

Factors influencing the adoption of Green Technology by individual consumers in South Africa

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

Johannesburg, 2023

Protocol number: WBS/BA2526425/520



Declaration

I, Rowenta Jainarain, declare that this research report 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.



Rowenta Jainarain

Signed at Durban, South Africa

On the 28th day of February 2023

Acknowledgements

I would like to express my sincere appreciation to all the respondents that took the time to answer my survey.

A special thank you to all my friends of the MBA cohort, for their constant support and motivation.

A heartfelt gratitude and thank you to my supervisors, for their guidance during my research and their insightful advice and teachings.

I am extremely grateful to my Mom, for all the assistance, support, encouragement and motivation throughout. Thank you for your patience and love.

Supplementary Information

Nominated Journal: Journal of Energy in Southern Africa

Supervisor: Professor Diane Hildebrandt

Dr Bruce Young

Word count †: 15013

Supplementary files: Research Instrument

Statistical Data

† Including Abstract, Table of Contents, List of Figures, List of Tables, Abbreviations, Appendix and References. Excluding Title page, Acknowledgements and Supplementary Information

Abstract

The effects of climate change are becoming more evident, across the world. It is imperative that humans act as a collective and start immediately, to change their modes and means of operating activities that add to greenhouse gas emissions and global warming. The United Nations (UN) developed the 17 Sustainability Development Goals (SDGs), to be achieved by the year 2030, with SDG 13, Climate Action, being one of them. Apart from companies and industries adding to greenhouse gas emissions, a substantial amount of greenhouse gases are directly and indirectly attributed to the individual consumers' activity. SDG 17 then comes into play, being, "Partnerships for goals", whereby this study focuses on the part that individual consumers' have in the case against climate change. Consumers use electricity in their everyday lives and electricity generation is usually from fossil fuel powered stations, which significantly contribute to greenhouse gas emissions. An alternative would be for consumers, to adopt green technology, in the form of renewable energy, such as solar panels and solar water heaters. This study took a quantitative approach, to assess the factors that influence the adoption of green technology in South Africa. Primary data was collected from 102 respondents via a survey questionnaire, with 87 valid responses after data cleaning. Factor analysis was employed to ascertain the factors that influenced adoption. Multiple regression was used to test the hypotheses developed from the literature survey as well as to determine which factor influenced adoption most. The theory of planned behaviour was the model and framework against which, intention to adopt green technology was tested.

The literature survey study found that awareness, self efficacy, ease of access, belief of benefits, cost perception, risk perception, environmental concern, aesthetics and social norms have an impact on intention to adopt. The regression analysis in the study found that awareness, belief of benefits and cost perception had an influence on the intention to adopt green technology and that awareness was the most influential factor.

There is very little literature on factors that influence adoption in the South African context, hence this study aims to fill that gap and assist governments, sustainable development organisations and societies, with practical recommendations to influence

the uptake of green technology in the form of renewable energy in South Africa as well as recommendations for future research.

Keywords: Climate change, greenhouse gases, individual consumer, renewable energy, green technology, theory of planned behaviour, solar panels, solar energy

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List of Acronyms

IPCC: The Intergovernmental Panel on Climate Change, otherwise known as the IPCC

UN: United Nations

SDG's: Sustainability Development Goals

PV: Photovoltaic

KMO: Kaiser-Meyer-Olkin

1 Introduction

1.1 Background and Context

Technology either can be our boon or bane, depending on how we, as humans harness the potential benefits that lie within. A study conducted by Zhongwei et al, (2010), looked at the period between 1980 and 2005, having analysed 152 countries around the world and how domestic economic progress impacts upon the surrounding environment, including biodiversity and ecosystems. This essentially indicated that human activity in the pursuit of economic growth has resulted in environmental dependence and reliance, resulting in environmental degradation as well biodiversity depletion, (Zhongwei Guo, 2010). More recently, the Global Footprint Network indicated that the earth is currently consuming resources such as water, wood, fossil fuels such as coal and the like, at an alarming rate that can be compared to the use of 1.75 earths. They have coined what is known as ecological overshoot, whereby the earth's resources are depleted by more than what the earth can generate in a year (Global Footprint Network, 2022). In turn, the World Economic Forum advises that if such "overshoots" are more frequent and sustained, it can result in total ecosystem disintegration, (Lambertini, 2022).

1.1.1 Fossil fuel reliance and Climate change

The overburden on earth has given way to an outlet in terms of changes in temperatures across the world as well as in changes in weather patterns. This climate change, then can be attributed to the production activities of humans, whereby the burning of fossil fuels such as coal, unsustainable agricultural farming, deforestation and the use of greenhouse gases is causing global warming. This directly causes changes to the climate and earth's temperatures (European Commission, 2022).

Examples of this are evident whereby studies indicate, that over the last 10 years, the sea level has been rising by 3.6mm per year and by 16cm, from the year 1902 to 2020, (The Royal Society, 2020). It has been noted that global average temperatures have

increased by 0.39 °C per decade. Visible signs are serious and destructive changing weather phenomena such as wildfires in Australia and heat waves in India, as evidenced by The Guardian, (Milman, 2020).

In addition, the drought recently experienced in Southern Africa in the period of 2015 and 2016, was because of the El Nino effect, which subsequently decreased corn production by 50%, compared to the 5-year average timeframe, (Sazib et al. 2020). The Intergovernmental Panel on Climate Change, otherwise known as the IPCC, predicts that temperatures will rise at a faster rate than before, at about 1.5 °C in the next few decades, (IPCC, 2021). The resulting effects will be more drastic, affecting water cycles, such as extreme rainfalls and extreme droughts, (NASA, 2022). This translates into floods, droughts affecting agricultural production and water scarcity, to name a few.

South Africa experienced ravaging floods in its eastern regions in April 2022, which caused the deaths of over 440 and left more than 40 000 homeless. Pinto et al, conducted a study in 2022, where climate models were correlated with environmental observations in South Africa and it was found that greenhouse gases and aerosol emissions were key contributors to the observable climate change and heavy rains in April 2022, (Pinto, et al., 2022).

The best recourse is to act now, as a unified collective, to tackle such colossal issues as climate change.

1.1.2 Actions to resolve climate change

The impact of climate change conditions is dire, hence, amongst other pressing “wicked problems” we currently face globally, the United Nations (UN) developed the 17 Sustainable Development Goals (SDGs) in 2015, which countries around the world, including South Africa, have committed to resolve and achieve by the year 2030, (United Nations, 2022). Production and economic activity have to occur, however, this should be done sustainably, whereby the activities do not deplete our natural resources or cause harm to the present or future generations, (UNESCO, 2022).



Figure 1: The United Nations 17 Sustainable Development Goals (United Nations, 2023)

This being said, progress in countries and globalisation goals need to move away from the old paradigm of only maximising the economic bottom line and must also look toward what is otherwise known as, the triple bottom line, including social and environmental development, for development to be sustainable, (Correia, 2019).

At the core of solving this problem, society as a whole, including individuals and businesses, need to come together and employ unified action steps, despite electricity production, transport and manufacturing, owing to 73.2% of global greenhouse gas emissions in the year 2016, worldwide, (Ritchie & Roser, 2022). These gases constitute of carbon dioxide, methane and nitrous oxide as the major contributors amongst others.

Harder's (2019) article on the challenges of tackling climate change, points to the fact that it is mostly due to our high dependence on fossil fuels such as coal, which has been created by ourselves over time, that makes it difficult to move away from such technology, (Harder, 2019).

1.1.3 The current fossil fuel dependence and energy climate in South Africa

South Africa is highly dependent on coal for energy and about 77% of coal production is used for electricity generation, (Department : Mineral Resources and Energy South Africa, 2022). Adebayo et al, in their 2021 paper, looked into coal energy consumption, economic growth as well CO₂ emissions in South Africa, which showed that pollution and greenhouse gas emissions are fuelled by the economic growth of the country, as a result of the dependence on coal for energy and electricity generation, (Adebayo, Awosusi, Bekun, & Altuntaş, 2021). In line with the UN 17 SDGs, South Africa would need to find alternative forms of cleaner energy, (SDG 7), to empower climate action, (SDG 13), which can be achieved with partnerships for the goals, (SDG 17). Partnerships here would refer to individual consumers of South Africa, playing a role in the energy consumption of South Africa.

1.1.4 Individual consumer perceptions and adoption of Green Technology, in the form of solar panels and solar water heaters in South Africa

Green technology is that which is environmentally friendly and sustainable, (Koons, 2022). Solar panels and solar water heaters, use photovoltaic panels which can be made from elements such as silicon, which capture the sun's solar energy and converts it into electricity, for heating and providing general electricity and fall under the banner of green technology, as it is a renewable source of energy and environmentally friendly, (Koons, 2022).

Understanding the impact of factors such as demographics, green technology awareness, cost perceptions, self efficacy, risk perception, environmental concern and attitudes toward the adoption of green technology in the form of renewable energy, has on adoption, would assist countries to develop methods and strategies that would help encourage individual consumers to take up the use of green technology in the form of renewable energy, (Wall, Khalid, Urbański, & Kot, 2021).

1.2 Research Conceptualisation

1.2.1 The Research Problem Statement

The United Nations have cited that in order to achieve the SDGs by 2030, it is crucial that the goals and actionable steps, as part of the strategy developed to meet the goals, run through every sector of the value chain of the business. This will hold suppliers and other stakeholders to account as companies should only conduct business with stakeholders who are also aligned to the above and have strategies in place to also change operations to operate sustainably whilst achieving the SDGs, (United Nations Global Compact, 2022).

The tools at disposable then to change operations to behave sustainably, is to employ innovation and what is known as green technology, as alternative methods. Green technology specifically speaks to technology or innovative methods that are environmentally friendly and decreases the negative effects that humans have on the environment, (Greenly, 2022). Examples of green technology include the use of solar energy, vertical farms, electric cars, wave energy generation, waste-to-energy innovations as well as wastewater recycling, to name a few, (TECAM, 2019).

An important factor when it comes to achieving SDG 17: Partnership for goals, is the role of individual consumers in creating a sustainable environment and not just corporations alone. Individual consumers, in their daily activities and own capacity, such as transportation, electricity and energy use, water consumption as well as waste production also contribute to the un-sustainability challenges at hand. In 2018, the average US citizen contributed towards 18 tonnes of greenhouse gases per year, (Ritchie & Roser, 2022), consumed around 11770 kWh of electricity, (WorldData.info, 2022) and generated around 811 kg of waste per year, (Krososky, 2021). This demonstrates the magnitude of the impact that individuals add to the sustainability challenges of energy consumption, greenhouse gas emissions and waste generation if we multiply each of the preceding data by the total population in the US in 2018, which was 327,096,265 people, (MacroTrends, 2022).

It is evident then that individual consumers in their capacity contribute significantly to factors attributing to climate change; hence, this group should also engage in the use of green technologies to decrease their impact on climate change.

Specifically speaking to South Africa, a high dependence on fossil fuels such as coal for electricity generation is noted, (Department : Mineral Resources and Energy South Africa, 2022).

Mentioned in section 1.1.4, solar energy is a green technology, which uses renewable energy and therefore is an attractive source of energy for sustainable development for industry and the individual consumer alike, whilst allowing for minimal environmental impact, (Maka & Alabid, 2022).

If solar energy then, is a viable source of green technology, in the form of renewable energy in order to combat climate change, why is it not being utilised by the population at large and why is a heavy reliance on fossil fuels still at play? Why is South Africa still so heavily dependent on coal and fossil fuels for energy generation? Why is it, that despite being fraught with load shedding from South Africa's monopoly electricity generator Eskom, are individual consumers not using alternative forms of green technology and renewable energy, in the form of solar energy?

The research problem statement then begs to explore the reasons as to why South Africans in their individual capacities are not utilising renewable energy in their individual capacities for their electricity needs.

1.2.2 The research problem statement - aim and objectives

This study aims to shed light on the problem statement, of understanding the factors that influence the adoption of green technology, in the form of solar panels and solar water heaters by individual consumers in South Africa.

The objectives:

- to use the concept of factor analysis to firstly understand what factors influence the adoption of green technology by individual consumers in South Africa
- To then use the concept of multiple regression, to ascertain the most influencing factor that promotes the use of green technology by individual consumers.

A closed questionnaire survey instrument was used, to try to ascertain factors influencing the espousal of green technologies in individual capacities, in South Africa. The study was quantitative in nature and used a cross-sectional design for data collection. The survey method was useful as it was able to reach a large number of respondents and provide data in a short period of time, as opposed to an interview. As per Wright, surveys are able to reach individuals from different geographies and individuals with different beliefs, attitudes and interests, (Wright, 2005), hence the mode of choice.

The survey instrument collected demographic data via closed-ended questions, as well as questions on consumer perceptions towards adopting green technology.

