical software SPSS. The inferential and descriptive statistics were determined by compiling and statistically analysing the quantitative data generated by the research. All of the variables were subjected to descriptive analysis. To examine any changes in the constructs' demographic composition, cross-tabulation was also performed. Following that, the findings were displayed in tables and in some cases in a normal distribution curve to help demonstrate the percentages and sums related to the different aspects of the selected question. To quantify the linear correlations between pairs of variables, Pearson

correlation coefficients were utilized. A one-way ANOVA, Levene's tests, t-tests, and regression analysis were all conducted at a 5% significance level to determine if there are any observed differences between two or more variables. The significance level is a criterion that defines whether a study result may be regarded as statistically significant after running the intended statistical tests (Eupati, 2023). For instance, if the significance level is set at 0.05, there is a 5% chance that the results will be interpreted as indicating a difference when none exists. Every analysis was conducted at a 5% significant level, which means that any probability value (p-value or sig-value) less than 0.05 implies a significant difference or the results obtained are significant.

3.5. RELIABILITY

According to Heale and Twycross (2015), a measure's consistency is related to its reliability. An individual taking a test designed to gauge motivation ought to provide somewhat consistent answers each time. Although reliability cannot be calculated precisely, it can be estimated using a number of techniques. The three attributes of reliability are outlined in Table 3.

Table 3: Reliability attributes

Attributes	Description
Stability	Consistency of outcomes from repeated testing using an instrument
Homogeneity (or internal consistency)	The degree to which all the scale's elements measure the same construct
Equivalence	Consistency between replies from several instrument users or between different instrument configurations

In this study the attribute that was adopted to measure reliability was homogeneity (or internal consistency). Items-to-total correlation, split-half reliability, the Kuder Richardson coefficient, and Cronbach's alpha are used to measure homogeneity (internal consistency). The most used test to assess an instrument's internal consistency is Cronbach's alpha. Hence, to ensure its dependability, the survey instrument's internal consistency was evaluated using the Cronbach's alpha reliability test.

3.6. VALIDITY

According to Heale and Twycross (2015), validity refers to how accurately a topic is measured in quantitative research. When interpreting test results for the desired purposes, validity refers to how strongly theory and evidence support those conclusions (Knekta et al., 2019). According to (Polco, 2022), measures of statistical validity help to determine how confident one should be in the results of the survey. In addition, a margin of error, which is used to produce confidence intervals, is the most typical indicator of statistical validity. When carrying out a survey on a representative sample of locals, these are triggered (i.e., one has a list of residents that one can randomly choose from so that every resident has an equal chance of being chosen). Further, the margin of error and level of confidence are the two most important factors in this. The amount of survey replies received will determine the margin of error; as the number of respondents rises, the margin of error decreases. The degree of confidence reflects how certain the researcher is that the actual rating would fall within the margin of error if the entire population were tested.

The significance level (or level) is a criterion that defines whether a study result may be regarded as statistically significant after running the intended statistical tests (Eupati, 2023). For instance, if the significance level is set at 0.05, there is a 5% chance that the results will be interpreted as indicating a difference when none actually exists. Every analysis was conducted at a 5% significant level, which means that any probability value (p-value or sig-value) less than 0.05 implies a significant difference or the results obtained are significant.

3.7. ETHICAL CLEARANCE

In any research project, it is crucial to protect research participants by using the proper ethical norms. Due to the extensive nature of the research process in a quantitative study, ethical considerations have a special resonance.

This study considered six significant ethical considerations, which are mentioned below.

Informed consent - before choosing to participate or not, participants were made aware of the study's objectives and benefits.

Confidentiality - participants' comments and survey replies are stored in a university Qualtrics database that only the researcher has access.

Voluntary participation - participants in the study were advised that they could decide at any time whether or not to participate, and that doing so would not subject them to any consequences.

Potential for harm - by using reasonable questions and multiple-choice responses, the risk of psychological, social, physical, and other forms of harm was reduced to the absolute minimum.

Anonymity - The participants' identities are unknown because no information was gathered that could be used to identify them.

Results communication - the work was carefully reviewed to make sure there was no plagiarism or other research misconduct and that the results are appropriately represented.

CHAPTER 4: QUANTITATIVE ANALYSIS OF CONSUMER PERCEPTION TOWARD RENEWABLE ENERGY

4.1. RELIABILITY

The survey sample data was assessed using a Likert scale, and the Cronbach's alpha was used to evaluate the multi-item scale's internal reliability. Cronbach's alpha is a method for evaluating reliability that compares the amount of shared variance, or covariance, among the items that make up an instrument to the amount of overall variance (Lee, 2021). Given that Cronbach's alpha based on standardized items was > 0.65, as shown in Table 4, it can be said that the scale used to measure the participants knowledge, belief and attitude about renewable energy technology is reliable (Lee, 2021, p8).

Table 4: Scale reliability Cronbach’s alpha

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0,602	0,655	5

4.2. BIOGRAPHY OF THE PARTICIPANTS

4.2.1. PARTICIPANTS GENDER

According to the data from the survey, which is shown in Table 5, out of 107 participants, 54 were female, or 50%; 50 were male, or 47%; 1 was non-binary/third, or 1%; and 2 participants, or 2% of the population sample, did not disclose their gender.

Table 5: Participants gender

Gender	Frequency	Percentage
Female	54	50%
Male	50	47%
Non-binary / third gender	1	1%
Prefer not to say	2	2%
Total	**107**	**100%**

Figure 9 displays the results of computing a normal distribution curve to see if the population sample is evenly distributed between the different genders. The value 1 represents females, 2 represents men, 3 represents non-binary/third, and 4 represents people who decided not to state their gender. The graph indicates that the distribution of participation among males and females is normally distributed. However, the non-binary/third gender is not adequately represented.

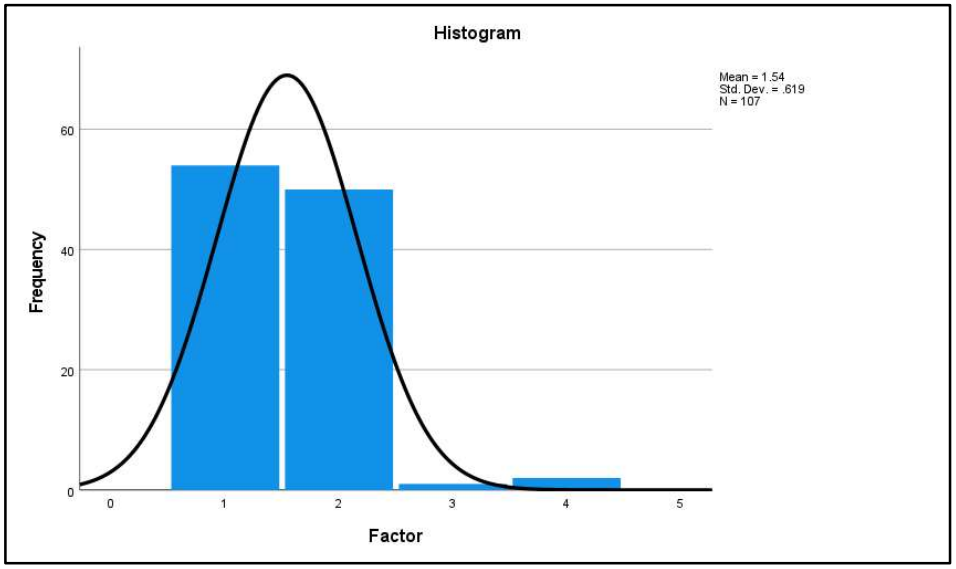

Figure 9: Normal distribution curve for participants genders

4.2.2. PARTICIPANTS AGE

As shown in Table 6, the population was divided into age groups between 20 and 29, 30 and 39, 40 and 49, and 50 and over. The data reveals that 47.7% of the population, or the bulk of participants, are between the ages of 30 and 39. 26.2% of the population is between the ages of 20 and 29, 19.6% is between the ages of 40 and 49, and 6.5% is between the age of 50 and above.

