MOTIVES AND BARRIERS TO THE IMPLEMENTATION OF RENEWABLE ENERGY SOURCES IN SOUTH AFRICAN TERTIARY INSTITUTIONS

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ABSTRACT

Organisations face major challenges to address the exploitation of non-renewable resources and consider management considerations for dealing with climate change. Organisations have been pushed to play a part in their carbon footprints and in curbing climate change. Among these organisations are tertiary institutions that can greatly impact environmental sustainability and address carbon dioxide emissions by embarking on renewable energy technologies. Tertiary institutions play a major role in society by the provision of skilled labour and personnel that are equipped to deal with a range of advancements and challenges. The sustainability of these tertiary institutions has thus been called into question due to the impact they can bring to societies.

This research thus aims to identify the motives and barriers to renewable energy adoption in tertiary education institutions. To do this, a literature review was conducted to identify possible motives and barriers to renewable energy adoption. These were then compiled into a questionnaire that was sent to respondents of three different institutions. Respondents were then requested to give feedback on each of the motives and barriers. The respondents were also asked general questions found in literature that addressed the adoption of renewable energy technologies in tertiary institutions. The data was collected using the designed questionnaires. The respondents were able to articulate their perceived barriers and motives to the implementation of renewable energy technologies in tertiary institutions. Data analysis was done using thematic analysis.

The results showed that the barriers in the implementation of renewable energy technologies in tertiary institutions were: 'Cost to Install', 'Transition Process' and 'Government Policies'. The motives on why educational institutions need to embark on renewable energy projects were found to be 'Energy Independence', 'Cleaner Source of Energy' and 'Reduction in Carbon Emissions'. The cost of renewable energy technologies, the process of moving from the Eskom grid, and renewable energy policies that are ambiguous were some factors that were highlighted by respondents on why it is challenging to adopt renewable energies in tertiary institutions. On the other hand, the effects of load shedding currently being experienced in the country and the migration to cleaner sources of energy that cause less harm to the environment, are some of the drivers noted by respondents on why tertiary institutions need to embark on renewable energy technologies.

More emphasis needs to be put by stakeholders on tertiary institutions to migrate to cleaner sources of energy, and policies need to be put in place in order to promote institutions to adopt these types of energies. Governments and other role-players need to be visible at all times in addressing energy challenges in tertiary institutions in the wake of the recent load-shedding concerns that have been crippling South Africa.

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Table of Contents

Chapter 1 – Introduction

At the United Nations summit of September 2015, seventeen sustainability goals were voted in by world leaders to address the environmental and social issues being faced in the world (United Nations, 2015). One of the identified goals is goal number 7, which aims to address sustainable, reliable, clean, and affordable energy for all by 2030. Energy is seen as the leading contributor to climate change, with a combined total of 65% of greenhouse gas emissions (Aly, Moner-Girona, Szabó, Pedersen, and Jensen, 2019). This makes the reduction of carbon intensity an important objective in realising the long-term climate goals. Despite the widespread benefits of renewable energy (RE) technologies, widespread barriers inhibit their adoption in the developing world (Painuly, 2001).

In South Africa the year 2016 was one of the years in history that recorded high temperatures which fueled a major drought that was further exacerbated by one of the severest El Ninos ever recorded in History (Baudoin, Vogel, Nortje, and Naik, 2017). Looking at this, a need for change is evident. South Africa's government has formulated strategies in trying to address environmental stewardship with one of the strategies being National Strategy for Sustainable development and Action Plan (2011-2014) that seeks to address short, medium and long term goals for a sustainable environment, low carbon economy and curbing climate change.

Though Higher tertiary institutions in South Africa still lag behind in the implementation of cleaner sources of energy and hence managing their carbon foot prints, there are some institutions that have been taking strides in reducing their carbon footprints (Nhamo and Ntombela, 2014). This is evident through the work done by University of South Africa and Rhodes university that have come up with management strategies to curb greenhouse gas emissions. Nevertheless, there is still more work to be done on the ground in terms of new projects that can implemented (Nhamo and Ntombela, 2014).