1.2.3 The research questions and accompanying research hypotheses/ propositions

1.2.3.1 Question 1: Do consumer perceptions influence whether individual consumers in South Africa adopt green technology or not

Null Hypothesis: Consumer perceptions do not have an influence on whether individual consumers in South Africa adopt green technology

Alternate Hypothesis (The research hypothesis): Consumer perceptions do have an influence on whether individual consumers in South Africa adopt green technology.

This question will be answered, by assessing the significant regression coefficients, which indicate the direction and strength of influence of the independent variables on the dependent variable, being the intention to adopt.

As shall be discussed later in the literature survey and results, various literature on the topic point to several factors that can influence whether a consumer will in fact adopt green technology or not.

1.2.3.2 Question 2: Does a factor exist that most influences whether individual consumers in South Africa adopt green technology or not

Null Hypothesis: There is no variation in the factors that influence whether individual consumers in South Africa adopt green technology

Alternate Hypothesis (The research hypothesis): There is a variation in the factors that influence whether individual consumers in South Africa adopt green technology

1.3 Delimitations and assumptions of the research study

1.3.1 Delimitations

The survey instrument is not limited to any particular subset of the populace. This being said, due to the nature of the survey instrument being electronic, only individuals with access to the internet on either a mobile phone or personal computer would be able to respond. This possibly limits the results to include that of individuals from a certain income bracket or affluence.

1.3.2 Assumptions

No personal data linking the identification of an individual to respondent answers, hence it was assumed that respondents answered the survey as freely and honestly as possible.

It was also assumed that the respondents answering the survey possess the appropriate literacy level to comprehend and answer the questions as logically as reasonably possible.

Despite using convenience-sampling methods, it was assumed that the data received from respondents, will in general, represent the attitudes, beliefs and norms of South Africans at large.

1.4 Significance of the research study

Notwithstanding the impact of the use of unsustainable energy resources such as coal, South Africa has for long been perturbed by load shedding, since 2007, (Eskom, 2023). This has resulted in losses in business, especially for small to medium enterprises as well as created the obvious uncomfortable circumstances for daily living for many households. The use of gas stoves in homes has posed a risk resulting in fire accidents. Diesel generators further exacerbate the impact of climate change by the burning of diesel fuels, (Lawson, 2022). This, one would believe, should give greater impetus to harness green technology such as solar panels and solar water heaters, to supplement the energy supply. Studies have been undertaken to understand the factors influencing the adoption of green technology in the form of renewable energy in other countries such as Pakistan, (Irfan, Zhao, Rehman, Ozturk, & Li, 2021) and Thailand, (Wall, Khalid, Urbański, & Kot, 2021). Minimal research had been conducted in South Africa in this perspective. This study aims to close the gap by providing more data and literature on this subject matter.

In addition, this study could benefit the South African renewable energy industry, governments as well as environmental and societal non-profit organisations, to understand what factors would most influence individual consumers in South Africa, to use green technology in the form of solar panels and solar water heaters.

1.5 Preface to the research report

Chapter 1 provides the background and reasoning for this research report, outlining the problem statement at hand, objectives and significance.

Chapter 2 delves deeper into the topic, via a literature review, of previous research in the area. It also expounds upon perceptions of individual consumers about renewable energy that influence their choices and how various frameworks were used to provide a yardstick for evaluation and interpretation of the results.

Chapter 3 looks at the research methodology, limitations, assumptions and ethics involved and required in such as study.

Chapter 4 provides the research findings on factors that influence the adoption of green technology by individual consumers in South Africa.

Chapter 5 discusses and analyses the results using the theoretical frameworks presented in Chapter 2, to systematically cross-examine research questions and the total results.

Chapter 6 summarises the research study, suggesting a way forward in terms of the research topic at hand.

2 Literature Review

2.1 Introduction

Understanding the impact that individual activities have on the climate change scenario, would assist individuals in a mindset change and possible adoption of green technologies, in the form of solar panels and solar water heaters. It is only, if sustainable methods of operating, be it by householder individuals or organisations, are inculcated in the mindset and forms part of the thread and fibre of everyday activity, can we decrease the reliance and dependence that we built on fossil fuels and unsustainable methods, over many years.

This literature review chapter looks at understanding the research problem, ascertaining where any gaps exist in terms of the knowledge in literature related to the research problem as well as creating a framework to be able to interpret what has been construed from the research.

The literature survey, in Section 2.2, will look at the research problem and the challenge of getting consumers to adopt the use of green technology. In addition, similar research to this study will be explored to ascertain the various factors that have influenced individual consumers, to adopt green technologies in the form of renewable energies in their personal capacities. Section 2.3 then carves out the framework that will be utilised to interpret the research study results. Section 2.4 summarises the literature review.

2.2 Research Problem Analysis

Climate change and its effects have become more prolific. The impacts are dire. Hydro fluorocarbons, methane, carbon and short-lived pollutants, not only contribute to global warming and climate change but also impact upon, food, air and water quality, thereby affecting the health of individuals as well as the biodiversity and ecosystems, (Climate and Clean Air Coalition, 2022). Antonio

Guterres, the UN Secretary General, has publicly advised that the time to act is now, to prevent possibly irreversible damage to food security, health and wellbeing, increase in sea levels as well as climate change, (Climate and Clean Air Coalition, 2022).

No one can predict the future, however growing evidence points to the fact, that to be sustainable in the future, we need to become more resilient to the dynamic forces of the environment and world around us. It is only natural, that if we continue to rely upon non-renewable resources, they will soon deplete in the future. Issues such as soil degradation, increases in the urban population and pollution, will push society in the future to find alternative and renewable green technologies, (Green Machines, 2022).

It is necessary therefore to understand why individual consumers will not want to implement green technologies in the form of renewable energies themselves, in their everyday lives in order to establish ways to mitigate this.

Irfan et al (2021) conducted a study in China in 2021, on 355 households, amongst four of its largest cities, looking at the willingness of consumers to utilise solar energy, for individual households. A country that is also heavily reliant on fossil fuels. The researchers used the Theory of Planned Behaviour (TPB), encompassing aspects of perceptions of self efficacy, beliefs on solar energy benefits as well as the perception of neighbours' uptake of solar energy. The study found that in terms of willingness to use solar energy, cost had a negative effect and neighbours' participation had an insignificant effect. Awareness, beliefs, environmental concern and self efficacy, related to solar energy use, had positive impacts on their willingness, (Irfan, Elavarasan, Hao, Feng, & Sailan, 2021). The study purports that by raising awareness of benefits and rebranding social norms, willingness can be improved.

A study was conducted by Wall et al (2021) that analysed the factors that influenced consumers' adoption of renewable energy, in Thailand. It was found that perception of self effectiveness, awareness, concern for the environment

and beliefs, have a positive and significant impact on the adoption of green energy by individuals. On the other hand, cost of renewable energy had a negative impact and trust/risk perception had a positive impact on adoption, however, both of the latter was not significant. The study advises that governments should look toward these factors to promote and campaign for green energy adoption by the people of Thailand, (Wall, Khalid, Urbański, & Kot, 2021).

Financial incentives seem to have a strong influence on the likelihood to adopt. Genoudi and Sardinou (2013) looked at responses from 200 people, from December 2009 to January 2010, focusing on age, marital status, education level, income level, homeowner status, average electricity consumption, energy tax deduction incentives and willingness to adopt as a result of rising energy prices. The study showed that energy tax deductions and higher income levels were positively correlated to the adoption of green energy methods and suggested that policies that aim at tax deductions and subsidies, to improve the uptake of green energies in the residential sector can result in higher rates of adoption, (Genoudi & Sardinou, 2013).

Hendricks (2016), assessed the uptake of rooftop solar photovoltaic, (PV) panels for energy supply, in the small upper-income suburb in Johannesburg, South Africa, called Parkhurst. Uptake of this particular type of alternative energy was low, despite Parkhurst individuals being in the upper-income bracket and at the time, being fraught with frequent load sheds and power outages from the dominant electricity supplier of South Africa, Eskom. Hendricks found that lack of support from Eskom and being able to feed back energy into the grid, lack of subsidies and tax rebates, played a vital role in adoption levels. Rooftop PV panels were not well marketed and the individuals in the study did not fully understand this technology. In addition, respondents felt that solar panels did not add to the aesthetic appearance with concerns that it might also decrease the retail value of the home in the future. PV panels were also perceived as being expensive, taking a long time period to pay off and

obtain a positive net present value on the “investment”. Hendricks seeks to propose that companies have a major role to play, by building trust with consumers, marketing well and educating as well as implementing measures to decrease the high costs of PV systems, (Hendricks, 2016).

Sangroya and Nayak (2017), advise that governments alone cannot solve the issue of environmental damage. Consumers as well need to employ “green” living to promote environmental sustainability. One needs to understand the perception that consumers have of green technology to know what to target and how to improve consumer willingness. They developed a novel multidimensional construct scale to look at levels of perceived green value. Looking at emotional, conditional, functional and social value, their study indicated that emotional and social constructs of perceived value also play a role, in terms of what influences consumers to use green technologies, (Nayak & Sangroya, 2017). They suggest that governments need to market the aspect of solidarity and citizen responsibility to the environment, as opposed to just financial incentives.

Masrahi et al. (2021), published an article, correlating the Theory of Planned Behaviour (TPB) and the willingness that a consumer has to pay for the use of green energy in the United States. The study considered 22 states of the US. It was found that household income influences whether a consumer will in fact use green technology. Masrahi et al, study outcomes were consistent with the TPB model, (Masrahi, Wang, & Abudiyah, 2021). It showed that subjective norms, and perceived behavioural control, were able to predict the individual residential consumers’ willingness to pay for renewable energy, however, attitudes were not predictors. Once again, the study advises the role of policymakers in focusing on the socioeconomic factors to influence individuals’ willingness to pay for green energy technologies, (Masrahi, Wang, & Abudiyah, 2021).

It appears thus far, that perceived cost in general seems to be a limiting factor when it comes to the willingness to adopt green technology. Zulu et al. (2021)

collected 947 responses via an online survey, via convenience sampling. Multiple linear regression assisted in identifying that perceived benefits, trust, knowledge of solar solutions and load shedding, positively impacted the intention to adopt renewable energy such as solar, whilst the opposite was true for perceived cost, (Zulu, Chabala, & Zulu, Perceptions and beliefs influencing intention to use solar energy solutions in Zambian households, 2021).

It appears that not only do perceptions play a role in green technology uptake, but demographics as well. Rahut et al. (2017) utilised secondary data from the Livings Standards Measurement Surveys of Ethiopia, Uganda and Tanzania in 2017. It was found that as the level of education of the household head increased and when families were wealthier, the probability to take up solar energy in households was higher. The study further suggested, that based on these results, policymakers in these countries, should harness the aspects of education and income levels, to promote the use of domestic solar energy generation, (Rahut, Mottaleb, Ali, & Aryal, 2018).

Structural equation modelling fed into an Artificial Neural Network model highlighted aspects that influenced the adoption of solar panels in Kerala, India. Parsad, Mittal and Krishnankutty (2020), assessed 237 and 387 households, via survey questionnaires, as two different data sets, looking at drivers of householder investment in rooftop PVs. In line with some of the previous literature, findings mentioned earlier found that cost was an inhibitor to uptake, however, subsidies from the government would help pass the initial investment cost in rooftop PV's, increasing householder propensity to uptake, (Parsad, Mittal, & Krishnankutty, 2020).

2.3 Framework for interpreting research findings

This study will also utilise the Theory of Planned Behaviour, as purported by Wall, Khalid, Urbanski and Kot (2021) and Masrahi, Wang and Abudiyah,

(2021), in their studies, as mentioned above. Human behaviour and intentions vary upon a number of factors ranging from genetic to environmental influences, (KPU, 2022).

The TPB was developed by Icek Ajzen, (Ajzen, 1991). Translated to the issue at hand in this study, it indicates that the intention to use green technology by individual consumers can predict the behaviour of the consumer and whether or not they will actually utilise green technology in their individual capacities. Ajzen however, noted that intentions encompass the factors that influence a behaviour, (Ajzen, 1991). This means, that intention to use green energy is made up of the motivating factors, that would actually make an individual engage in such an activity.