Table 6: Participants age group

Age group		
	Frequency	**Percent**
20 – 29	28	26,2
30 – 39	51	47,7
40 – 49	21	19,6
50 and above	7	6,5
Total	**107**	**100,0**

A normal distribution curve was computed for the participants ages to determine if the data is normally distributed, and the results are shown in Figure 10. The value 1 represent ages between 20 – 29, 2 is ages between 30 – 39, 3 is ages between 40 – 49, and 4 is ages between 50 and above.

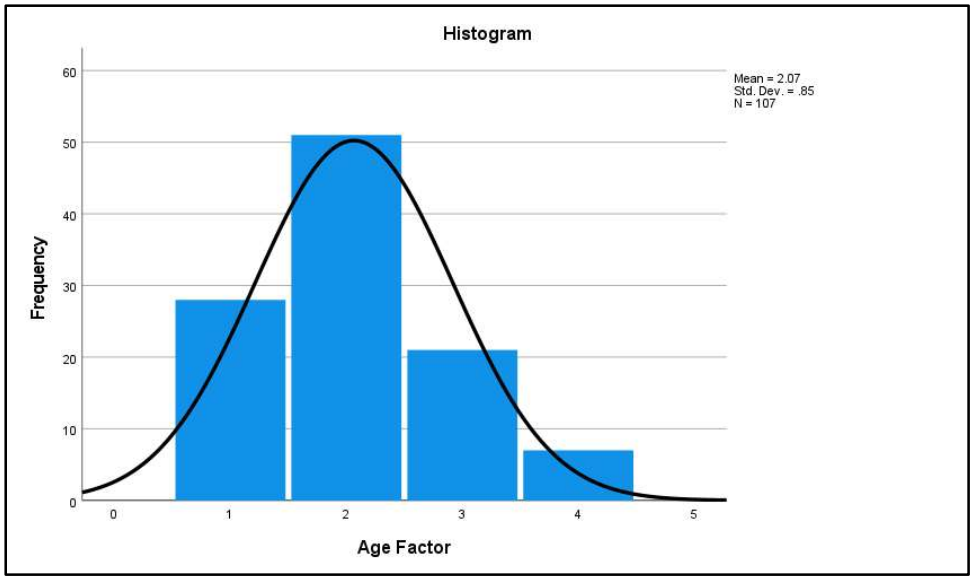

Figure 10: Normal distribution curve for participant's age

4.2.3. GEOGRAPHICAL LOCATION OF THE PARTICIPANTS

The population sample's distribution was broken down into South Africa's several provinces, and Table 7 makes clear that the bulk of the population at 41.1% lives in Gauteng province, followed by Mpumalanga with 29.9% of the population sample. There is 1.9% of the participants that did not close where in South Africa they live.

Table 7: Geographical location of the participants

Geographical Location					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Gauteng	44	41,1	41,1	41,1
	Mpumalanga	32	29,9	29,9	71,0
	Limpopo	13	12,1	12,1	83,2
	North West	5	4,7	4,7	87,9
	Northern Cape	5	4,7	4,7	92,5
	Western Cape	5	4,7	4,7	97,2
	South Africa	2	1,9	1,9	99,1
	Free State	1	0,9	0,9	100,0
	Total	107	100,0	100,0	

A normal distribution curve as indicated by Figure 11, shows that the participants geographical location does not follow a normal distribution and the data computed on the graph represent the following: 1 is Gauteng, 2 is Mpumalanga, 3 is Free State, 4 is Limpopo, 5 is North West, 6 is Northern Cape, 7 is South Africa and 8 is Western Cape.

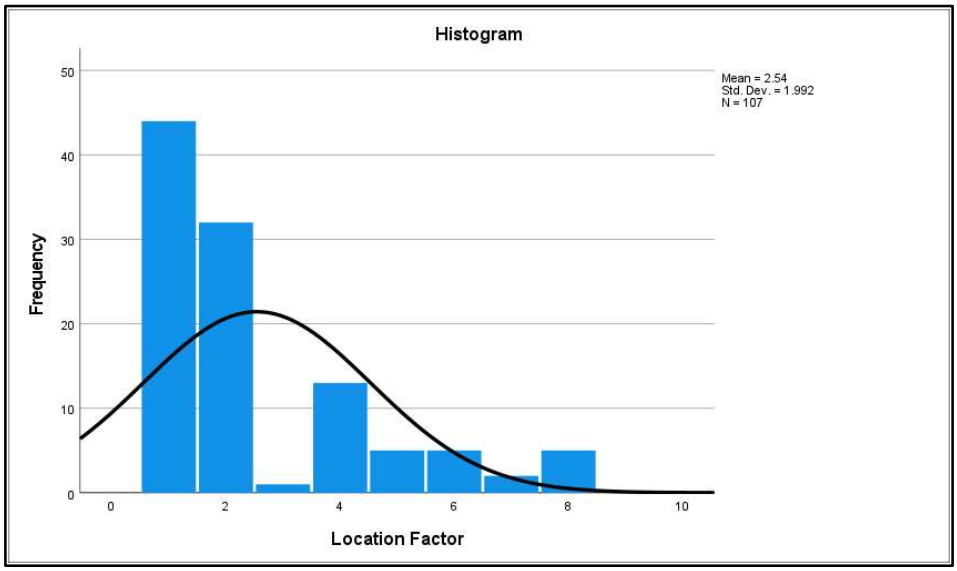

Figure 11: Normal distribution curve for participants geographic location

4.2.4. EDUCATION OF THE PARTICIPANTS

Table 8 summarizes the population sample's educational levels, showing that postgraduate education is the most common level at 38.3%, followed by graduate education at 30.8%, national diploma at 14%, national senior certificate at 11.2%, secondary education at 2.8%, national higher certificate at 1.9%, and undergraduate education at 0.9%. According to the data, the majority of participants in the study had higher levels of education than those who did not hold graduate degrees.