Despite endeavours to promote the adoption of renewable energy in tertiary institutions, its adoption has remained fairly low hence a need to investigate the adoption of renewable energy in tertiary institutions (Jo, 2017). The drivers and barriers to renewable energy adoption by tertiary institutions in South Africa will be investigated in this paper using a qualitative methodology.

1.1 Background

The importance and relevance of energy efficacy and the need for alternative renewable energy (typically small hydro, biomass, wind and solar photovoltaic) options on consumers, for example, households and business entities, has been the focal point of many organisations in the 21st Century. Many industries and organisations were affected by Eskom's (a state-owned enterprise) power cuts in 2015 (Donnelly, 2015). Organisations are being affected by the unreliability in the energy supply, the rising cost of energy, the mounting concerns about the environmental impact on non-renewable energy, and the planet's diminishing fossil fuel energy resource reserves (Lange, 2011).

South Africa has a substantial amount of coal fields, leading to a very low production cost of electricity (Pegels, 2010). South Africa's dependence on fossil fuels has led to the resource being depleted at a faster rate than anticipated (Sekoai and Daramola, 2015). The low production cost of electricity is further coupled with the country's old power stations built between 1970 and 1980; hence, they have fully depreciated, leaving coal as the prime factor of electricity production (Pegels, 2010). In South Africa, coal is still the cheapest source of energy due to low production costs, but with an increasingly carbon-constrained world and the effects of climate change caused by global warming, South Africa needs to curb greenhouse gas emissions soon and decisively (Pegels, 2010). It has been established that the use of fossil fuels, for instance, natural gas and coal, contributes to the increase of greenhouse gases in the atmosphere, which contributes to global warming (Seinfeld and Pandis, 2016). This heightened greenhouse gas effect leads to greater amounts of radiative energy becoming absorbed in the earth's atmosphere, causing large amounts of heat to be trapped in the troposphere (Seinfeld and Pandis, 2016).

Many benefits have been realised when organisations replace fossil fuel technologies with renewable energy technologies (DeLlano-Paz, Calvo-Silvosa, Antelo, and Soares, 2015). Renewable energy technologies can be defined as "energy that is obtained from natural resources which can be cyclically replenished by nature" (Luthra, Kumar, Garg, and Haleem, 2015, page. 764).

Different scholars (Jo, 2017; Nhamo and Ntombela, 2014) have ascertained why many educational institutions will opt for the use of solar energy compared to other energy sources. The main reasons educational institutions are becoming more interested in using renewable energy is to lower carbon emissions and go green in their mandate to deliver sustainable energy

to their stakeholders (Jo, 2017). The desire to save money and the desire to cut carbon emissions are some of the reasons that have been mentioned (Letete, Mungwe, Guma, and Marquand, 2011). Solar energy has also been considered to have stable long-term financial savings. The use of solar energy at Harlington Community School in West London has dropped the energy costs for the school while increasing environmental awareness amongst staff and students (Rogers, 2005). As of 2016, the cheapest source of energy worldwide has been solar energy, with trends showing that the bigger or larger the solar system, the more money that is saved per kilowatt (Nield, 2016).

In undertaking renewable energy projects, there have been lots of resistance and opposition due to the fact that the benefits of having renewable energy installations have never been laid bare (Nasirov, 2016). Nasirov (2016) further states that the main concerns to public understanding are:

i. Lack of information regarding the financial benefits and ecological considerations.
ii. Insufficient awareness campaigns of renewable energy.
iii. Reservations with regards to the financial feasibility of renewable energy installation projects.

The South African government has embarked on steps to promote renewable energy and promote energy efficiency, but they come short in cutting down on emissions (Nhamo and Ntombela, 2014). The South African government came up with a National Strategy that looks at sustainable development to cut carbon emissions, climate change mitigation, and environmental sustainability (Nhamo and Ntombela, 2014). The Integrated Resource Plan (South Africa Department of Energy, 2011) further enhances such a drive for electricity generation.