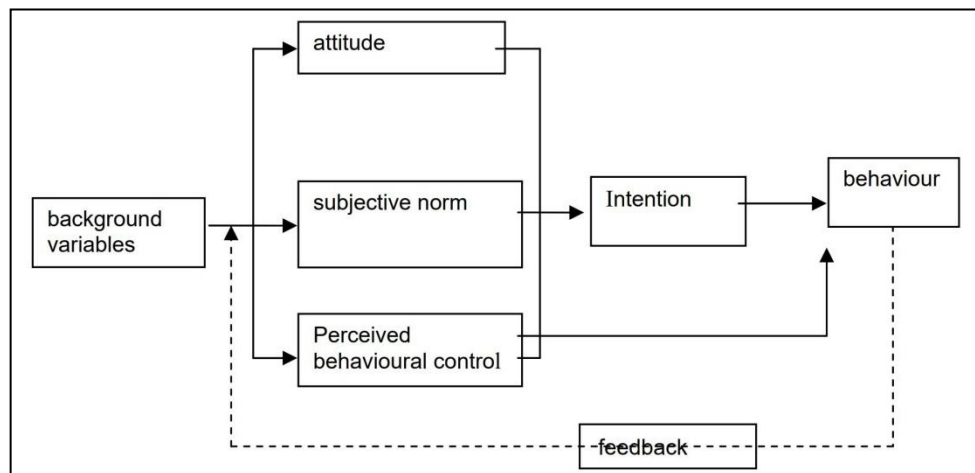


Figure 2: Theory of Planned Behaviour (Ajzen, 1991)

The TPB, extended to this study, looks at three variables, namely, personal attitudes, subjective norms and perceived behavioural control. Personal attitudes here are the attitude that consumers have toward using green technology. The issue of subjective norms would look at the consumers' perception of other consumers' attitudes toward using green technology. Lastly, perceived behavioural control would imply the perception that we have of aspects that we can control such as our fortitude and external factors such as our income level. In essence, if for example, consumers believe that income is a

motivational factor to use green technology and they have no control over their income, one could predict that they are most likely not going to engage in the behaviour of using green energy.

Despite Ajzen's theory being presented in the early nineties, TPB has been used and referenced in more than 4200 papers. This data was obtained from the Web of Science bibliographic database, in April 2020, (Bosnjak, Ajzen, & Schmidt, 2020). In addition, Bosnjak and Schmidt found that a substantial amount of papers covering environmental and psychology applied studies have used the TPB as a guiding framework to interpret research findings, (Bosnjak, Ajzen, & Schmidt, 2020). This aids in confirming that the TPB would be applicable in interpreting the outcomes of this research study.

There are some noted criticisms to the theory however in that the three constructs of subjective norms, attitude and perceived behavioural control, may in fact not be the only behaviours influencing intention to act, (Zulu, Zulu, & Chabala, Factors Influencing Intention to Adopt Solar Energy Solutions in Households in Zambia: Insights from the Theory of Planned Behaviour, 2021). Ajzen however advises that if there are other constructs, that can account for large variances in intention and behaviour, they can be included as adjuncts to the three main ones, (Ajzen, 1991).

2.4 Literature Review Summary

This study was tested against the hypotheses mentioned earlier in the introduction to this study. Using the TPB as a framework, the attitudes, subjective norms and perceived behavioural control of individual consumers in South Africa will be assessed by the following constructs. To further explore constructs and their determinants as applied to the adoption of solar energy by households, the previous studies were analysed to understand verified construct allocations.

These have been adapted from the study by Wall, Khalid, Urbański, & Kot, (2021), having analysed factors influencing consumers' adoption of renewable energy in Thailand. These include the awareness of green technologies, self effectiveness perception, environmental concern, green technology generation cost, belief about green technology benefits, intention to adopt green technology and risk perception of green technology.

Based on the literature survey, a few more constructs were tested, based on findings particular to the South African context. These include, effect of aesthetics of green technology and ease of access to green technologies

Demographical data will include age, gender, average monthly income net level and educational level.

From the survey above, most studies suggest that policymakers, target the negative constructs of cost, to influence adoption. In addition, environmental concern and benefits appear to play a positive role in influencing willingness to adopt.

2.4.1 Awareness

Awareness refers to the knowledge that individual consumers have about solar energy in South Africa and their perceptions in terms of availability and benefits. Consumers, who are more knowledgeable of green renewable energy, are more likely to understand the positive benefits associated with it and therefore are more likely to have the intention to adopt. Irfan et al, support this in their 2021 study on a similar topic, (Irfan, Zhao, Rehman, Ozturk, & Li, 2021). It should be noted however that education levels as well as access to solar panels, could also have an impact, as limited formal education, in developing countries for example as well as less ease of access, could have a negative impact on intention to adopt, (Wall, Khalid, Urbański, & Kot, 2021).

It is from this and other literature studies, that the below sub-hypotheses are developed, in order to answer question 2.1.

Hypothesis 1, (H1): *Awareness positively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa*

2.4.2 Self Efficacy

Self effectiveness looks at the belief that an individual has in their own ability, to uptake and use solar panels in their daily lives. It is their belief that nothing would hinder them from using it and obtaining any associated benefits. For example, if they lacked knowledge, they would be able to increase it, or if they did not know where to obtain it, they would be able to obtain it and use it. In addition, if they needed to purchase it and purchase other adjuncts to make use of its benefits, they would be able to do so and nothing would prevent them from doing so, (Makki & Mosly, 2020). In the study by Thiangtam (2016), Thiangtam found that consumers' perception of self effectiveness had a positive effect on their intention to adopt renewable energy, (Thiangtam, 2016). The next hypothesis then is:

Hypothesis 2, (H2): *The perception of self-effectiveness positively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.3 Ease of Access

Consumers' living in rural areas, as in developing populations or far off from areas where they can obtain solar panels or renewable energy, intuitively, may be less inclined to make an extra concerted effort to access renewable energy commodities, unless they have a strong alternate driving factor of influence. This concept was cited in Joshi et al study in 2019 in India and it is the factor of

ease of access, that would also be tested in South Africa in this study, (Joshi, Choudhary, Kumar, Venkateswaran, & Solanki, 2019).

Hypothesis 3, (H3): *The perception of ease of access positively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.4 Environmental Concern

Environmental concern, as the name suggests, refers to the attitude that individual consumers have concerning climate change and the negative effects of pollution on the environment and people. Mentioned earlier in this study, the 17 SDGs include partnerships towards achieving the goals. This then includes the active participation of individual consumers in achieving the UN's goals for 2030. Joshi et al, in another paper written in 2015, on factors influencing green purchase behaviour, found that environmental concern positively affects consumers' intention to adopt green technology, (Joshi & Rahman, 2015). This shall also be tested in the South African context.

Hypothesis 4, (H4): *Environmental concern positively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.5 Cost Perception

The cost perception here refers to the cost of capital investment of solar panels and solar water heaters as well as the costs associated to maintain such. Unless one is extremely affluent, one would expect that in the current economic climate, a consumer would only invest in such if once again, there is compelling belief that the consumer would benefit from it or that it actually has a net positive benefit in the long run. Wall et al. (2021) found in their study that there was a negative impact of cost on consumers' intention to adopt green energy, (Wall, Khalid, Urbański, & Kot, 2021).

Hypothesis 5, (H5): *Cost perception negatively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.6 Social Norms

Social norms, as described by UNICEF in 2021, refer to perceived and unwritten “rules” of acceptable actions within a society that governs and guides human behaviour, (UNICEF, 2021). Ajzen in his Theory of Planned Behaviour, 1991, puts this as the perceived social stresses arising from acting or not acting in a certain way, (Ajzen, 1991). In the literature survey conducted by Irfan et al, 2020, it was found that the influence of others has a large and positive impact on the buying intentions of individual consumers with regards to renewable energies, (Irfan, Zhao, Li, & Rehman, 2020). This was supported by Ozaki in his 2011 study on, “What makes consumers sign up for green energy,” (Ozaki, 2011). This lays the foundation for the next hypothesis.

Hypothesis 6, (H6): *Social norms positively influence individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.7 Belief of Benefits

Ntanos et al. (2018) found that willingness to adopt green renewable energy was based on the socioeconomic benefits associated with it. It is in line to assume, that, as with other products, individuals are willing to spend their income on something that would be of use to them. Benefits are not just limited to that of the consumer, such as getting cheaper energy in the long run, but also the positive impact that renewable has on the environment, in terms of fewer carbon emissions and climate change. Wall et al, found that belief of benefits positively impacted consumers' intention to adopt renewable energy in Thailand

and this shall be tested in the South African context as well, (Wall, Khalid, Urbański, & Kot, 2021).

Hypothesis 7, (H7): *Positive belief of benefits positively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.8 Risk Perception

Risk in the case of the study refers to the tolerance that consumers have in terms of any risks associated with the use of renewable energy. This could be a safety risk such as fires due to electrical faults as well as the risk of investing in solar panels, yet there is the potential that the benefits would decrease over time. Doci and Gotchev, (2016) looked at risk perceptions with regards to renewable energy in Germany and the Netherlands and found that low-risk perceptions with regard to renewable energy positively influenced adoption (Dóci & Gotchev, 2016). It is with this and other literature surveyed that the next hypothesis is developed.

Hypothesis 8, (H8): *Low-risk perception positively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

2.4.9 Aesthetics

Solar panels and solar water heaters, as mentioned earlier, have to be positioned in such a way, so as to harness maximum sunlight energy to be of benefit. This usually means placing panels on the roofs of houses and is dependent on the angle of the sun and not determined by householder preference. Individuals may or may not feel that these additions of panels, may affect the look of their house, which could in turn affect valuation. Notwithstanding this, one could feel that it alters the look and feel of the home aesthetics either positively or negatively. This in turn could affect their buying

decision. Faiers and Neame (2006) found that the adoption rate of solar cells decreases with a perception of a negative visual landscape as a result of solar cells, (Faiers & Neame, 2006). It is with this, that the perception of aesthetics was tested.

Hypothesis 9, (H9): *Non aesthetic perception negatively influences individual consumers' intention to adopt green technology, in the form of renewable energy (solar panels and solar water heaters) in South Africa.*

Figure 3 below, shows the summary of the findings from the literature survey, as well as hypotheses to be tested, of factors that influence the adoption of green technology in the form of renewable energy, which will also be the adopted research model for this study.

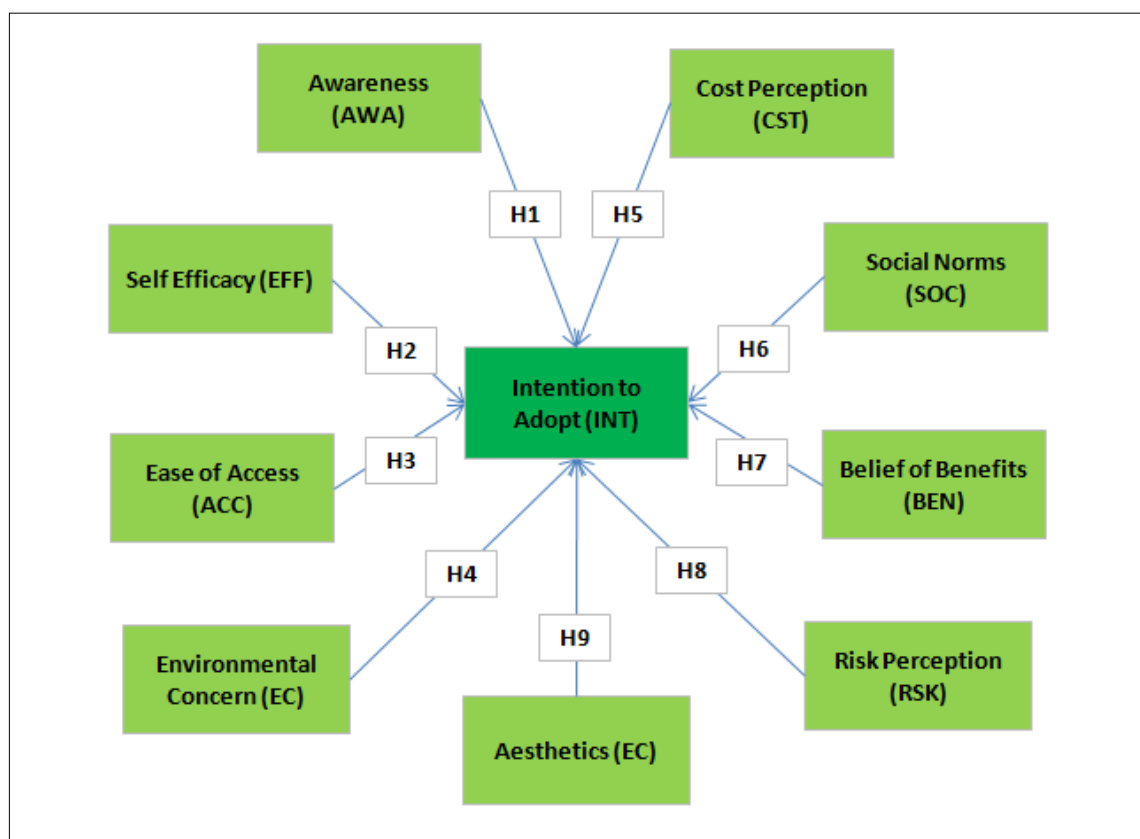


Figure 3 : Adopted Research model for the study based on literature survey

3 Research Strategy, Design, Procedure and Methods

This chapter looks at the methodology utilised in order to conduct the research for this study. The different methods to conduct such studies are also discussed, such as quantitative, qualitative and mixed methods. This is followed by the design of the research and design of the research instrument used. Discussion of the methods of data collection and analysis, validity and reliability is also discussed.