Table 8: Educational background of the participants

Educational Background		
	Frequency	Percent
Postgraduate	41	38,3
Graduate	33	30,8
National Diploma	15	14,0
National Senior Certificate	12	11,2
Secondary	3	2,8
National Higher Certificate	2	1,9
Undergraduate	1	0,9
Total	107	100,0

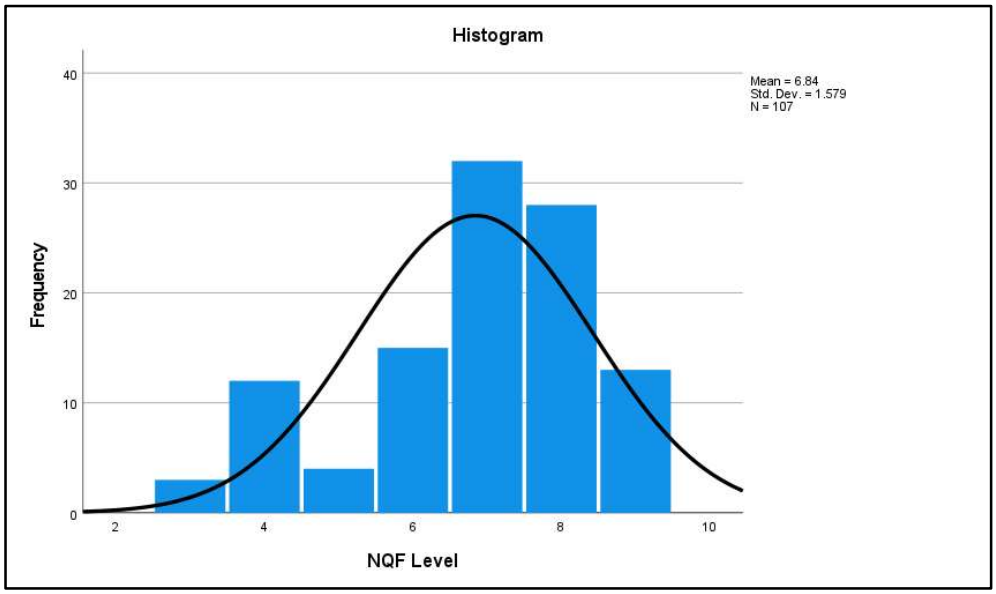

Figure 12: Normal distribution curve for participants education level

A normal distribution curve was computed to determine if the population sample is evenly distributed based on the participants education level. The education level is measured using the highest National Qualification Framework (NQF) level obtained by the participants. Based on data in Figure 12, it can be concluded that the education level of the participants is not evenly distributed as majority of the participants at least have a graduate degree or obtained NQF level 7. In South Africa, 38.3% of people have completed some form of secondary school, and 32.5% have completed grade 12 or its equivalent (Mamphokhu Khuluvhe, 2021)

4.2.5. GENDER EDUCATION LEVEL

To ascertain whether there are any differences between the educational levels of the various genders as shown in Table 9, a descriptive statistical analysis was carried out. The data revealed that females have a mean of 7.04 and a standard deviation of 1.303, whereas males had a mean of 6.76 and a standard deviation of 1.779, when the education levels is analysed based on the NQF level rating.

Table 9: Educational level of the different genders

Descriptive Statistics			
Dependent Variable:			
Gender	**Mean**	**Std. Deviation**	**N**
Female	7,04	1,303	54
Male	6,76	1,779	50
Non-binary / third gender	4,00		1
Prefer not to say	5,00	1,414	2
Total	6,84	1,579	107

To see if there is a significant difference between the education levels for the various genders in the population sample, a Levene's Test of Equality of Error analysis was performed. Table 10 reveals that there is a significant difference on the education level of the various participants genders at a sig-value or p-value of 0.042, which is below the 0.05 level of significance.

Table 10: Educational level's Levene's Test of Equality of Error for the Variances

Levene's Test of Equality of Error Variances[a,b]					
		Levene Statistic	df1	df2	Sig.
Education Level	Based on Mean	3,262	2	103	0,042
	Based on Median	2,323	2	103	0,103
	Based on Median and with adjusted df	2,323	2	96,482	0,103
	Based on trimmed mean	2,813	2	103	0,065

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Education Level

b. Design: Intercept + Gender

4.2.6. OCCUPATION OF THE PARTICIPANTS

Participants' occupations were grouped by the various departments as shown in Table 11. According to a breakdown of the participants' occupations by departments, the study's top 5 departments that participated include engineering (18.7%), operations (16.8%), management (8.4%), human resources (7.5%), and finance (both 7.5%).

Academic, legal, security, procurement, and retirement represent the bottom 5 departments, all of whom make up 0.9% each.

Table 11: Occupation of the participants

Employment - Occupation		
	Frequency	Percent
Engineering	20	18,7
Operations	18	16,8
Management	9	8,4
Human Resource	8	7,5
Unemployed	8	7,5
Finance	5	4,7
Project Management	5	4,7
Safety	5	4,7
Administration	4	3,7
Marketing	4	3,7
Self Employed	4	3,7
Health Care	3	2,8
Learning & Development	3	2,8
None	3	2,8
Student	3	2,8
Academic	1	0,9
Law	1	0,9
Procurement	1	0,9
Retirement	1	0,9
Security	1	0,9
Total	107	100,0

4.3. RESULTS ANALYSIS - PHASE 1

The focus of this study's section is on the answer to the research question: “What is the general consumer's perception of renewable energy technologies in South Africa (including knowledge, attitudes, and beliefs)?"

A set of questions was created to assess the responses from the participants to these research questions, with the aim to assess the participants' knowledge, beliefs, perceptions, and attitudes regarding renewable energy technology.

4.3.1. BELIEF AND KNOWLEDGE ABOUT RENEWABLE ENERGY

The participants' beliefs and knowledge about renewable energy technology were assessed using a total of 5 questions.

Question 1: Which of the terms are you familiar with?

Sustainable development, climate change, renewable energy, and global warming were the terms linked to renewable energy that the participants were asked to share their awareness about, as shown in Table 12. According to the population sample, 79% of participants are most familiar with the terms "climate change," "renewable energy," and "global warming." 64% of the population sample know the term sustainable development, whereas 2% of respondents indicated that they are unfamiliar with any of the terms.

Table 12: Renewable energy terms

Terms	Frequency aware	Percentage aware	Frequency not aware	Percentage not aware
Sustainable Development	68	64%	39	36%
Climate Change	84	79%	23	21%
Renewable Energy	84	79%	23	21%
Global Warming	85	79%	22	21%
None of the terms	2	2%	105	98%

Question 2: How knowledgeable are you about renewable energy?

The knowledge of the participants on renewable energy was assessed using a Likert-type scale. This test measures knowledge on a 6-point scale, with 1 (not interested) and 6 (a great deal) as indicated in Table 13. The sample reveals that 41.1% of participants know a fair amount about renewable energy, 26.2% know a little about renewable energy, 17.8% know a great deal about renewable energy, 14% have heard of renewable energy but know nothing about it, and 0.9% of participants have never heard of renewable energy. Additionally, no participant expressed no interest in

learning more about renewable energy. These findings indicate that even though a sizable portion of participants had some knowledge of renewable energy, education was still required in South Africa to increase awareness and knowledge about renewable energy.

Table 13: Participants knowledge of renewable energy

How knowledgeable are you about renewable energy?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not interested	-	-	-	-
	Never heard of renewable energy	1	0,9	0,9	0,9
	Heard of but know nothing about it	15	14	14	14,9
	A little	28	26,2	26,2	41,1
	A fair amount	44	41,1	41,1	82,2
	A great deal	19	17,8	17,8	100
	Total	107	100	100	

Question 3: What types of renewable energy sources are you familiar with?

Table 14 illustrate the participants knowledge about the source of renewable energy. 85% of the participants are aware of solar energy, 50% are aware of wind as a source of renewable energy, and 35% are aware of renewable energy derived from hydroelectric sources. While 13% of the sample shows that participants have said they know all the renewable energy sources, which include fossil fuel, and 24% of the participants have indicated that fossil fuel is a renewable energy source. Based on the statistics, it appears that more education is necessary to raise public understanding of the different types of renewable energy technology that are available in the nation and globally, and to be able to differentiate between fossil fuels and renewable energy sources.

Table 14: The renewable energy sources

Renewable Energy Source	Frequency familiar	Percentage familiar	Frequency not familiar	Percentage not familiar
Fossil Fuel	26	24%	81	76%
Solar	91	85%	16	15%
Wind	53	50%	54	50%
Biomass	10	9%	97	91%
Hydroelectric	37	35%	70	65%
All of the above	14	13%	93	87%

Question 4: Where did you hear about renewable energy?