1.2 South Africa's energy structure

Energy generation of the South African economy in 2016 was principally dominated by coal, which constituted an average of 69% of the total energy supplied, followed by crude oil with 14% and then renewable energy with 11% (Ratshomo and Nembahe, 2019). Both nuclear power and natural gas had 3% over the same period (Ratshomo and Nembahe, 2019). Ratshomo and Nebahe (2019) illustrate the energy structure of South Africa as depicted by the figure below.

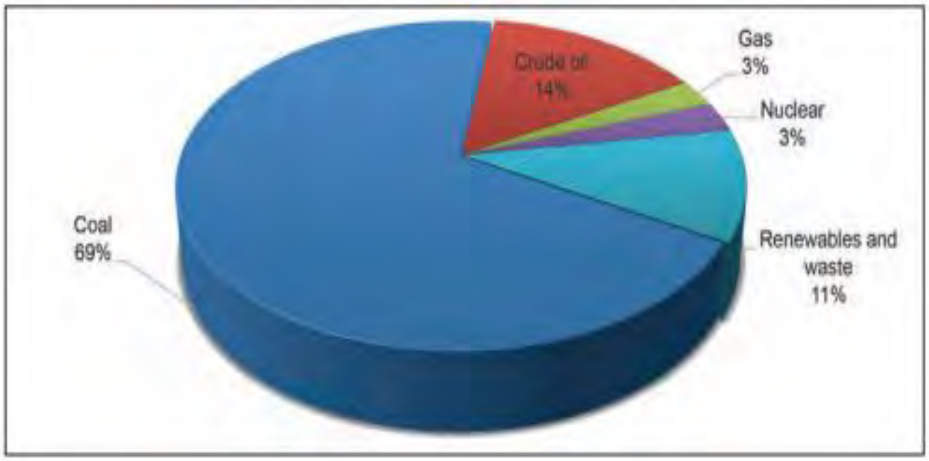


Figure 1: Total primary energy supply, 2016

The figure above shows that coal-powered stations still dominate the energy supply in South Africa. Some of the reasons that might be attributed to this are the country's shallow coal deposits, hence paving the way for easy and cheaper extraction (Ratshomo and Nembahe, 2019). The low cost of coal-generated electricity makes it a challenge for other sources of energy to be implemented (Ratshomo and Nembahe, 2019).

1.3 South Africa's renewable energy sources

Eskom has had the lion's share in the production of energy in South Africa, and pressure has been mounting on this state-owned enterprise since 2008 due to high energy demands from all over the country (Sekoai and Daramola, 2015). Critics have blamed Eskom senior executives for various reasons, including poor maintenance, inadequate long-term planning, inadequate investments, and poor corporate governance (Mannak, 2015). This is one of the motives why there is an emphasis on organisations and business bodies to embark on renewable energy technologies in South Africa (Sekoai and Daramola, 2015).

In 2014, the Department of Energy (2014) identified four types of renewable energies, mainly hydro-power, biofuel, wind power, and solar power. Hydropower is a renewable energy that uses primarily flowing water as a source of electricity generation (Solway, 2008). The disadvantages associated with this type of energy are its effects on the communities' perspective and that major human settlements and natural areas will be destroyed (Solway, 2008). Solar energy is the type of renewable energy harnessed from the sun and is available

almost everywhere (Zahedi, 2011). Solar energy also has minimal impacts on the environment compared to other sources of energy (Zahedi, 2011). Biofuel energy is the renewable energy that is derived from biomass, and this type of energy requires specialised equipment and facilities that use fossil fuels to run (Solway, 2008). Wind energy is a type of renewable energy that uses wind and has minimal running costs compared to other sources of energy (Saidur, Rahim, Islam, and Solangi, 2011). The past few years have seen the growth to generate electricity from wind energy gradually increasing. Wind energy has become the most economical new power plant technology, mainly because of no fuel costs, reduced installation costs, and can be constructed in less than a year (Jaber, 2013). But in the South African context, the cheapest source of renewable energy is concentrated solar power (CSP), which uses solar energy to produce electricity (Pegels, 2010).