3.1 Research Strategy

Sogunro (2002) analysed the process of selecting either quantitative or qualitative approaches to a research study. He noted that the two were inherently interrelated, where quantitative approaches rely on numerics and statistics, which give an understanding to qualitative data, (Sogunro, 2002). Basias and Pollalis (2018) advise that the choice depends upon the aims and objectives, the type of data and research questions in order to analyse the topic of study, (Basias & Pollalis, 2018).

Quantitative methods are able to use correlations to establish and validate relationships between various variables. Hammarberg et al. (2016), from their research into research methods, advise that quantitative methods be used when factual data is required. It is also appropriate for using data to test hypotheses, where percentages and relationships can be discerned, (Hammarberg, Kirkman, & Lacey, 2016). Quantitative methods assist when there is due a high number of individuals that would be assessed. The results can be generalised to other subsets as well. It also allows to statistically evaluate relationships and strengths of correlations with other variables, (Apuke, 2017). Quantitative methods also make it easier to quantify demographics and infer associations between variables, (Apuke, 2017).

Qualitative methods on the other hand are more useful for understanding experiences and thoughts. It is able to gather expression and emotion. This

transcends to analysing beliefs, views, preferences and feelings that are unique to different case studies at hand. In addition, sample groups are smaller, enabling interviews and transcription to be undertaken by the researcher, (Berkwits & Inui, 1998).

Apuke, in his 2017 article, relates the comparisons between quantitative and qualitative studies, from which, the quantitative study was found to suit this study better, based on the prior statements (Apuke, 2017). A qualitative study on the other hand would be difficult in this case, as one would have to travel to the various locales across South Africa, which would not be feasible, for the large subset under study.

A number of studies have used quantitative research to investigate the factors that influence the adoption of renewable energy, especially as cited in the literature survey above. In many of the studies, replication was possible with quantitative methods. Likert type scale questions were used, with coding of various constructs, hence such replica ability allowed for reliability and validity to be carried through. The literature also shows how causal inferences could be made as a result of the quantitative methods. Based on the above supporting research, quantitative methods were chosen for this study.

3.2 Research Design

A link to a survey questionnaire was placed on various forms of social media and also emailed to various participants with a request to share it with other participants. Internet surveys make it easy to access individuals from different places in a short period of time, (Surveys, 2019). The population for data collection was any South African, across the nine provinces and from any background, which had access to the link. The questionnaire covered the period from November 2022 to December 2022, a total period of 2 months, in order to get the most accurate cross-sectional data.

The actual instrument was a closed ended questionnaire that asked individuals to rank their answers on a 5-point Likert scale, 0 being totally disagree, 3 being neutral and 5 totally agree. Likert scales are able to give a better understanding of the strength and propensity of an individual's responses. Likert scales also show the attitude of an individual, which would be useful in this case, depending on how the closed ended construct is worded, (Pescaroli, Velazquez, Alcánt, Galasso, Kostkova, & Alexander, 2020).

3.3 Research Information Processing and Analysis

3.3.1 Data Analysis

The raw data was first coded, for example, awareness constructs as AWA 1, AWA 2 etc. This was followed by entering the data onto the computer, thereafter the process of data cleaning, to remove issues of missing data and other data, which can skew the data and final results if not removed, (Ridzuan, Nazmee, & Zainon, 2019). The Statistical package used was SPSS v28. This programme assists in regression analysis as well as descriptive statistics. Ong and Puteh (2017) in their research on various types of statistical packages for research methods, advise that SPSS is suited for comparison and correlation assessments for multivariate studies, which aptly suits the subject matter at hand here. (Ong & Puteh, 2017).

Factor analysis was employed. It helps to understand the underlying relationships existent. It is basically a statistical technique that allows for patterns and relationships to be drawn, from summarised data. It is able to cluster determinants of constructs, hence isolate and interrelate for simplified associations, (Yong & Pearce, 2013). From the constructs that have been chosen and as mentioned in the literature survey summary, a vast number of correlations will most likely develop. The factor analysis methodology then will help to make the matrix of correlations simple for analysis, as advised by

Tavakol and Wetzel, (Tavakol & We, Factor Analysis: a means for theory and instrument development in support of construct validity, 2020).

In addition, multiple regression was used. This methodology is useful to determine the fit and explain the variance in the model that will evolve as a result of the processed data set. It also helps in understanding the strength of the relationship between a dependent variable and one or more other independent variables. This will give an idea of which factors have greater influence on the dependent variable, (Laerd Statistics, 2022). In this case, multiple regression was able to assist in understanding the strength of impact or the strength that the constructs have in influencing individual consumers to adopt green technology in their everyday lives.

3.4 Research Reliability, Validity and Limitations

3.4.1 Reliability

Reliability is ensured due to the specific, non-ambiguous and close ended questions in the survey. It also speaks to how the results can be repeatable. Reliability can be tested with a smaller alternative population sample, such as links sent to emails of friends and family in Kwa-Zulu Natal specifically, in a different month. This test and retest will be able to indicate correlation and stability including reliability, (Rosaroso, 2015).

In addition, Wall et al, use the Cronbach alpha of their study, to assess reliability. The Cronbach alpha of their latent variables ranged from 0.837 to 0.935, which indicated a high degree of reliability, (Wall, Khalid, Urbański, & Kot, 2021). Reliability in this study was maximised by ensuring that each construct had at least three different questions that focused on the same construct. This method of improving reliability is also advised by Meshguides, 2022, (Meshguides, 2022).

3.4.2 Validity

Validity is kept due to the large number of potential respondents from across South Africa. The instrument is well designed based on the thorough literature survey undertaken. Bolarinwa, confirms this in his article on questionnaires used in social sciences as we as medical research, (Bolarinwa, 2015). External validity is ensured by the study being non-biased and open to any respondent willing to take the survey. It is therefore a highly randomised subset of the population that will be analysed. Internal validity assesses if the research is sound and if the dependent variable is actually influenced by that independent variable alone and not other variables, (Statisticshowto, 2022). Decreasing the number of confounding variables and adding control variables will help in increasing internal validity, (Statisticshowto, 2022). Voxco advises that randomisation is also a way to decrease confounding variables by averaging out the confounding variable effects amongst all the participants, (Voxco, 2022). In the study by Wall et al. (2021), 536 responses were received and after cleaning, 388 responses were evaluated. The validity was found to be between 0.511 and 0.636 for the average extracted variance, which was above the threshold of 0.5, hence deemed valid. The aim therefore was to obtain a large number of responses, in order to get a large and randomised data set to eliminate low validity.

3.4.3 Limitations

Lower-income individuals may not have access to the internet or social media, hence there is a high possibility that this data set may not be well represented. Individuals may also believe strongly in an aspect, but whether would they would actively take it up and actually utilise green technology, is subjective. Respondents may make errors in interpreting reversed questions on the Likert scale. Individuals may not answer honestly, or fully complete the questionnaire.

3.5 Ethical Considerations

Viljoen and Cilliers (2020) assessed the various potential ethical issues in conducting research. They advise that breach of confidentiality, anonymity and questions that are ambiguous can potentially cause harm to an individual psychologically, by inferring something in a question itself, (Viljoen & Cilliers, 2020). In addition, by stating limitations at the outset and placing non-disclosure statements, confidence and trust can be built into the survey, for any potential respondent, (Pierides & Zyphur, 2017).

4 Presentation of Research Results

Internal reliability is measured via the Cronbach alpha. High internal reliability, is when the Cronbach alpha for that construct is great than 0.65, therefore there is confidence in aggregating the scale items as variable indicators.

4.1 Demographics

Table 1: Demographic Profile of Respondents: Demographic profile of respondents

Demographic Category		Frequency	Percentage (%)
Age Group	18-25	2	2.3
	26-30	9	10.3
	31-40	25	28.7
	41-50	26	29.9
	51-60	17	19.5
	60+	7	8
Profession	Business Owner	9	10.3
	Government Employee	15	17.2
	Other	4	4.6
	Prefer not to say	6	6.9
	Private Employee	33	37.9
	Self Employed	15	17.2
	Student	4	4.6
Educational Level	Degree	19	21.8
	Diploma	17	19.5
	High School	7	8
	Honours	25	28.7
	Masters	9	10.3
	PhD	3	3.4
	Prefer not to say	6	6.9
Gender	Female	44	50.6
	Male	38	43.7
	Non Binary/third gender	2	2.3
	Prefer not to say	2	2.3
Monthly Income (Rands)	<R6000	3	3.4
	R6000 to R15000	7	8
	R16000 to R25000	7	8
	R26000 to R35000	15	17.2
	R36000 to R45000	17	19.5
	>R45000	32	36.8
	Prefer not to say	4	4.6
Location	Eastern Cape	8	9.2
	Free State	2	2.3
	Gauteng	25	28.7
	Kwa Zulu Natal	33	37.9
	Limpopo	1	1.1
	Mpumalanga	4	4.6
	Northern Cape	3	3.4
	Western Cape	8	9.2

The data in Table 1, will be further explored according to each category. The figure below looks at demographics according to age category.

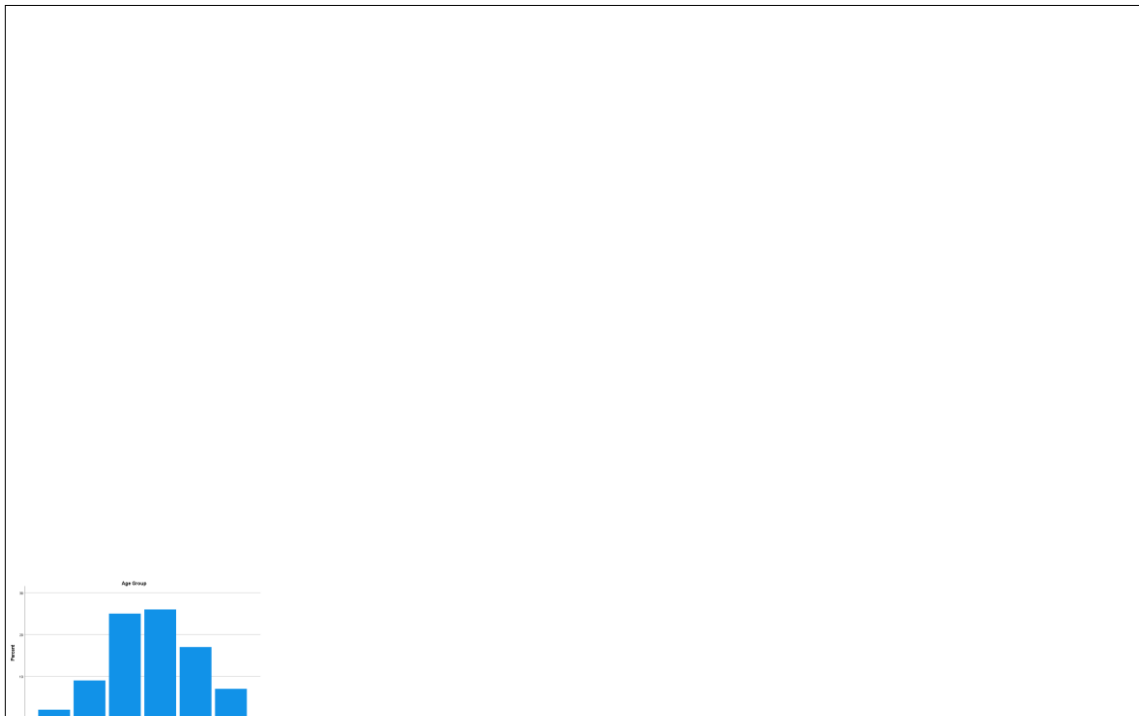


Figure 4: Graphical representation of the age demographic

In the figure, it can be seen that majority of the respondents are in the 41-50 age group (29.9%) as well as in the 31 to 40 years age group (28.7%). Closely matched is the 51 to 60 year age group, being 19.5% of the sample population. The youth between 18 and 30 years as well as the senior citizens represent a smaller subset of this population, 12.6% and 8% respectively. At this stage, not much can be inferred, other than that the representative sample contains majority of middle-aged adults, in the prime working age bracket.