The sample reveals that 73% of participants said they first learned about renewable energy on the internet, while 50% said they first learned about it from television, 45% said they first learned about it in school, 40% said they first heard about it on the radio, 30% each said they learned about it at a workshop or conference and 27% said they first learned about it from a journal or academic article, as shown in Table 15. This data indicates that schools, radio stations, and television are not doing enough to ensure that the public has more information and knowledge about renewable energy technology and that without the internet, the knowledge and information about renewable energy will not reach the majority of the public.

Table 15: Renewable energy information sources

Source	Frequency of source	Percentage source	Frequency of not source	Percentage of not source
Internet	78	73%	29	27%
School	48	45%	59	55%
Workshop/Conference	32	30%	75	70%
Radio	43	40%	64	60%
Television	54	50%	53	50%
Newspaper	29	27%	78	73%
Journal/Academic Articles	32	30%	75	70%

Question 5: What do you think would be the reason for us to replace fossil fuels with renewable energy?

Based on the information in Table 16, 63% of the participants think that using fossil fuels causes the atmosphere's carbon dioxide levels to rise and harm the environment. In comparison to the use of fossil fuels, 50% of participants think that renewable energy does not deplete the planet's natural resources. Fossil fuels are excessively expensive and might become scarce in the future, according to 24% of participants. 7% of the respondents are unsure of the justifications for switching from fossil fuels to renewable energy, while 2% think that none of the justifications hold true, and 6% say that all of them do. This result shows that participants' attitudes toward renewable energy technologies are influenced by their knowledge and beliefs as they will

transition from fossil fuels to renewable energy sources in the interest of protecting the environment and natural resources.

Table 16: Participants reasons for substituting fossil fuels.

Reason	Frequency	Percentage
Not sure	8	7%
Fossil fuels are too expensive, and they may become rare in the future	26	24%
Burning fossil fuels raises carbon dioxide level in the atmosphere, which pollute the environment	67	63%
Renewable energy does not deplete the planet's natural resources	53	50%
None of the reasons	2	2%
All of the reasons	6	6%

4.3.2. TOTAL KNOWLEDGE SCORE

The evaluation of the total knowledge is based on the participants' collective understanding of the terms, which has four components, and renewable energy sources, which also has four components but does not include fossil fuel. The weight of one was applied to each component equally. Fossil fuels were given a weight of negative one if it was chosen as a source of renewable energy, and the same rule applied if a participant choose “all of the above” (meaning a score of 3 was given). According to Table 17, the respondents' average score was 4.92 (mean), with a standard deviation of 1.982 on a scale of 1 to 8. This is higher than the average score of 4.0, which represents the sum of all the knowledge that may be attained by one respondent divided by half.

Table 17: Total knowledge score

	N	Minimum	Maximum	Mean	Std. Deviation
Total Knowledge	107	1	8	4,92	1,982

To establish which gender has greater knowledge, the total score of knowledge was further examined by gender. According to data in Table 18, participants who were male had higher mean knowledge score value of 5.30 about renewable energy than participants who were female who achieved a mean knowledge score value of 4.72.

Table 18: Renewable energy total knowledge for various genders

Dependent Variable: Gender	Mean	Std. Deviation	N
Female	4,72	1,947	54
Male	5,30	1,919	50
Non-binary / third gender	2,00		1
Prefer not to say	2,00	0,000	2
Total	4,92	1,982	107

The significance of the difference between the total knowledge scores for various genders, was assessed using Levene's test for equality of variance, as shown in Table 19. The test has a p-value of 0.058, which is just 0.008 above the 0.05 level of significance, indicating that there is some degree of significant difference in the total knowledge attainment by the various genders about renewable energy.

Table 19: Total knowledge Levene's Test for various genders

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Total Knowledge	Based on Mean	2,926	2	103	0,058
	Based on Median	1,565	2	103	0,214
	Based on Median and with adjusted df	1,565	2	100,152	0,214
	Based on trimmed mean	2,785	2	103	0,066

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Total Knowledge

b. Design: Intercept + Gender

4.3.3. KNOWLEDGE SCORED BY EDUCATION LEVELS

Participants with a national senior or higher certificate do not meet the average score of 4.0, based on a descriptive analysis obtained from the one-way ANOVA analysis of the total knowledge score based on the education level indicated in Table 20. The statistics show that participants with a secondary education level know more about renewable energy than those with a national senior or higher certificate, however, it should be emphasized that there are only three participants with secondary education, which introduces bias into the data as seen by the lower (-2.57) and upper (10.57) bounds. Participants with national higher certificates also exhibit a similar trend. Even

if participants who are graduates and postgraduates had a total knowledge score over the score of 4.0, it is still evident that education is insufficient to increase awareness, information, and understanding about the renewable energy technology in South Africa.

Table 20: Descriptive analysis (ANOVA) of total knowledge score for various education level

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Secondary	3	4,00	2,646	1,528	-2,57	10,57	2	7
National Senior Certificate	12	3,58	2,151	0,621	2,22	4,95	1	7
National Higher Certificate	2	3,00	1,414	1,000	-9,71	15,71	2	4
National Diploma	15	4,20	1,821	0,470	3,19	5,21	2	7
Undergraduate	1	6,00					6	6
Graduate	33	4,97	1,895	0,330	4,30	5,64	1	7
Postgraduate	41	5,66	1,769	0,276	5,10	6,22	1	8
Total	107	4,92	1,982	0,192	4,54	5,30	1	8

The one-way ANOVA test in Table 21 demonstrates that there are significant mean differences in the total knowledge score for all participants, with a sig-value or p-value of 0.011, which is below the 0.05 level of significance.

Table 21: One-way ANOVA for total knowledge score for various education level

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	62,737	6	10,456	2,958	0,011
Within Groups	353,506	100	3,535		
Total	416,243	106			

4.3.4. PERCEIVED USEFULNESS OF RENEWABLE ENERGY

As shown in Table 22, this element of the survey analysed the participants' opinions on whether they thought renewable energy could help protect the environment. According to the population sample, 50.5% and 38.3% of respondents agree and strongly agree that renewable energy has the capacity to protect the environment, respectively. 11.2% of responders are uncertain about the ability of renewable energy

technology to contribute to environmental protection. Additionally, the population sample reveals that none of the respondents are unconcerned, disagree, or strongly disagree that renewable energy can protect the environment. Similar to the analysis in Table 16 about the reasons to replace fossil fuel, this finding also suggests that belief and knowledge has a major influence on the attitude toward renewable energy.

Table 22: Perceived use of renewable energy technologies

Can renewable energy help to protect our environment?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unconcerned	-	-	-	-
	Not sure	12,00	11,20	11,20	11,20
	Strongly disagree	-	-	-	11,20
	Disagree	-	-	-	11,20
	Agree	54	50,5	50,5	61,7
	Strongly agree	41	38,3	38,3	100
	Total	107	100	100	

4.3.5. PERCEIVED EASE OF USE OF RENEWABLE ENERGY

The participants' opinions on how simple it is to employ renewable energy technology were solicited. According to the population sample results in Table 23, 36.4% of respondents believe the technology is more trustworthy than fossil fuels, 11.2% strongly agree, 12.1% disagree, 4.7% strongly disagree, 33.6% are unsure, and 1.9% are unconcerned. These results imply that further education regarding the use of ,reliability or adoption of renewable energy technology is required within the general public.