Other forms of energy are becoming essential in the generation of electricity (Pegels, 2010). Alternative forms of energy will play a massive role in the future generation of electricity as these will address both climate change problems and energy security (Schellekens and Finlay, 2010). With concerted efforts, many benefits can be reaped in adopting renewable energy, such as increased security, energy and diversity, the creation of jobs, economic development, and environmental sustainability (Davidson and Winkler, 2003). Solar energy is the highest source of renewable energy in South Africa (Aliyu, Modu, and Tan, 2018). On the other hand, wind energy can also be harvested in South Africa due to the fact that the country has a wind regime of the westerlies in the northern and southern regions (Aliyu, Modu, and Tan, 2018). The wind speed can range from 7.29 to 9.70 m/s, making the country attractive for wind energy plants (Aliyu, Modu, and Tan, 2018).

1.4 Why this research was undertaken

Nations have used non-renewable energy sources profoundly in pursuit of increasing productivity while at the same time increasing unsustainable environmental costs and carbon dioxide (CO_2) emissions that lead to climate change (Aliyu, Modu, and Tan, 2018). This has led to an increase in the pursuit of environmentally friendly and cleaner energy sources, for instance, renewable energy sources (Aliyu et al., 2018). Climate change has brought about environmental challenges and negative sustainability outcomes in developed and developing countries (Aliyu et al., 2018).

Climate change and global warming have led to an increase in instability of the earth's climate, changes in the hydrological cycle, and the forecasted increase in droughts and unbearable heat waves (Allen, Macalady, Chenchouni, Bachelet, McDowell, Vennetier, Kitzberger, Rigling, Breshears, Hogg, and Gonzalez, 2010). Climate change has also caused the oceans to acidify, and changes in wind patterns and ocean currents have been noted (Allen et al., 2010; Pachauri, Allen, Barros, Broome, Cramer, Christ, Church, Clarke, Dahe, Dasgupta, and Dubash, 2014). High temperatures were recorded in South Africa in 2015 and 2016, which was also worsened by a major drought ever recorded due to the effects of one of the toughest El Nino's ever recorded (Baudoin, et al., 2017). In 2019, the South African weather service also noted that the average annual temperatures for that year were 1.1°C above the average annual temperatures from 1981 to 2010 (South African Weather Service, 2019). The report further states that in 2019, the West of South Africa received less than 50% of its annual rainfall, with no region receiving more than its normal amount of rainfall (South African Weather Service, 2019).

The establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988 gave rise to better assessments of greenhouse gas emissions' mitigation possibilities, and related costs thereof, in achieving those possibilities (Sathaye, Bouille, Biswas, Crabbe, Geng, Hallt, Imura, Michaelis, Peszko, and Verbruggen, 2001). A special report on renewable energy launched in 2008/2009 by the IPCC focused on the assessment of renewable energy potentials, and more importantly, energy sources as driving force behind the mitigation of climate change (Hohmeyer and Trittin, 2008). Mitigation is defined as "the effort to reduce loss of life and property by lessening the impact of disasters. In order for mitigation to be effective, we need to take action now before the next disaster to reduce human and financial consequences later" (Abdisalan, 2019, page. 3).

South Africa's dependence on generating electricity on coal-powered mechanisms is unsustainable and causes large-scale adverse effects on the environment (Blignaut, Koch, Riekert, Inglesi-Lotz, and Nkambule, 2011). This leads to climate change effects due to greenhouse gas emissions that are released into the atmosphere (Pachauri et al., 2014). The challenge of changing whole economies is enormous, especially for fossil fuel-dependent countries for energy generation, such as South Africa (Nhamo and Ntombela, 2014). However, with the world economies pushing for carbon awareness in all countries and South Africa already suffering from climate change impacts, the country is faced with enormous tasks of reducing greenhouse gas emissions decisively and speedily through renewable energy projects (Nhamo and Ntombela, 2014). The South African energy sector is an important division of the

country's economy but with most contributions to the problems of greenhouse gas emissions (Pachauri et al., 2014).