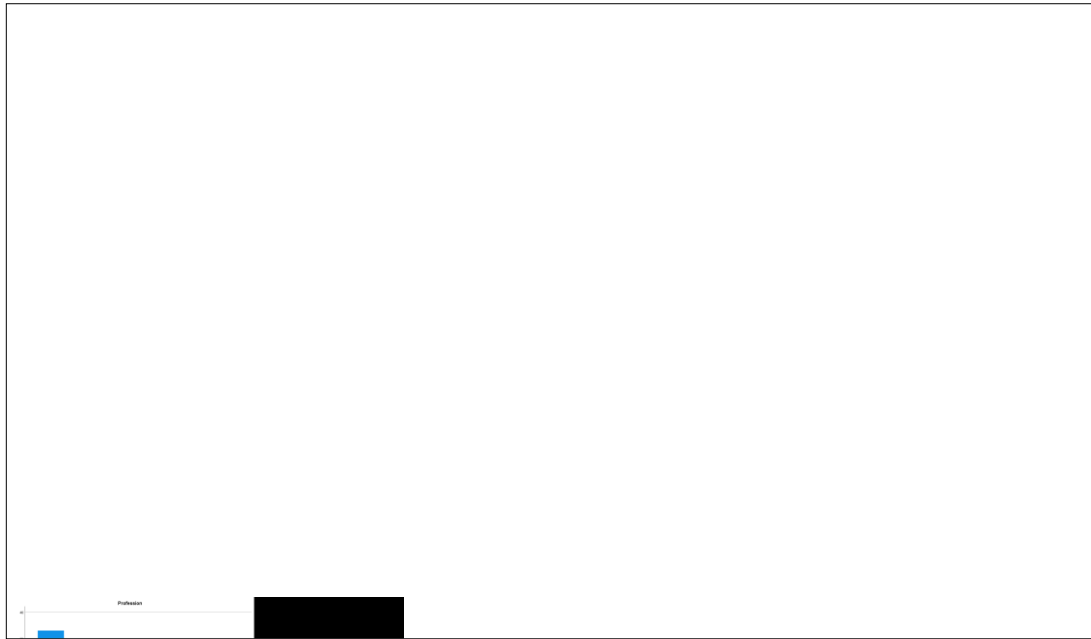


Figure 5: Graphical representation of profession demographic

In the graphic above, it can be seen that majority of the respondents, 82.6% were business owners, government employees, self-employed or private employees. The rest fell into the other, students and prefer not to say, categories.

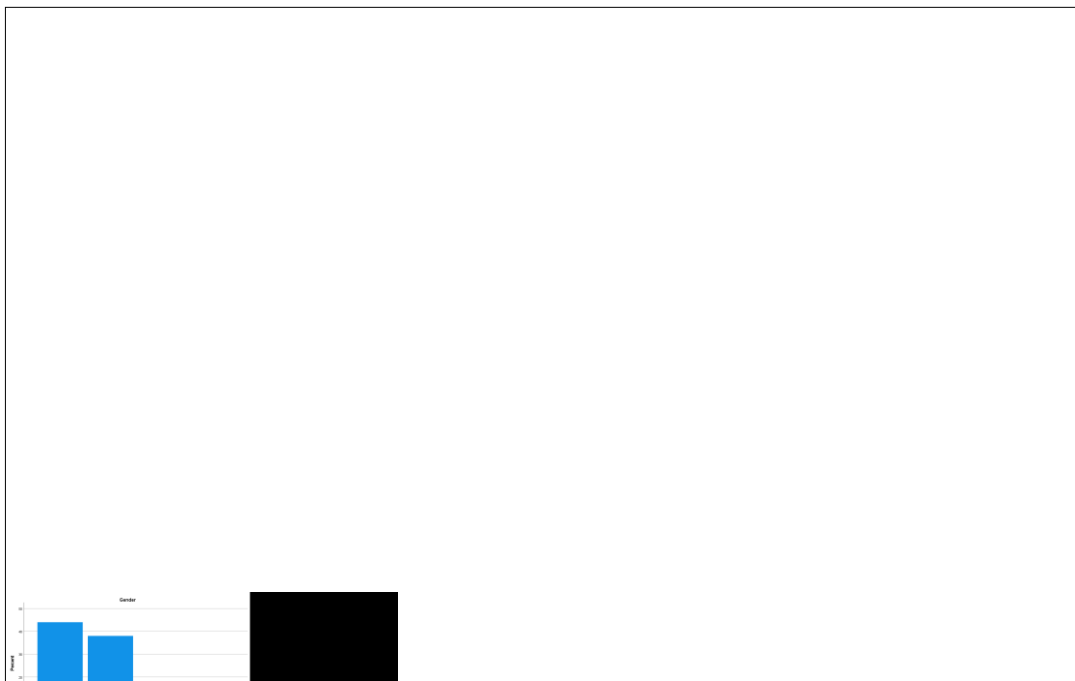


Figure 6: Graphical representation of gender

The sample represents an almost balanced population of male and female respondents.

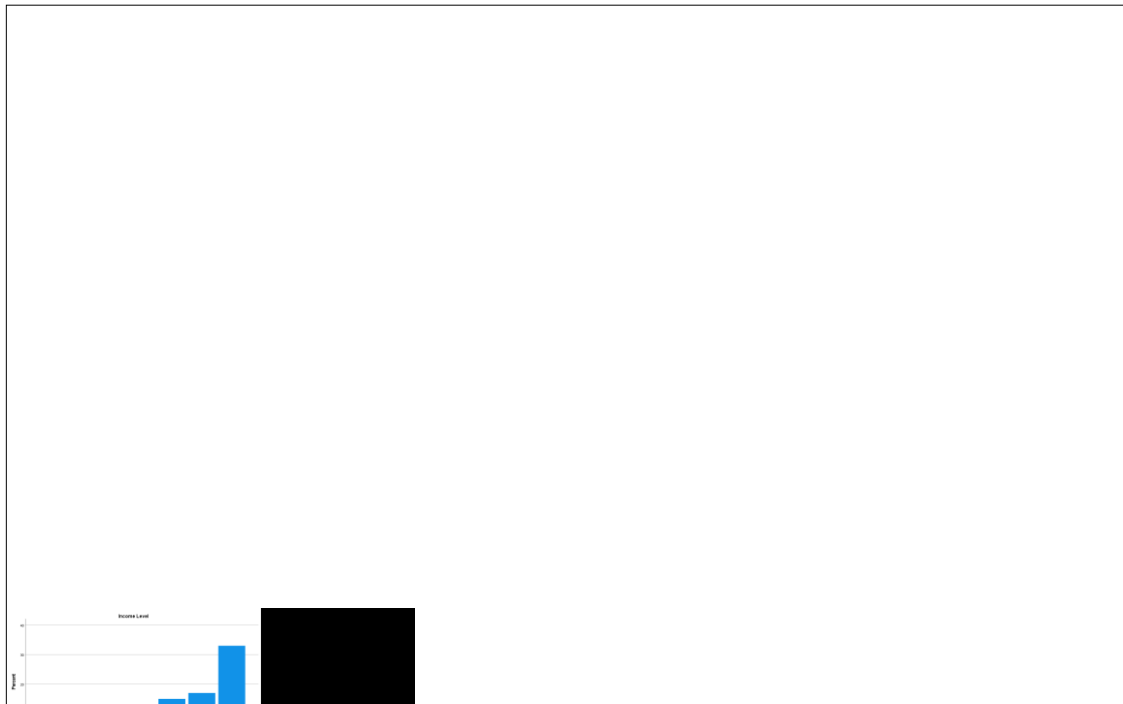


Figure 7 : Graphical representation of Income level

Figure 7 shows that the monthly income for 36.8% of respondents is above R45000. A substantial amount, 19.5% earn between R36000 and R45000 and 17.2% earning between R26000 and R35000.

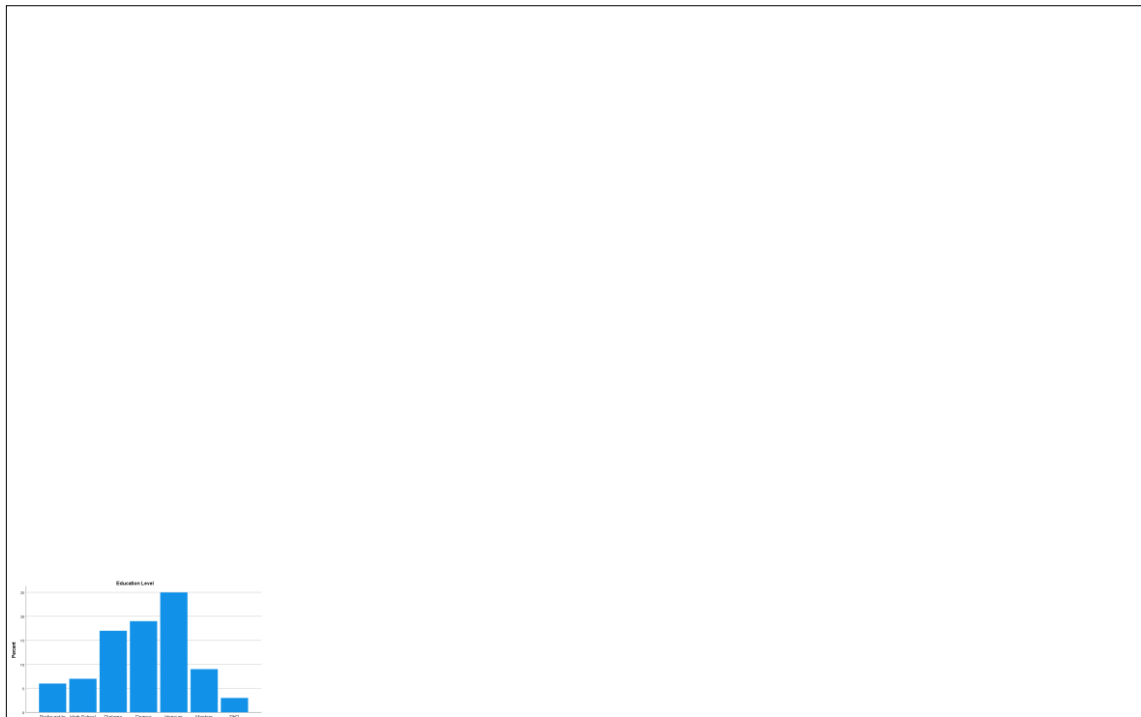


Figure 8: Graphical representation of the educational level

Figure 8 shows that most of the respondents are highly educated, with 21.8% holding degrees, 28.7% holding Honours' and 10.3% holding Masters'. A substantial amount, 19.5% hold Diplomas.

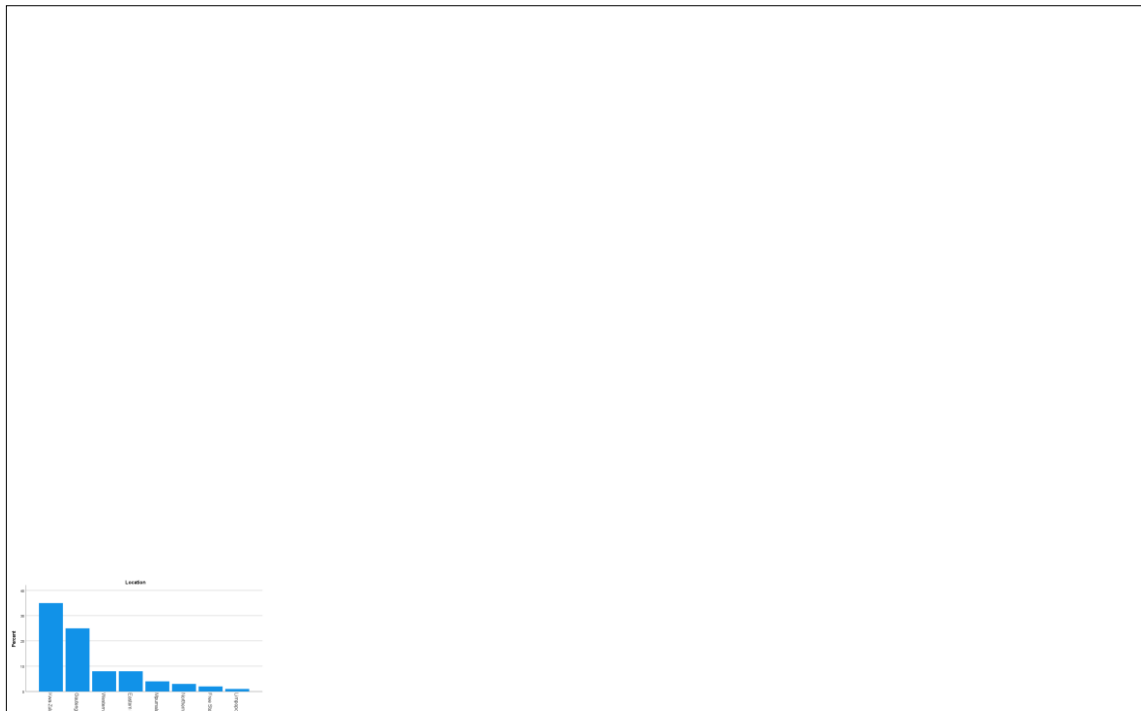


Figure 9: Graphical representation of the location of respondents

The majority of the respondents come from Kwa-Zulu Natal and Gauteng, 37.9% and 28.7 % respectively.

4.2 Factor Analysis

Table 12 in the Appendix, shows the coded items for each corresponding statement in the questionnaire. The 41 items were given to survey respondents. The questionnaire was a 5-point Likert scale, ranging from strongly disagree, (score 1) to strongly agree, (score 5). Each item was coded to a specific factor, (awareness, self efficacy, environmental concern, cost perception, belief of benefits, intention to adopt, risk, aesthetics, ease of access and social norms). The questionnaire can be found in Appendix 1.