Table 23: Perceived Ease of Use of renewable energy technologies

Is renewable energy more reliable than fossil fuel energy?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unconcerned	2	1,9	1,9	1,9
	Not sure	36	33,6	33,6	35,5
	Strongly disagree	5	4,7	4,7	40,3
	Disagree	13	12,1	12,1	52,4
	Agree	39	36,4	36,4	88,8
	Strongly agree	12	11,2	11,2	100,0
	Total	107	100	100	

4.3.6. ATTITUDE TOWARD RENEWABLE ENERGY

The following four questions were created to assess the participants' attitude on the use of renewable energy technology.

- Are you willing to install renewable energy in your house?
- Who should take the responsibility to increase our use of renewable energy?
- If you are not willing to install renewable energy in your house, what are the reasons?
- Do you think we should increase the use of renewable energy in South Africa?

4.3.6.1. The need for South Africa to use more renewable energy technologies.

According to the sample data in Table 24, of the 107 respondents, 49.5% strongly agree, 33.6% agree, 3.7% disagree, 0.9% strongly disagree, 12.1% are unsure, and 0% are unconcerned about expanding the usage of renewable energy technologies in South Africa. The overall percentage of respondents who agree and strongly agree that the usage of renewable energy technologies must increase in South Africa is 83.1%, suggesting that awareness and knowledge have a significant impact on attitudes toward renewable energy before behavioural intentions.

Table 24: Should we increase the use of renewable energy technologies.

Do you think that we should increase the use of renewable energy in South Africa?				
		Frequency	Percent	Cumulative Percent
Valid	Unconcerned	-	-	-
	Not sure	13	12,1	12,1
	Strongly disagree	1	0,9	13,1
	Disagree	4	3,7	16,8
	Agree	36	33,6	50,5
	Strongly agree	53	49,5	100,0
	Total	107	100	

4.3.6.2. Assuming responsibility for expanding the usage of technology for renewable energy.

As shown in Table 25 of the population sample data, the majority (73%) of the 107 respondents believe that increasing the use of renewable energy technology should be the responsibility of the government. To increase our use of renewable energy in South Africa, 50% of respondents indicated that private energy firms should assume responsibility. Meanwhile, 47% indicated that individuals and communities must take on the responsibility, respectively. And 4% indicated that they weren't sure who should be responsible.

Table 25: Who should take the responsibility of increasing the use of the renewable energy technologies.

Who should take the responsibility of increasing our use of renewable energy?		
	Frequency	Percentage
Unconcerned	0	0%
Not Sure	4	4%
Individuals	50	47%
Communities	50	47%
Private energy companies	54	50%
Government	78	73%

4.3.6.3. Willingness to install renewable energy technologies.

Table 26 reveals that 77% of respondents are willing to install renewable energy technologies in their homes as long as it is affordable or fits into their budget, 20% want to learn about the benefits of renewable energy before attempting to install the technology in their homes, 7% are only willing to install if it is free, 4% will install the renewable energy technology when it is the only option available, 2% are unsure, and 1% of the respondents are not interested in installing the renewable energy technology. The findings on this research question also suggests that belief and knowledge have an influence on the attitude toward renewable energy use before behavioural intentions.

Table 26: Willingness to install renewable energy technologies.

Are you willing to install renewable energy in your house?		
	Frequency	**Percentage**
Not Interested	1	1%
Not sure	2	2%
When it is the only choice available	4	4%
If it is affordable or meet my budget	82	77%
When I understand the benefits	21	20%
Only if it is free to install	7	7%

4.3.6.4. Reasons for not willing to install renewable energy technologies.

According to the sample results shown in Table 27, 31.8% of the participants will not install renewable energy technology in their homes as long as it is too expensive, 27.1% need more information about the technology, 26.2% don't have any reasons for not installing the technology, 6.5% won't install the technology if it is unreliable, 4.7% are unsure if there are any reasons for not installing, and 3.7% won't install the technology out of concern that it might not work. None of the survey participants cited "unattractive" as a justification for not installing the technology in their homes.

Table 27: Reasons for not installing renewable energy technologies.

If you are not willing to install renewable energy technology in your house, what are the reasons?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Too expensive	34	31,8	31,8	31,8
	Need more information	29	27,1	27,1	58,9
	-	28	26,2	26,2	85,0
	Unattractive	-	-	-	85,0
	Not reliable	7	6,5	6,5	91,6
	Not sure	5	4,7	4,7	96,3
	Fear it might not work	4	3,7	3,7	100,0
	Total	107	100,0	100,0	

4.4. RESULTS ANALYSIS - PHASE 2

4.4.1. ATTITUDE OBSERVED AND CALCULATED

Research Question Two: Is there a link between the consumer's perception and awareness of sustainable development and renewable energy technology in South Africa?

If true,

- What is the nature of it, and?
- What implications does this have for renewable energy technology and sustainable development awareness in South Africa?

If false,

- What implications does this have for renewable energy technology and sustainable development awareness in South Africa?

According to the Theory of Reasoned Action model, a person's attitude toward an object or behaviour is made up of all of his or her beliefs and an assessment of the effects of those beliefs. This is mathematically expressed as:

$$Aact = \sum_{i=1}^{n} b_i \, e_i$$

Where A_{act} = attitude

b_i = believes

And e_i = valenced evaluation.

In this study,

A_{act} = Attitude towards renewable energy technology.

bi = beliefs about renewable energy technology.

ei = Perceptions about renewable energy technology/beliefs evaluation.

I therefore posited:

H1: Attitude calculated is positively related to attitude observed.

H2: Attitude calculated is positively related to Behavioural Intention

In order to provide answers to the two-research hypothesis above, three variables were computed, similar to the study conducted by Wojuola and Alant (2017, p.88).

1. Total knowledge is a variable calculated by taking the sum of the items in the belief and knowledge about renewable energy section as explained previously.
2. Total Perception is a variable that was calculated by adding the answers to the following questions, which were based on perceive ease of use and perceived usefulness:
    - Is Renewable Energy more reliable than fossil fuel energy - Evaluates how participants feel about the use of renewable energy technologies.
    - Can Renewable Energy help to protect our environment – This measures participants' perceptions of the usefulness of renewable energy technology.
3. The Observed Attitude is a variable that was calculated by adding the answers to the two questions below:
    - Are you willing to install renewable energy in your house?
    - Do you think that we should increase the use of Renewable Energy in South Africa?
4. Attitude Calculated is a variable, derived from the total knowledge plus the sum of all perceptions.

H1: Attitude calculated is positively related to attitude observed.

The research model proposes that beliefs and perceptions combine to form attitudes (evaluation of beliefs). Pearson correlation was used to assess the direction and strength of the linear relationship between the attitude observed and attitude calculated. The results in Table 28 show a 0.524 significant positive correlation between attitude calculated and attitude observed, with a sig-value or p-value of 0.000, which is less than 0.05.

Table 28: Pearson correlation for attitude calculated and observed attitude.