At a climate change summit held in South Africa in 2009, the South African government defined the plan to migrate towards a low carbon emission economy, but the role of tertiary institutions in managing and physically ensuring that they move to reducing their carbon emissions on their campuses was not outlined (Nhamo and Ntombela, 2014). Leaving such issues unexplained or unresolved in South African tertiary institutions will have a negative effect on South Africa as a country, making the migration to cleaner sources of energy difficult and challenging (Nhamo and Ntombela, 2014). For example, in the United Kingdom, higher tertiary institutions are expected to implement carbon management approaches to curb climate change and play a role in having greener economies and cleaner sources of energy (Visser, 2011). Globally, higher tertiary institutions are expected to play leading roles through training, research, education, and in the provision of solutions to mitigate the adverse effects of climate change in their day-to-day running (Atlan, 2010). To this end, higher educational institutions in Australia, the United Kingdom, and the United States of America are taking visible and decisive roles to reduce their greenhouse gas emissions through the implementation of cleaner sources of energy on their campuses (Atlan, 2010).

The risks associated with climate change are worsening daily (Allen et al., 2010), and it is our duty and responsibility to make sure that our tertiary institutions are not caught napping still using energy derived from fossil fuels as their major source of energy hence the migration to renewable energy (RE) technologies. It is a matter of time before regulators and governments put hefty carbon taxes on entities such as tertiary institutions due to their negative impact on the environment (Nhamo and Ntombela, 2014). Despite efforts to encourage the implementation of renewable energy technologies in South African tertiary institutions, their adoption has remained fairly low (Jo, 2017).

This study aims to propose the motives on why South African tertiary institutions could embark on renewable energy projects and the challenges these institutions could face if they decide to embark on such projects. The research will look at the issues of sustainability, specifically looking at the use of cleaner energies or sustainable energy generation measures within South African higher tertiary institutions. Renewable energy in the South African energy sector is a relatively untapped sector with lots of opportunities for the growth of entrepreneurial activity.

This study will be important in raising energy awareness of the South African tertiary institutions and looking at the sustainable growth of these institutions. The research will also benefit economic decision-makers and policymakers to prioritise the motives and barriers affecting the implementation of renewable energy technologies (Blechinger, Richter, and Renn, 2015).

1.5 Objectives of the research

The goals of this research are to pinpoint and describe the various barriers and motives towards the implementation of renewable energy in South African tertiary educational institutions with the main focus on Technical and Vocational Educational and Training colleges.

The sub-objectives of this research can be outlined as follows:

(i) Identify and discuss current and potential motives behind the adoption and implementation of RE related projects at higher educational institutions;

(ii) Identify and discuss the current and possible barriers to adopting and implementing RE-related projects at higher educational institutions;

(iii) Make recommendations for improved adoption and implementation of RE-related projects at higher educational institutions in Gauteng, SA.

1.6 The thesis outline

The research investigates the barriers and motives of South African tertiary institutions in implementing renewable energy with a focus on Gauteng institutions. The study will follow the following structure: Chapter 1 has the introduction and the background to the study. This chapter will also highlight some of the issues that will be addressed in the study. Chapter 2 will be the literature review chapter that will emphasise the motives and barriers of implementing renewable energy sources on South African organisations with a particular focus on higher tertiary institutions. This will be followed by Chapter 3, which will give an insight into the methodology on how the research was conducted and how the data was collected. Chapter 4 will contain findings and results with a focus on how the data was analysed. The researcher will also provide recommendations in this chapter. Chapter 5 will provide the discussion for

this study, looking at findings and literature. The conclusion of the research will be found in Chapter 6 with an overview of the study and giving insights for future studies.