Exploratory factor analysis was conducted using the SPSS programme to test for the convergent validity of the proposed constructs.

In order to test the validity of using factor analysis for this study, two tests were done. This was the Keiser-Meyer-Olkin (KMO) test, which is a measure of sampling adequacy and Bartlett's test of sphericity, which is a test on the null hypothesis, that variables within the correlation matrix are indeed uncorrelated, (Williams, Onsman, & Brown, 2010). The results can be found in the table below.

Table 2: KMO and Bartlett's Test Results

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.764
Bartlett's Test of Sphericity	711.188
	df
	102
	Sig.
	.000

The KMO was 0.764 and Bartlett's test of sphericity is significant at 0.001 level indicating high significance. The KMO is higher than 0.5 and has a significance of less than 0.001, indicating that the study can proceed with factor analysis, (Rasheed & Abadi, 2014).

The principal component analysis was thereafter conducted, shown in Table 3 below. Eigenvalues greater than 1, have greater predictive power, hence these were the chosen factors to carry through (Goodwyn, 2012). In addition, varimax factor analysis rotation was used. Put simply, this method adjusts the data co-ordinates to maximise the variance between all items of the various factors. The maximised variance then makes it easier to identify how the data relates the principal component, (Dilbeck, 2017). The principal component analysis indicated that the variance could actually be explained by eight underlying factors as per the SPSS output below, with Eigenvalues greater than 1. These 8 factors captured a total of 72.214% of the variance of the data.

Table 3: Principal component extraction analysis: SPSS output

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Table 4 shows the actual factor loadings, whose absolute coefficients were greater than 0.45, whereby items of the questions posed to respondents, could actually load onto a predominant factor, (as per above, there were 8 predominant factors identified).

Table 4: Factors Loadings from SPSS output

Rotated Component Matrix ^a									
	1	2	3	4	5	6	7	8	9
ABST_1	.796								
ABST_2	.796								
ABST_3	.743								
ABST_4	.800								
ABST_5	.874								
ABST_6	.873								
ABST_7	.893								
ABST_8	.893								
ABST_9	.801								
ABST_10	.802								
ABST_11	.736								
ABST_12	.736								
ABST_13	.841								
ABST_14	.858								
ABST_15	.881								
ABST_16	.881								
ABST_17	.881								
ABST_18	.881								
ABST_19	.881								
ABST_20	.881								
ABST_21	.811								
ABST_22	.881								
ABST_23	.881								
ABST_24	.881								
ABST_25	.881								
ABST_26	.881								
ABST_27	.881								
ABST_28	.881								
ABST_29	.881								
ABST_30	.881								
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ABST_32	.881								
ABST_33	.881								
ABST_34	.881								
ABST_35	.881								
ABST_36	.881								
ABST_37	.881								
ABST_38	.881								
ABST_39	.881								
ABST_40	.881								
ABST_41	.881								

The analysis shows that of the 41 items, four had not loaded onto the 8 predominant factors. These were (CST_3, INT_4, INT_2 and ACC_1). This is because their factor coefficients were less than 0.45 and were eliminated from

the rest of the analysis. The rest of the items loaded onto single factors, whereby the coefficients were greater than 0.45. This indicated an acceptable level of internal validity, (Falk & Miller, 1992).

The various items were then grouped and reliability tests were conducted by assessing the Cronbach alpha values. Tables 13 to 20 in the appendix, give the construct reliability analysis for each factor.

Table 5 below shows a summary of the Cronbach's alpha values for each factor

Table 5: Cronbach's alpha values for each factor

Factor	Items loaded onto factor	Cronbach's Alpha
1	AWA_1;AWA_2;AWA_3;AWA_4;EFF_1;EFF_2;EFF_3;EFF_4	0.899
2	AES_1;AES_2;AES_3;AES_4;AES_5	0.908
3	BEN_1;BEN_2;BEN_3;BEN_4;ACC_4	0.883
4	INT_1;INT_3;ACC_2;ACC_3	0.867
5	EC_1;EC_2;EC_3;EC_4	0.892
6	CST_1;CST_2;CST_4	0.945
7	SOC_1;SOC_2;SOC_3;SOC_4	0.859
8	RSK_1;RSK_2;RSK_3;RSK_4	0.85

All Cronbach Alpha values were greater than 0.7, meaning that the multi-item scales, within the new predominant factors have acceptable internal consistency and reliability, (Taber, 2018).

Factor 1 comprised of items from awareness (AWA_1; AWA_2; AWA_3; AWA_4) and belief of self effectiveness (EFF_1; EFF_2; EFF_3; EFF_4). Upon further analysis of the items relating to Factor 1, these items when taken together, relate more so to the awareness of green technology relating to solar panels and solar water heaters.

Factor 2 comprised of all of the items from the perception of aesthetics, (AES_1; AES_2; AES_3; AES_4; AES_5).

The next Factor 3 consisted of items Perceived benefits and an item relating to ease of access, (BEN_1; BEN_2; BEN_3; BEN_4; ACC_4). These items, once again, when taken together, including, ease of access item 4, relate to the perceived benefits of green technology in the form of renewable energy. Factor 4 consisted of items relating to intention to adopt and ease of access, (INT_1; INT_3; ACC_2; ACC_3). These items, when assessed together, all relate to the intention to adopt green technology, relating to renewable energy.

Factor 5 consisted of environmental concern items, (EC_1; EC_2; EC_3; EC_4) and Factor 6 consisted of three items from cost perception (CST_1; CST_2; CST_4).

Factor 7 contained items of societal norms (SOC_1; SOC_2; SOC_3; SOC_4) and Factor 8 contained items related to risk perception (RSK_1; RSK_2; RSK_3; RSK_4).

Table 6 below, gives a composite of the factor loading structure. It also includes the communalities, whereby the higher the communality value, the greater is the ability of the item, to explain the variance of the factor identified, (Tavakol & Wetzels, Factor Analysis: a means for theory and instrument development in support of construct validity, 2020).

Table 6: Factor loading structure summary

	Factor Loading	Communality	Cronbach's Alpha
Factor 1 - Awareness			
AWA_1	0.656	0.635	0.899
AWA_2	0.759	0.7	
AWA_3	0.715	0.793	
AWA_4	0.758	0.809	
EFF_1	0.635	0.705	
EFF_2	0.674	0.711	
EFF_3	0.672	0.662	
EFF_4	0.686	0.732	
Factor 2 - Perception of Aesthetics			
AES_1	0.645	0.749	0.908
AES_2	0.768	0.758	
AES_3	0.851	0.879	
AES_4	0.73	0.793	
AES_5	0.822	0.841	
Factor 3 - Perceived Benefits			
BEN_1	0.845	0.857	0.883
BEN_2	0.856	0.894	
BEN_3	0.667	0.797	
BEN_4	0.481	0.62	
ACC_4	0.491	0.671	
Factor 4 - Intention to Adopt			
INT_1	0.527	0.735	0.867
INT_3	0.564	0.785	
ACC_2	0.814	0.816	
ACC_3	0.809	0.745	
Factor 5 - Environmental Concern			
EC_1	0.811	0.752	0.892
EC_2	0.807	0.751	
EC_3	0.884	0.883	
EC_4	0.813	0.844	
Factor 6 - Cost Perception			
CST_1	0.898	0.926	0.945
CST_2	0.883	0.93	
CST_4	0.857	0.876	
Factor 7 - Societal Norms			
SOC_1	0.868	0.882	0.859
SOC_2	0.873	0.872	
SOC_3	0.706	0.67	
SOC_4	0.62	0.618	
Factor 8 - Risk Perception			
RSK_1	0.649	0.733	0.85
RSK_2	0.812	0.708	
RSK_3	0.774	0.779	
RSK_4	0.798	0.766	

4.2.1 Hypothesis Testing and Regression Analysis

The above factor loading structure, therefore, changes the hypotheses to be tested to an extent, based on how respondents answered the survey. The table below indicates what factors will be used to test which hypotheses.

Table 7: Factors related to each Hypothesis

Factor		Hypothesis
1	Awareness	Hypothesis 1
2	Perception of Aesthetics	Hypothesis 9
3	Perceived Benefits	Hypothesis 7
4	Intention to Adopt	This is the dependent variable being tested against
5	Environmental Concern	Hypothesis 4
6	Cost Perception	Hypothesis 5
7	Societal Norms	Hypothesis 6
8	Risk Perception	Hypothesis 8

The table below indicates that 52.8% of the variation in the dependent variable can be explained by the model. Adjusted R squared was utilised as the model contained more than one independent variable. The Durbin-Watson statistics was 1.738, hence autocorrelation was unlikely, as it fell within the 1.5 to 2.5 range.

Table 8: Model Summary

Model Summary ^a				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.727 ^a	.528 ^a	.528	432.22
a. Predictors: (Constant), Factor 8 Risk Perception, Factor 5 Environmental Concern, Factor 6 Cost Perception, Factor 7 Societal Norms, Factor 3 Benefit of Benefits, Factor 1 Awareness, Factor 2 Perception of Aesthetics				
b. Dependent Variable: Factor 4 Intention to adopt				

The ANOVA statistics were also calculated and are shown in the table below. This is an indicator if the linear regression model met the linearity assumptions and if it indeed was a “good fit.” It can be seen that $p < 0.001$, which is a strong

level of significance, hence the assumption of linearity was valid and the model was a good fit.

Table 9: ANOVA Statistics

ANOVA ^a					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	40.871	7	5.839	14.807	<.001 ^b
Residual	21.181	73	.290		
Total	62.052	80			

a. Dependent Variable: Factor 4 Intention to adopt
b. Predictors: (Constant), Factor 6 Risk Perception, Factor 5 Environmental Concern, Factor 8 Cost Perception, Factor 7 Recycle Factors, Factor 3 Belief of Benefits, Factor 1 Awareness, Factor 2 Perception of Accessibility

Table 10 below shows the results of the coefficients of the independent variables.

Table 10: Table of Coefficients

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients		95% Confidence Interval for B
	B	Std. Error	Beta	t	
1 (Constant)	-.265	.719		-.369	[-1.693, 1.163]
Factor 1 Awareness	.351	.104	.347	3.373	[.143, .559]
Factor 2 Perception of Accessibility	.170	.106	.164	1.602	[-.036, .376]
Factor 3 Belief of Benefits	.346	.104	.340	3.320	[.138, .554]
Factor 4 Intention to adopt	.271	.105	.267	2.580	[.061, .481]
Factor 5 Environmental Concern	-.286	.105	-.282	-2.724	[-.497, -.075]
Factor 6 Risk Perception	.351	.104	.347	3.373	[.143, .559]
Factor 7 Recycle Factors	.271	.105	.267	2.580	[.061, .481]
Factor 8 Cost Perception	-.373	.104	-.367	-3.581	[-.581, -.165]

a. Dependent Variable: Factor 4 Intention to adopt

The regression had been set to a 95% confidence level. The regression analysis also indicated the statistical significance of each of the independent variables. Here, it can be seen that Factor 1, Awareness ($t=3.073$, p -value 0.003), Factor 3, Belief of Benefits ($t=3.940$, p -value <0.001) and Factor 6, Cost Perception ($t=-3.731$, p -value <0.001) were all statistically significant at the 5% level.

4.2.2 Hypothesis testing and research questions

To answer Question 1 of this study, *Do consumer perceptions influence whether individual consumers in South Africa adopt green technology or not*, the sub hypotheses are used. Indicated by the Beta coefficients above, the correlation between each independent variable and the dependent is seen.

Awareness, $B=0.321$, is positively correlated with Intention to adopt, hence Hypothesis 1 is accepted at the 5% significance level.

Perception of Aesthetics, $B=0.15$, is positively correlated with intention to adopt. On the basis of the study participants, this would indicate that Hypothesis 9 should be accepted, however, based on the high p-value = 0.162, the null is rejected.

Belief of benefits, $B = 0.546$, is positively correlated with intention to adopt, hence Hypothesis 7 is accepted at the 5% significance level.

Environmental concern, $B = -0.071$, is weakly, negatively correlated with intention to adopt in this study, however, it is noted that the p value = 0.578. This is quite high for a p-value, hence Hypothesis 4 is rejected at the 5% significance level.

Cost perception, $B= -0.259$, is negatively correlated with intention to adopt. The p-value is low as well, hence Hypothesis 5 is accepted at the 5% significance level.

Societal norms, $B = 0.105$, is positively correlated with intention to adopt, however the p-value = 0.243. The significance is high, hence Hypothesis 6 is rejected at the 5% significance level.

Risk perception, $B = 0.017$, is weakly correlated with intention to adopt, however the p-value = 0.849. This is high, hence Hypothesis 8 is rejected at the 5% significance level.

The above indicates that, at the 5% significance level, Awareness, belief of benefits and cost perceptions do influence consumers intentions to adopt green technology in South Africa, hence answers Question 1 of this study.