Correlations			
		Observed-Attitude	Attitude-Calculated
Observed-Attitude	Pearson-Correlation	1	.524**
	Sig-(2-tailed)		0,000
	N	107	107
Attitude Calculated	Pearson Correlation	.524**	1
	Sig-(2-tailed)	0,000	
	N	107	107

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

4.4.2. BEHAVIOURAL INTENTIONS

4.4.2.1. Pearson correlation

The population sample data in Table 29 demonstrates that 39.3% of participants do not want to pay more for electricity produced using renewable energy, while 27.1%, 19.6%, 6.5%, and 6.5%, respectively, are willing to pay 25%, 50%, 75%, and 100% more. Additionally, 0.9% of participants did not respond to this question, according to the data. The results show that although the respondents are very motivated to replace fossil fuels and protect the environment, a sizable portion of the participants are unwilling to pay for or assume responsibility for expanding the usage of renewable energy sources. Additionally, this study implies that attitudes toward renewable energy are influenced by belief and knowledge before there is a behavioural intention.

Table 29: Behavioural intention to pay for renewable energy.

Are you willing pay double for renewable energy since it can help protect our environment					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N/A	1	0,9	0,9	0,9
	0%	42	39,3	39,3	40,2
	25%	29	27,1	27,1	67,3
	50%	21	19,6	19,6	87,0
	75%	7	6,5	6,5	93,5
	100%	7	6,5	6,5	100,0
	Total	107	100	100	

The degree and direction of the linear association between the behavioural intention and attitude calculated were assessed using Pearson correlation as illustrated in Table 30. The findings show a weak but statistically significant positive correlation between behavioural intention and attitude calculated of 0.357, with a sig-value or p-value of 0.000 which is less than 0.05.

Table 30: Pearson correlation between attitude calculated and behavioural intention.

Correlations			
		Attitude-Calculated	Behavioural-Intention
Attitude Calculated	Pearson-Correlation	1	.357**
	Sig-(2-tailed)		0,000
	N	107	107
Behavioural Intention	Pearson-Correlation	.357**	1
	Sig-(2-tailed)	0,000	
	N	107	107

**. The 0.01 level of significance for correlation (2-tailed).

4.4.2.2. Regression

Regression analysis was conducted to confirm the association between the behavioural intention and attitude calculated and assessed in Table 30, and the results are displayed in Tables 31, 32, 33 and 34.

Table 31: Regression model summary

Model	Variables_Entered	Variables_Removed	Method
1	Attitude Calculated[b]		Enter
a. Dependent Variable: Behavioural_Intention			
b. All requested variables entered.			

It was determined whether autocorrelation existed in the regression analysis using the Durbin Watson statistical test. There is a positive autocorrelation, as evidenced by the Durbin-Watson value of 1.816 found in the regression analysis, which is presented in Table 32. However, it is generally accepted that Durbin Watson test statistic scores between 1.5 and 2.5 are considered to be normal (Lee, 2021). According to the regression model, R-value of 0.357 indicate a weak positive association between the attitude calculated and behavioural intentions, and R Square-value of 0.119 shows a large variation in the data because only 11.9% of the consumer behavioural intention can be explained by the independent variable (attitude calculated).

Table 32: Regression model summary on attitude calculated and behavioural intention.

Model Summary[b]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.357[a]	0,128	0,119	1,129	0,128	15,378	1	105	0,000	1,816

a. Predictors: (Constant), Attitude Calculated

b. Dependent Variable: Behavioural Intention

The dependent variable (behavioural intention) is significantly well predicted by ANOVA[a] analysis in Table 33, which demonstrates the regression model's statistical relevance. In this case, p-value is 0.001, which is less than 0.05, and F-value of 15.378 shows that the regression model statistically substantially predicts the outcome variable on the whole, demonstrating that the model fits the data well. This evaluation shows a significant relationship or association between attitude calculated and behavioural intention.

Table 33: ANOVA[a] test results

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19,599	1	19,599	15,378	<,001[b]
	Residual	133,821	105	1,274		
	Total	153,421	106			

a. Dependent Variable: Behavioural Intention

b. Predictors: (Constant), Attitude Calculated

These findings suggest that since the p-value of the ANOVA[a] table is below the acceptable level of significance of 0.05, the evidence suggests that attitude calculated and behavioural intention are positively correlated.

The coefficient analysis in Table 34, indicate a significant t-test value of 3.921 which is greater than a statistical t-test of 1.96 at a significance level of 0.05. The p-value is 0.000 which is less than the significance level of 0.05. This demonstrates that the behavioural intention and attitude calculated have a positive relationship or association.

Table 34: ANOVA Coefficients[a]

Coefficients[a]											
		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B		Correlations		
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	0,178	0,507		0,351	0,727	-0,828	1,184			
	Attitude Calculated	0,141	0,036	0,357	3,921	0,000	0,070	0,212	0,357	0,357	0,357

a. Dependent Variable: Behavioural Intention

CHAPTER 5: DISCUSSIONS AND IMPLICATIONS

5.1. DISCUSSION OF THE FINDINGS OF RESEARCH QUESTION 1

The variables that support the study's theoretical framework will be discussed together with the study's findings:

1. Beliefs and knowledge about renewable energy technology.
2. Perceptions about renewable energy technology.
3. Attitude toward the renewable energy technology.
4. Behavioural intention to use renewable energy technology.

5.1.1. BELIEFS AND KNOWLEDGE ABOUT RENEWABLE ENERGY TECHNOLOGY

The quantitative data revealed that majority of the population sample know a fair amount about renewable energy technology. However, it was indicated in the data that 79% of participants are most familiar with the terms "climate change," "renewable energy," and "global warming." 64% of the population sample know the term

sustainable development, whereas 2% of respondents indicated that they are unfamiliar with any of the terms. In contrast to Edem E. Selormey's (2019) research, which found that fewer than half of the people knew what "climate change" was, the survey revealed that a higher percentage (79%) of the population is familiar with the term.

Additionally, the total knowledge score of 4,92 was higher than the score of 4.0 (halfway score on the scale). The statistics also showed that the population's overall knowledge score on renewable energy is equal to the sum of those who know a fair amount and a great deal about renewable energy technology.

This finding highlights the need for further education to improve the public's or consumers' knowledge of renewable energy technologies. According to Cortese (2003), imagine that every individual is aware of their relationships with the environment and other people. What if individuals actually understood the sources of goods and services, the destinations of trash, the effects they have on people and other living things, and how to reduce their ecological footprint (our impact on the Earth)?

5.1.2. KNOWLEDGE SCORE BY DIFFERENT EDUCATION LEVEL

The data revealed that there is a significant difference on the knowledge scored by the participants with different education level. The participants with a graduate and post graduate degree have scored a slightly higher knowledge score to those without a degree. The data also highlighted that male participants have more knowledge about renewable energy technology as compared to female participants. In their findings Wojuola and Alant (2017) supports Meyer and Nel (2016), that the engineering community in South Africa and around the world includes a modest but significant number of women engineers. Women in the sector, as well as governments, corporations, and higher education institutions, face a substantial issue as a result of the gender inequality that results in all technical professions.

5.1.3. THE SOURCE OF INFORMATION ABOUT RENEWABLE ENERGY TECHNOLOGY

The quantitative data indicated that 73% of participants said they first learned about renewable energy technology on the internet, while 50% said they first learned about

it from television, 45% said they first learned about it in school, 40% said they first heard about it on the radio, 30% each said they learned about it at a workshop or conference and 27% said they first learned about it from a journal or academic article.

It is clear from these statistics that schools are not participating enough to increase awareness and knowledge of renewable energy technology. Based on Cortese (2003) study, institutions of higher learning have a moral obligation to foster the values, awareness, and knowledge necessary to build a just and sustainable future. Making this vision a reality depends critically on higher education, but this is a role that is frequently ignored. Institutions trains the majority of professionals who create, administer, instruct, work in, and have an impact on society's institutions, including the most fundamental K–12 (primary and secondary) schooling. Additionally, government regulations are required to promote and guarantee that media outlets, including radio and television, regularly broadcast on renewable energy technology and its advantages for the general population.

5.1.4. PERCEPTION ABOUT RENEWABLE ENERGY TECHNOLOGY

5.1.4.1. Perceived use of renewable energy technology

The data indicate that 50.5% and 38.3% of respondents agree and strongly agree that renewable energy technology has the capacity to protect the environment, respectively. However, it was also noted that 64% of the participants are familiar with sustainable development. This result demonstrates that some of the participants were unaware of the connection between environmental preservation and sustainable development. Additionally, this shows that there is a lack of public education aimed at increasing knowledge of sustainable development and the initiatives required to attain it. According to Rahim and Musa (2019), the consumers' knowledge of green technology and related practices can be increased, and the negative influence on the environment reduced. The government should raise consumer knowledge of green initiatives so that they have a basic understanding.

5.1.4.2. Perceived Ease of Use of renewable energy technology

The survey data revealed that 36.4% of respondents believe the technology is more reliable than fossil fuels, 11.2% strongly agree, 12.1% disagree, 4.7% strongly disagree, 33.6% are unsure, and 1.9% are unconcerned. It can be concluded from this

data that those that are not sure, disagree, strongly disagree, or not concerned about the reliability of renewable energy technology do not have sufficient knowledge about the technology.

In addition, it was also identified that 85% of the participants are aware of solar as the source of renewable energy, 50% are aware of wind as a source of renewable energy, and 35% are aware of renewable energy derived from hydroelectric sources. While 13% of the sample shows that participants have said they know all the renewable energy sources, which include fossil fuel, and 24% of the participants have indicated that fossil fuel is a renewable energy source. Based on this conclusion, it can be inferred that more research is required to determine whether the general public is aware of the components and technical expertise needed to install renewable energy technology and which of the technology can be installed by companies or households. Additionally, education is necessary to raise public awareness of how the technology functions.

5.1.5. ATTITUDE TOWARD RENEWABLE ENERGY TECHNOLOGY

The quantitative data revealed that 49.5% strongly agree, 33.6% agree, 3.7% disagree, 0.9% strongly disagree, 12.1% are unsure, and 0% are unconcerned about expanding the usage of renewable energy technology in South Africa. The majority of participants agreed that South Africa should utilize more renewable energy, however it is unclear whether this is a result of the nation's present energy crisis because 63% of the respondents indicated that burning fossil fuels has an impact on the environment. While 24% of participants indicated that fossil fuels are too expensive and that these resources may become scarce in the future, and 50% said that the usage of renewable energy technology does not deplete the planet's resources.

The participants also mentioned that if consumers' budgets are not met, renewable energy technology may not be affordable, and the public may not fully comprehend its benefits, the expansion of renewable energy technology in South Africa may be constrained. However, if the constraints are minimal, 27.1% of the participants still need more information, while 26.2% have no objection to using renewable energy technology in their houses. The results also imply that education is essential for ensuring that the public is aware of the advantages, financial ramifications, and

technical know-how required to install and use electricity produced by renewable energy technologies.

In support of the research hypothesis, the relationship between observed and calculated attitudes revealed a significant positive correlation of 0.524 at a significance level of 0.000. The study supports the findings from Wojuola and Alant (2017), that indicated a positive correlation between the observed and calculated attitude.

5.1.6. BEHAVIOURAL INTENTION

The data indicate that 39.3% of participants do not want to pay more for electricity produced using renewable energy, while 27.1%, 19.6%, 6.5%, and 6.5%, respectively, are willing to pay 25%, 50%, 75%, and 100% more. Additionally, 0.9% of participants did not respond to this question, according to the data. The results show that although the respondents are very motivated to replace fossil fuels and protect the environment, a sizable portion of the participants are unwilling to pay for or assume responsibility for expanding the usage of renewable energy sources.

The data also indicated that there is a significantly weak positive correlation of 0.357 between the behavioural intention of the consumers and the attitude calculated at a significance level of 0.000. In addition, the regression analysis confirmed that there is a weak positive correlation of 0,128 and has shown a significant link between the behavioural intention and attitude calculated with a p-value of 0.001, F-value of 15.378 and statistical coefficient t-test value of 3.921. Further, the regression analysis has indicated that 11.9% of the consumer behaviour can be explained by the attitude calculated. This finding supports the results obtained by Wojuola and Alant (2017), that there is a positive relationship between behavioural intention and attitude calculated.

5.2. IMPLICATIONS

The study revealed that electricity consumer’s attitudes and behavioural intentions toward the adoption of renewable energy technology in South Africa are influenced by knowledge and belief. The study's conclusions can therefore be applied to enhance or improve the following components of South Africa's policy and educational systems:

- As data has revealed that there is a significant knowledge gap between male and female participants on renewable energy technologies, there should be conferences for women that focuses on energy, similar to "women in mining" programs, to ensure that women continue to gain knowledge in the energy sector.
- The government should have regulations that assess media content and make sure that media outlets such as radio and television inform the public about renewable energy sources, current technology, and how it will benefit society as a whole. Moreover, the distinctions between fossil fuels, renewable energy, and other energy sources must be clearly explained to the public. This can be accomplished through regulated and sponsored advertisements from renewable energy technology companies.
- Subsidies must be offered to households that install renewable energy technologies into their homes to encourage and accelerate the adoption of technology and this can be achieved using the method used to compute the subsidy given to farm dwellers' homes for non-grid supply.
- Some renewable energy technology, such as solar panels and battery storage, is available for individual purchase at retail establishments; however, these products are neither certified nor subject to government regulation which can lead to the public being supplied with unreliable and inferior technology.
- Institutions such as universities, college and associations need to establish a framework for training that includes enough information about renewable energy technology and sustainable development to address its advantages, simplicity of use, and maintenance.
- The foundation of primary and secondary education in South Africa must include lessons on renewable energy sources and current technology.
- To ensure that existing renewable energy facilities are maintained and that upcoming projects are carried out successfully and efficiently, the government must impose stringent protocols that allows audits from independent parties.
- As a marketing strategy and government mandated key performance indicator, private businesses with a focus on renewable energy technologies must offer workshops and conferences to inform the public about modern renewable energy technologies.

- As majority of the consumers believe that the government and private companies must accelerate the use of renewable energy technologies in South Africa, it is important to continue updating the Integrated Resource Plan, expediting the development of solar and wind power capacity, and enabling greater embedded or distributed power investments by companies up to a 50 MW licence exemption.
- Renewable energy technology providers need to hold workshops and conferences to showcase how reliable their technology is and to inform electricity consumers about alternate methods that guarantee the consumer will still have access to electricity in adverse weather conditions.
- Incentives for people who use electricity generated from renewable sources should be considered by the government and commercial organizations that support clean energy (including electricity) initiatives.

5.3. CONTRIBUTION TO THE BODY OF KNOWLEDGE

The purpose of this study is to add to the body of knowledge regarding consumer perception, knowledge, belief, and attitude towards the usage of renewable energy technologies for electricity generation in South Africa. Although the sample shows that knowledge is needed to change the perceptions and attitudes of electricity users toward electricity generated by renewable energy technologies, it is noted that the data does not represent the population of South Africa as a whole based on educational level. The results showed that climate change is a well-known term associated with renewable energy technology and that a sustainable development or lifestyle focused education is required to provide consumers with knowledge and information. Consumers are willing to transition from fossil fuel-generated electricity to that produced by renewable energy sources in order to combat climate change and protect the environment. The data has revealed that barriers to adoption of such technology is lack of information, affordability, and unknown benefits that the renewable energy technology has on the public's lives. Further, the study has shown that consumers are more dependent on the government and private companies to increase the use of renewable energy technologies for electricity generation and that they are not willing to pay more to accelerate the transition from fossil-fuel generated electricity.