Question 2 looked at, *Does a factor exist that most influences whether individual consumers in South Africa adopt green technology or not.*

The Absolute Beta coefficients indicate as to the strength that the independent variable has on influencing the dependent variable. The table below summarises the Beta values in order of size:

Table 11: Summary of Influential Factors

Factor	Beta Value	Most influential Ranking
Belief of Benefits	0.546	1
Awareness	0.321	2
Cost Perception	-0.259	3
Perception of Aesthetics	0.15	4
Societal Norms	0.105	5
Environmental Concern	-0.071	6
Risk Perception	0.17	7

The above, therefore answers Question 2, in that belief of benefits, most influences South African consumers intention to adopt green technology in the form of renewable energy such as solar panels and solar water heaters.

This is followed by awareness and then cost perception, according to this study.

5 Discussion of Research Findings

Chapter 5 provides an interpretation and discussion on the findings from the research. This is compared and contrasted to the literature survey analysis, highlighting new insights from the study as well as a discussion on the framework, (Theory of Planned Behaviour), against which this study was modelled.

5.1 Demographic Profile

Majority of the respondents are in the 41-50 age group (29.9%), 31 to 40 years age group (28.7%) and 51 to 60 year age group, (19.5%). It can be inferred then that the sample population contained relatively mature adults. 82.6% were business owners, government employees, self-employed or private employees. The data could suggest then, that majority of the sample population are working individuals, generating income and hence have the ability to purchase green technology. Counter to this, however, is that their disposable income may not be enough to invest in solar panels and solar water heaters at this stage.

The sample represents an almost balanced population of male and female respondents, 43.7% and 50.6% respectively with the remainder choosing not to divulge or non-binary/third gender.

The monthly income for 36.8% of respondents is above R45000. A substantial amount, 19.5% earn between R36000 and R45000 and 17.2% earning between R26000 and R35000. This indicates that majority of the group sit in the relatively affluent bracket. Individuals with higher income have a greater ability to invest in green technology in the form of solar panels and solar water heaters, however, this does not necessarily imply that they will purchase the technology.

Most of the respondents are highly educated, with 21.8% holding degrees, 28.7% holding Honours' and 10.3% holding Masters'. A substantial amount,

19.5% hold Diplomas. This indicates that the representative group is highly educated and one would expect, that with higher education, individuals would be more knowledgeable about green technology as well the benefits of renewable energy. This however does not mean that the more educated you are, the more likely you will invest in green technology. The study is also based on perceived risks, perceptions and attitudes, which could change the relationships entirely.

Majority of the respondents come from Kwa-Zulu Natal and Gauteng, 37.9% and 28.7 % respectively. This is most likely because both convenience sampling as well as randomisation was used. Survey links were shared with family and friends of the researcher, with requests for extension to others. In addition, links placed on social media, resulting in some degree of randomisation. Not much can then be inferred other than the fact that both Kwa-Zulu Natal and Gauteng are generally hot locales, with much sunlight. Kwa-Zulu Natal experiences on average 320 days of sunshine each year and Gauteng being a bit cooler on average, (Gautengmarlboro, 2022). Sunlight, being a primary input for solar energy generation, hence location, should not be a deterring factor.

5.2 Factors influencing the adoption of green technology, in the form of renewable energy

The study found that a number of factors could influence consumers to adopt green technology in the form of renewable energy, such as solar panels and solar water heaters. From the 9 main constructs in the survey questionnaire, the exploratory factor analysis indicated that respondents were actually speaking to 8 main constructs. These were tested for reliability and validity, which passed statistically. These included Awareness, Perception of Aesthetics, Perceived Benefits, Environmental Concern, Cost Perception, Societal Norms, and Risk Perception, all in relation the factor of Intention to Adopt.

5.2.1 Awareness

Awareness, which included items from awareness and self efficacy, after further interpretation, was found to relate more so to awareness than self efficacy. Factor 1 then was interpreted and assumed to relate to the awareness construct. This can be related to the knowledge of renewable energy and how one understands and perceives the facts of renewable energy, (Wall, Khalid, Urbański, & Kot, 2021). From section 4.2.2 above, it can be seen that awareness had a positive influence on intention to adopt. This result supports the findings of Wall et al (2021), in that they found that renewable energy awareness positively influences adoption in Thailand. Irfan et al, 2021, in a similar study in China, found a strong correlation between awareness and willingness to adopt, (Irfan, Elavarasan, Hao, Feng, & Sailan, 2021).

The study also found that Awareness was the second most influential factor on adoption in South Africa. It is natural to assume that the more aware one is about the benefits of something, the more likely, a logical decision will be made to pursue the concept, provided there are no other extenuating circumstances, or holding all else constant. This speaks to the perceived behavioural control of Ajzen's TPB model. It is enlightening to know, that something, which is within the "control" of individual consumers, is the factor with the highest influence. Renewable energy uptake should be strongly marketed by increasing consumer and public awareness at large.

5.2.2 Perception of Aesthetics

This factor had a weak and positive, yet non-significant influence on intention to adopt. Questions had been worded in the negative, in order to prevent complacency during answering of questions, hence this meant that indifference to aesthetics positively influenced adoption. 102 respondents answered the survey, however, after data cleaning only 87 valid responses evolved. The reason for non-significance in this factor could be due to the relatively smaller sample size. Nonetheless, the finding is in line with other studies in literature,

such as Aziz et al. (2017), which found that government policy, environmental policy, demographics as well as aesthetics had insignificant relationships with the intention to purchase, (Aziz, Wahid, Sallam, & Ariffin, 2017). In line with the TPB, aesthetics could refer to attitudes that people have regards to renewable energy, by answering the question, “What do I hold more important, climate benefits or solar panel aesthetic appeal?” This factor is highly subjective as it is also based on consumers’ perceptions, which could vary based on a number of reasons, hence, it is not recommended that efforts be expended on propagating this factor of improving the aesthetic appeal of solar panels.

5.2.3 Belief of Benefits

Belief of benefits was the most influential factor, with a strong and highly significant positive influence. Wall et al, 2021, indicated that belief of benefits is in line with the knowledge and understanding of what the advantages are over normal electricity generation using coal, (Wall, Khalid, Urbański, & Kot, 2021). Their study, including that of Aziz et al. (2017), confirm that perceived benefits were also a highly influential factor on willingness to purchase solar panels. Logical reasoning would assume that the reasonable man would pursue something that is of benefit to him. Belief, although being highly subjective, is linked to the benefits of renewable energy. According to Ajzen’s TPB then, beliefs relate to the attitude that people have towards to the benefits. This means that South African’s are more likely to take up renewable energy, if they are aware of the associated benefits.

5.2.4 Environmental Concern

The questions here referred to concern that “dirty” energy has on climate change. There was a very weak, negative ($B=-0.071$), yet no significant influence on intention to adopt. Aziz et al. (2017), found that environmental concern was also statistically non-significant. This study also finds that environmental concern has no influence on the intent to adopt renewable

energy. This contradicts a number of other literature surveyed, such as Kumar et al, in their 2020 study on a similar matter in Punjab, India, (Kumar, Hundal, & Syan, 2020). This could be due to the understanding of the questions or the sample size. Nevertheless, it is suggested that efforts are not enforced at this stage on the matter of environmental concern. There could be other correlating factors, ranging from political to energy supply restrictions that could have subverted answers to this item.

5.2.5 Cost Perceptions

Cost perceptions were the third most influential factor. It had a strong, negative, yet highly significant influence on intent to purchase. Unless there are other strong motivating factors, it is logical to assume, that the higher the cost, the less likely one is to purchase or invest in something. The study finding is supported by most of the literature reviewed in Chapter 2, including that of Wall et al. (2021) and Zeng et al. (2022), (Zeng, Tanveer, Fu, Gu, & Irfan, 2022). According to the TPB, cost, would be out of the control of the consumer, however, perceptions are changed, if costs can be manipulated. This is highly enlightening, as costs, which can to some extent be under the control of policymakers, can be altered, to alter beliefs and perceptions of cost and hence increase the uptake of renewable energy.

5.2.6 Societal Norms

Societal norms had a weak, positive and non-significant influence on intention to adopt. This looks at what others, in the consumers' social circles, are doing in terms of renewable energy and if their activities are likely to influence the consumer to uptake solar panels as well. This is a highly subjective concept, as some individuals are concerned with following the norm and others are not. This particular sample population, who belong to the more affluent and mature group, could behave differently to another subset, especially when it comes to social norms. Nevertheless, Wall et al. (2021) and Elumstapha et al. (2018),

(Elmustapha, Hoppe, & Bressers, 2018), found that activities of those in the neighbourhood and family, had a positive influence, as they were also influenced to take up renewable energies.

5.2.7 Risk Perception

Risk perception was found to be non-significant, but indicating a weakly positive influence. This finding was in contradiction to most other bodies of research, including Elumstapha et al. (2018). One would assume that the riskier that a concept is, the less likely is one inclined to pursue the activity. This could be due to how the questions were understood by the subset and the non-significance also indicating sample population size. Nevertheless, it is suggested that expending efforts in decreasing or increasing risk perceptions is not pursued at this stage until further studies are conducted.

6 Summary and Conclusions

6.1 Recommendations

The study found that the three most significant factors, were Awareness, Belief of Benefits and Cost Perception. These key factors then could provide insight as to what policymakers, government, environmental and sustainability bodies should target, in order to increase the uptake of renewable energy in South Africa.

Looking further into the questions that related to awareness, respondents were asked about knowledge of green technology, in South Africa, the associated benefits and ability to increase knowledge if required. It is suggested that knowledge of how renewable systems work, the benefits and how to increase knowledge therefore, should be mass assimilated through media (television and radio), social media as well as relevant learning institutions, such as universities and schools.

The question relating to the most influential factor, belief of benefits, questioned how renewable energy would benefit in terms of increased employment (important in the South African context and current economic climate), less environmental impact in terms of emissions and climate change as well as improved energy supply (important in the South Africa context with regards to load shedding presently). The ability of solar panels to assist during load shedding, decrease carbon emissions, as well as the possibility that investing in such creates employment downstream, needs to be highlighted to the public at large. Seeing that this is the most influential factor, it is suggested that policymakers market renewable energy as an all-rounded beneficial investment, especially during times of low energy supply such as load shedding.

Questions relating to cost perceptions, looked at high initial costs, the impact of tax rebates (which was a reversed item question) as well as ongoing maintenance costs. Not surprisingly, capital and maintenance costs were

detering factors, yet tax rebates were an influencing factor. If governments then can look at making the costs of purchasing and maintenance costs low, by offering tax rebates for investing and using one's own renewable energy, the uptake can be highly influenced.

6.2 Future Research

It is possible that there exist correlations between factors, which could aid policymakers by changing marketing approaches to include multi factors in a dynamic way. There were a few constructs that exhibited non-significance, which could be attributed to sampling error and population size. It is recommended, that a similar study be conducted, over an extended time period and with more participants, in order to reduce the chances of sampling error in the data analysis set. In addition, adding more multi-item questions, to each construct, could help in getting strong responses, in terms of agree/disagree as opposed to the effect of smoothing based on averaging of responses on the Likert scaling, which could also help the case of non significance.

South Africa is a unique case, subject to load shedding and many issues surrounding energy supply. Adding questions on this topic, could help in determining if contradictory responses could be attributed to inter-correlations with perceptions about load shedding.

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7 Appendix

7.1 Statistical Information

Table 12: Table of coded factors and constructs

Factor	Item	Statement (green renewable energy relating to solar panels and solar water heaters)
Awareness	AWA_1	I have interacted with green technology resources in the past
Awareness	AWA_2	I know of different types of green technology that I can use in my daily life
Awareness	AWA_3	I am aware that green technology -based solutions are available in South Africa
Awareness	AWA_4	I am aware of the benefits of green technology utilization for the environment
Self Efficacy	EFF_1	I have the necessary information and knowledge to adopt green technology resources and methods if I wanted to
Self Efficacy	EFF_2	I believe that I am able to use green technologies in my daily life if I want to as I have full control over my actions, (nothing prevents me from using green technologies)
Self Efficacy	EFF_3	If I lack knowledge on green technology, I know what I can do to increase my knowledge
Self Efficacy	EFF_4	I would not have difficulty in adopting green technology if I wanted to
Environmental Concern	EC_1	I am concerned about the impact that factors such as pollution and “dirty” energy, (non renewable energy) made by individual citizens of South Africa has on the environment
Environmental Concern	EC_2	I am concerned about the impact that factors such as pollution and “dirty” energy, (non renewable energy) made by corporations of South Africa has on the environment
Environmental Concern	EC_3	I am concerned about climate change and the associated hazardous effects on the environment
Environmental Concern	EC_4	I am concerned that if we do not act now, our unsustainable actions that harm the resources of the earth, will cause long term damage to the environment
Cost Perception	CST_1	The use of green technology may be costly, hence I prefer not to use it
Cost Perception	CST_2	Green technologies are expensive and usually require a high initial installation cost, hence I prefer not to use it
Cost Perception	CST_3	I would use green technology in my home if government offered a tax rebate, if I can demonstrate use
Cost Perception	CST_4	Using green technologies creates high ongoing costs such as maintenance amongst other things, hence I prefer not to use it.
Belief of benefits	BEN_1	I believe that the utilization of green technology such as solar panels reduces carbon emissions and helps improve the energy structure of the country
Belief of benefits	BEN_2	The utilization of green technology would improve public surroundings in terms of less pollution and less environmental impact
Belief of benefits	BEN_3	Energy supply would become improved with the utilization of green technology
Belief of benefits	BEN_4	Employment opportunities will be increased with the installation of new green technology projects
Intention to adopt	INT_1	I have the intention to adopt green technology because I can afford it
Intention to adopt	INT_2	The use of green technologies and energy-saving behavior appeals to me because it is environmentally friendly, therefore I am willing to adopt it
Intention to adopt	INT_3	I have the intention to spend more on green technology applications in my daily life because it has a positive benefit on the environment
Intention to adopt	INT_4	I strongly recommend others to adopt and use green technology in their daily lives
Risk Perception	RSK_1	I believe that adoption of green technology such as solar panels in a home would come with a lot of safety risks.
Risk Perception	RSK_2	Adopting green technology is risky, as it may not always be reliable, for example solar panels may not always generate energy on cloudy days
Risk Perception	RSK_3	There is a risk, that the using green technologies, such as solar panels, can cause fires with electrical faults on roofs
Risk Perception	RSK_4	There is the risk that over time, green technologies will produce less benefits than expected, for example, solar water heaters not generating enough energy to heat water to a desired temperature and this bothers me
Aesthetics perception	AES_1	I believe that green technologies are unsightly (green renewable energy relating to solar panels and solar water heaters).
Aesthetics perception	AES_2	If I use Green technologies, such as solar panels on my house, it will decrease the value of my house because of its look
Aesthetics perception	AES_3	Green technologies such as solar panels are messy and require extra work to clean up
Aesthetics perception	AES_4	I would not use green technology because they make my space look unsightly.
Aesthetics perception	AES_5	The look of green technology applications such as solar panels and solar water heaters is unpleasant and will affect my decision to buy it
Ease of access perception	ACC_1	Green technologies are easy to access
Ease of access perception	ACC_2	I will adopt green technology even if it is difficult to access
Ease of access perception	ACC_3	Green technology can be employed and created by myself to some extent, even if it is difficult to obtain elsewhere
Ease of access perception	ACC_4	Green technology is easily available in South Africa
Social Norms	SOC_1	People I care about have adopted green technology
Social Norms	SOC_2	A lot of people who are important to me encourage me to adopt green technology
Social Norms	SOC_3	The use of green technology is increasing my individuals in my neighbourhood
Social Norms	SOC_4	People close to me believe that using green technologies will have a positive effect on the environment and aid in decreasing aspects affecting climate change

Table 13: Factor 1 Statistics

Reliability Statistics					
Cronbach's Alpha					
Cronbach's Alpha if Item Deleted					
Item	Scale Mean if Deleted	Scale Variance if Deleted	Corrected Item Total Correlation	Squared Multiple Correlation	Partial Correlation
RES_1	25.00	35.524	.635	.805	.884
RES_2	25.00	35.512	.687	.880	.885
RES_3	25.00	38.684	.787	.712	.884
RES_4	24.80	39.045	.685	.870	.887
RES_5	25.84	35.910	.684	.557	.885
RES_6	26.00	36.235	.702	.621	.885
RES_7	25.17	38.869	.688	.608	.887
RES_8	25.00	38.350	.719	.621	.887

Item-Total Statistics					
Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
RES_1	25.00	35.524	.635	.805	.884
RES_2	25.00	35.512	.687	.880	.885
RES_3	25.00	38.684	.787	.712	.884
RES_4	24.80	39.045	.685	.870	.887
RES_5	25.84	35.910	.684	.557	.885
RES_6	26.00	36.235	.702	.621	.885
RES_7	25.17	38.869	.688	.608	.887
RES_8	25.00	38.350	.719	.621	.887

Table 14: Factor 2 Statistics

Reliability Statistics					
Cronbach's Alpha					
Cronbach's Alpha if Item Deleted					
Item	Scale Mean if Deleted	Scale Variance if Deleted	Corrected Item Total Correlation	Squared Multiple Correlation	Partial Correlation
RES_1	8.50	12.620	.718	.622	.888
RES_2	8.71	12.445	.847	.667	.882
RES_3	8.62	12.092	.847	.719	.878
RES_4	8.80	12.075	.781	.628	.881
RES_5	8.88	12.682	.837	.728	.874

Table 15: Factor 3 Statistics

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Table 17: Factor 5 Statistics

Table 19: Factor 7 Statistics

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7.2 Informed Consent

Consent Form

Informed Consent

Title of project: Factors influencing the adoption of green technology by individual consumers in South Africa

You are invited to participate in a study being conducted by Rowenta Jainarain, MBA student of the University of Witswatersrand. The purpose of the study is to investigate the factors that influence the adoption of green technology by individual consumers in South Africa. Also, what is the most influencing factor that promotes the use of green technology by individual consumers. Participation should take approximately 10 minutes to complete.

Participation

Your participation in this survey is voluntary. You may refuse to take part in the research or exit the survey at any time without penalty. You may skip any question you do not wish to answer for any reason.

Benefits and Risks

You will receive no direct benefits from participating in this research study, however, your responses may help us learn more about the factors that influence the use or non-use of green technology by individual consumers in South Africa. There are no foreseeable risks involved in participating in this study. The possible risks or discomforts of the study are minimal. You may feel a little tired answering detailed survey questions.

Confidentiality

Your survey answers are completely confidential and no identifiers will be collected such as name, email address, IP address, user name/online.

Contact

If you have further questions or concerns about your rights as a participant in this study, contact the University Human Research Ethics Committee, (Non-Medical), telephone +27(0) 11 717 1408, email : hrec-medical.researchoffice@wits.ac.za

If you have questions concerning the study, contact the principal researcher, Miss Rowenta Jainarain on 0737915091 or by email at 2526425@students.wits.ac.za

ELECTRONIC CONSENT: Please select your choice below. You may print a copy of this consent form for your records. Clicking on the "Agree" button indicates that

You have read the above information

You voluntarily agree to participate

You are 18 years of age or older

Agree

Disagree

7.3 Ethical Clearance Certificate

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg



Wits Business School Ethics Committee

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

Ethics Clearance Certificate

Ethics protocol number: WBS/BA2526425/520

This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title Factors influencing the adoption of green technology by individual consumers in South Africa

Investigator / Researcher Miss Rowenta Jainarain

Nature of Project MBA (Research Article)

Decision of the Committee Approved, provided stakeholders and participants are guaranteed anonymity and confidentiality.

Issue Date of Certificate 25 09 2022

Expiry date Date of submission of the project / research report

Chairperson Prof Anthony Stacey
☎ +27 11 717 3587
☎ +27 82 880 4531
✉ anthony.stacey@wits.ac.za

A handwritten signature in black ink, appearing to read 'A Stacey', written over a horizontal line.

Declaration by Researcher

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

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

A handwritten signature in black ink, appearing to read 'Rowenta Jainarain', written over a horizontal line.

Signature

26/09/2022

Date:

7.4 Information Sheet

Participant Information Sheet



Dear Sir/Madam,

I am Rowenta Jainarain, currently studying towards my MBA at the University of Witswatersrand, Johannesburg. In partial fulfillment of my degree, under the supervision of Prof Diane Hildebrandt, I am required to conduct a research study and collect data through an online questionnaire/survey. The title of my research is "Factors that influence the use or non-use of Green Technology in Southern Africa." I would like to invite you to please participate in this study and complete this questionnaire/survey. The questionnaire should take about 10 minutes to complete.

For the purposes of this survey, green technology refers to green renewable energy in the form of solar panels (photovoltaic) and solar water heaters.

Completion of the questionnaire is completely voluntary and all responses shall remain confidential. I will be using an untraceable link for the questionnaire in order to guarantee anonymity. The research has been approved by the Ethics Council of the University of Witswatersrand. Should you wish to not continue with the survey, you may exit at any stage. If you have any questions during or after about this research, please feel free to contact me on the details listed below.

This study will be written up as a research report, which will be available online through the university library website. If you wish to receive a summary of this report, I will gladly provide a copy to you. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee.

By understanding the factors that influence or discourage the use of green technologies, we as a society can work together to decrease the impacts on the environment that are leading the destructive effects of climate change. Your participation is highly valued and would therefore be greatly appreciated. Thank you for choosing to participate and aligning South Africa to a greener and cleaner future.

Non-Medical), telephone +27(0) 11 717 1408,
email : hrecmedical.researchoffice@wits.ac.za
Researcher: Rowenta Jainarain, telephone 0737915091,
email : 2526452@students.wits.ac.za
Yours sincerely,
Rowenta Jainarain

7.5 Data Collection Instrument

Statement (green renewable energy relating to solar panels and solar water heaters)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	-2	-1	0	1	2
Awareness					
I have interacted with green technology resources in the past					
I know of different types of green technology that I can use in my daily life					
I am aware that green technology -based solutions are available in South Africa					
I am aware of the benefits of green technology utilization for the environment					
Self Efficacy					
I have the necessary information and knowledge to adopt green technology resources and methods if I wanted to					
I believe that I am able to use green technologies in my daily life if I want to as I have full control over my actions, (nothing prevents me from using green technologies)					
If I lack knowledge on green technology, I know what I can do to increase my knowledge					
I would not have difficulty in adopting green technology if I wanted to					
Environmental Concern					
I am concerned about the impact that factors such as pollution and “dirty” energy, (non renewable energy) made by individual citizens of South Africa has on the environment					
I am concerned about the impact that factors such as pollution and “dirty” energy, (non renewable energy) made by corporations of South Africa has on the environment					
I am concerned about climate change and the associated hazardous effects on the environment					
I am concerned that if we do not act now, our unsustainable actions that harm the resources of the earth, will cause long term damage to the environment					
Cost Perception					
The use of green technology may be costly, hence I prefer not to use it					
Green technologies are expensive and usually require a high initial installation cost, hence I prefer not to use it					
I would use green technology in my home if government offered a tax rebate, if I can demonstrate use					
Using green technologies creates high ongoing costs such as maintenance amongst other things, hence I prefer not to use it.					
Belief of benefits					
I believe that the utilization of green technology such as solar panels reduces carbon emissions and helps improve the energy structure of the country					
The utilization of green technology would improve public surroundings in terms of less pollution and less environmental impact					
Energy supply would become improved with the utilization of green technology					
Employment opportunities will be increased with the installation of new green technology projects					
Intention to adopt					
I have the intention to adopt green technology because I can afford it					
The use of green technologies and energy-saving behavior appeals to me because it is environmentally friendly, therefore I am willing to adopt it					
I have the intention to spend more on green technology applications in my daily life because it has a positive benefit on the environment					
I strongly recommend others to adopt and use green technology in their daily lives					
Risk Perception					
I believe that adoption of green technology such as solar panels in a home would come with a lot of safety risks.					
Adopting green technology is risky, as it may not always be reliable, for example solar panels may not always generate energy on cloudy days					
There is a risk, that the using green technologies, such as solar panels, can cause fires with electrical faults on roofs					
There is the risk that over time, green technologies will produce less benefits than expected, for example, solar water heaters not generating enough energy to heat water to a desired temperature and this bothers me					
Aesthetics perception					
I believe that green technologies are unsightly (green renewable energy relating to solar panels and solar water heaters).					
If I use Green technologies, such as solar panels on my house, it will decrease the value of my house because of its look					
Green technologies such as solar panels are messy and require extra work to clean up					
I would not use green technology because they make my space look unsightly.					
The look of green technology applications such as solar panels and solar water heaters is unpleasant and will affect my decision to buy it					
Ease of access perception					
Green technologies are easy to access					
I will adopt green technology even if it is difficult to access					
Green technology can be employed and created by myself to some extent, even if it is difficult to obtain elsewhere					
Green technology is easily available in South Africa					
Social Norms					
People I care about have adopted green technology					
A lot of people who are important to me encourage me to adopt green technology					
The use of green technology is increasing my individuals in my neighbourhood					
People close to me believe that using green technologies will have a positive effect on the environment and aid in decreasing aspects affecting climate change					

Personal Information							
Age group	18 - 25	26 - 30	31 -40	41 -50	51 - 60	60 +	Prefer not to Say
Gender	Male	Female	Non binary/third gender	Prefer not to Say			
Profession	Self employed	Business Owner	Private employee	Government employee	Student	Other	Prefer not to Say
Average Monthly Net Income ®	< 6 000	6 000 - 15000	16000-25000	26000-35000	36000-45000	>45000	Prefer not to Say
Education Level	High School	Diploma	Degree	Honours	Masters	PhD	Prefer not to Say
Province	KZN	EC	FS	WC	NC	MP	Prefer not to Say
	NW	LP	GT				