5.4. SUGGESTED FUTURE STUDIES.

Further research is needed to determine how well consumers understand the differences between fossil fuel and renewable energy technologies used in the production of electricity. In addition, more study is needed in understanding the technical ability of consumers in managing and installing household renewable energy technologies.

CHAPTER 6: CONCLUSION

The study was able to demonstrate that consumer attitude toward renewable energy technology is influenced by their knowledge and beliefs before behavioural intentions. It was evident that consumer knowledge of renewable energy technology is above average, and most customers are in favour of increasing the use of sustainable technology (renewable energy technology) to decrease the environmental effects of carbon dioxide emissions brought on by the burning of fossil fuels. Additionally, a significant number of customers are aware of sustainable development and are inclined to switch from fossil fuels to renewable energy, but most of them do not want to pay more than the present electricity tariffs.

Lack of knowledge, uncertain advantages, and the affordability of renewable energy technologies are other factors that will hinder or prevent the usage of renewable energy. In addition, the study revealed that there is a positive association between the consumers' behavioural intentions and attitude calculated. Further, attitude calculated is positively correlated the consumer attitude observed.

To overcome the gaps identified by the study: There should be conferences for women that focuses on energy, similar to "women in mining" programs, to ensure that women continue to gain knowledge in the energy sector. More renewable energy awareness through radio and television is required to inform the public about renewable energy sources, current technology, and how it will benefit society as a whole. Moreover, the distinctions between fossil fuels, renewable energy, and other energy sources must be clearly explained to the public. To encourage and accelerate the adoption of renewable energy technology for electricity generation, electricity subsidies must be offered to households that install renewable energy technologies into their homes. To protect the public from being supplied with unreliable and inferior renewable energy

technology, such as solar panels and battery storage, from retail establishments the government must introduce regulations that requires these products to be approved and certified. An awareness training framework that includes enough information about renewable energy technology and sustainable development to address its advantages, simplicity of use, and maintenance must be increased by institutions such as universities, college, and other associations. The foundation of primary and secondary education in South Africa must include lessons on renewable energy sources and current technology. The government must impose stringent protocols that allows audits from independent parties, to ensure that existing renewable energy facilities are maintained and that upcoming projects are carried out successfully and efficiently. Private businesses with a focus on renewable energy technologies must offer workshops and conferences to inform the public about modern renewable energy technologies. The Integrated Resource Plan in South Africa must continuously be updated to expedite the development of solar and wind power capacity and enabling greater embedded or distributed power investments by companies up to a 50 MW licence exemption.

It should be emphasized that due to the nature of the study and the timeframe, the demography and sample were limited to all South African citizens who were 20 years of age or older. The study showed that, despite the participants being randomly selected, the sample is limited to people with at least a graduate degree in terms of educational level.

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APPENDICES

APPENDIX 1. QUANTITATIVE QUESTIONNAIRE

The purpose of this study is to understand more about South Africans' perceptions on renewable energy technologies. The data collected will only be used for research purposes. It is entirely up to you whether you choose to participate in this study.

SECTION 1. BIOGRAPHIC INFORMATION

Gender

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

Age group

- ○ 50 and above
- ○ 40 - 49
- ○ 30 - 39
- ○ 20 - 29

Employment

- ○ Occupation

Educational background

- ○ Highest level of education

Geographical Location

- ○ Your location (where you live)

SECTION 1. SURVEY

Which of the terms shown are you familiar with?

- ☐ Sustainable development
- ☐ Climate change
- ☐ Renewable energy
- ☐ Global warming
- ☐ None of the terms

How knowledgeable are you about renewable energy?

- ○ Not interested
- ○ Never heard of renewable energy
- ○ Heard of but know nothing about it
- ○ A little
- ○ A fair amount
- ○ A great deal

What type of renewable energy source are you familiar with?

- Fossil fuel
- Solar
- Wind
- Biomass
- Hydroelectric
- All of the above

Where did you hear about renewable energy?

- Internet
- School
- Workshops/Conference
- Radio
- Television
- Newspaper
- Journal/Academic articles

What do you think would be the reason for us to replace fossil fuel with renewable energy?

- Not sure
- Fossil fuels are too expensive, and they may become rare in the future.
- Burning fossil fuels raises carbon dioxide level in the atmosphere, which pollute the environment.
- Renewable energy does not deplete the planet's natural resources.
- None of the reasons
- All of the reasons

Do you think that we should increase the use of renewable energy in South Africa?

- Unconcerned
- Not sure
- Strongly disagree.
- Disagree
- Agree
- Strongly agree.

Is renewable energy more reliable than fossil fuel energy?

- Unconcerned
- Not sure
- Strongly disagree
- Disagree
- Agree
- Strongly agree

Can renewable energy help to protect our environment?

- Unconcerned
- Not sure
- Strongly disagree
- Disagree

- Agree
- Strongly agree

Who should take the responsibility of increasing our use of renewable energy?

- Unconcerned
- Not sure
- Individuals
- Communities
- Private energy companies
- Goverment

Are you willing to install renewable energy in your house?

- Not interested
- Not sure
- When it is the only choice available
- If it is affordable or meet by budget
- When I understand the benefits
- Only if it is free to install

If you are not willing to install renewable energy in your house, what are the reasons?

- Not sure
- Need more information.
- Fear it might not work.
- Unattractive
- Not reliable
- Too expensive

Are you will pay double for renewable energy since it can help protect our environment?

- 0%
- 25%
- 50%
- 75%
- 100%

Any further comments or suggestions?

- Your thoughts

APPENDIX 3. LETTER TO PARTICIPANTS

Dear Participant

My name is Captain Sebothoma, a student at the University of Witwatersrand, South Africa, pursuing Master's in Business Administration.

The title of my research is “Consumer perception toward the transition from fossil fuel to renewable energy technology for electricity generation in South Africa”. This study aims to investigate South African consumers' perceptions of renewable energy technologies, with the goal of using the findings to develop policies and increase the knowledge of renewable energy technology in the country.

I kindly request your assistance in completing the survey to contribute to the outcome of this study. This study is completely voluntary, and there are no consequences if you do not participate. You have the option to engage in the research, not participate in the research, or discontinue participation in the research. You will not be penalized if you do so.

I assure you that the information you provide will only be used for academic purposes. You may contact either myself (researcher) Captain Sebothoma, or my supervisor Dr Diane Hildebrandt:

Captain Sebothoma	**Dr Diane Hildebrandt**
Wits Business School	Wits Business School
2 St Davids Pl & St Andrew Rd, Parktown, Johannesburg	2 St Davids Pl & St Andrew Rd, Parktown, Johannesburg
+27724570158	+27833952921
600827@students.wits.ac.za	diane.hildebrandt@wits.ac.za

To demonstrate that you have read and understand the contents of this letter, please complete the declaration of consent form in the survey.

Thank you for participating in this research.

Yours sincerely

Captain Sebothoma

Student No. 600827

DECLARATION OF CONSENT

I_____ hereby certify that I am comfortable with the contents of this paper as well as the scope of the research. I agree to participate in this research project.

Participants signature: _____ Date: _____