Chapter 2 – Literature Review

Renewable energy can be defined as the energy that comes from a source that does not get used up and can be collected from many different sources that can be replenished in humanity's timescale (Gorjian, 2017). The sources of renewable energy include tides, solar, geothermal heat, waves, and wind (Gorjian, 2017). These forms of energy can be produced instantly and replaced at a swift rate through natural processes (Hasret, Kemal, and Mohamed, 2017). The availability of renewable energy is not affected by the rate of consumption, and thus their rate of being replenished is instant (Hasret, Kemal, and Mohamed, 2017). Renewable energy has been used to provide energy in many different areas, such as water cooling/heating and electricity generation, especially in remote rural areas and, most recently, in urban centres affected by power cuts (Gorjian, 2017).

Kariuki (2018) states that since the commencement of the 21st Century, scientists have contributed a lot to the study and research of renewable energies (Kariuki, 2018). However, despite scientists shedding light on the most convincing and practical technologies on renewable energies, the process of changing people's perspective or mindset from the traditional non-renewable sources to renewable energy sources has been predominantly slow, especially in developing countries (Kariuki, 2018). With the advent of load shedding, South African businesses have been affected by the power crisis over the past few years (Mannak, 2015). And with consumers and stakeholders looking at renewable energy as the best alternative source of energy (Sekoai and Daramola, 2015), tertiary institutions need to adapt and harness this new technology to meet stakeholders' expectations (Jo, Ilves, Barth, and Leszczynski, 2017).

This chapter will review general motives and barriers in implementing renewable energy (RE) technologies at a global as well as local level. There was minimal literature that addressed the motives and barriers in implementing renewable energy technologies in tertiary institutions, thus reviewing the general motives and barriers.

2.1 Barriers to renewable energy adoption

In layman's language or scope, a barrier can be seen as an obstacle or anything that prevents the passage of things from one point to another (Verbruggen, Fischedick, Moomaw, Weir, Nadai, Nilsson, Nyboer, and Sathaye, 2010). The IPCC (2007, p. 180) contextualised a barrier

concerning the study at hand as "an obstacle to reaching a goal, adaption or mitigation potential that can be overcome or attenuated by a policy, program or measure". Specific countries or districts can have certain barriers that are directly linked to them (Luthra et al., 2015). When looking at the implementation of renewable energy sources in different countries, it varies owing to diverse policies and political agendas, natural geography as well as economic states (Painuly, 2001). Barriers may also be pinned on a particular area, region, or technology (Mirza, Ahmad, Harijan, and Majeed, 2009).

Barriers can be classified as political and regulatory barriers, technical barriers, social-cultural barriers, financial and economic barriers, market-related barriers, and geographical and ecological barriers (Kariuki, 2018). De Jongh, Ghoorah, and Makina (2014) came up with the same categories for barriers in the implementation of renewable energy sources in the South African context. As such, this classification is used as a framework in comparing literature concerning the barriers to renewable energy adoption.

2.1.1 Political and Regulatory barriers

There are no clear-cut policies that favour the adoption of renewable energy technologies, and this poses a challenge to the adoption of these energies (Koua, Koffi, Gbaha, and Touré, 2015). Clear policies and regulatory mandates or procedures will increase the adoption of renewable energy since these will cause a buy-in from investors (Kariuki, 2018). This is because "enabling policies to create a stable and predictable investment environment, help overcome barriers and ensure predictable project revenue streams" (Kour, and Dar, 2013, p. 41). In addition to this, some regulatory measures and policies, for instance, codes and standards, promote the adoption of renewable energy technologies by lessening the regulatory and technological risks that are associated with investing in projects such as these (Lund, Werner, Wiltshire, Svendsen, Thorsen, Hvelplund, and Mathiesen, 2014).

But some countries do not have renewable energy technological policies solely because these kinds of technological developments remain in the advanced stages or are just in the infant's stage (Eleftheriadis and Anagnostopoulou, 2015). In their study on RE technologies in Sub-Saharan Africa, Mohammed et al. (2013) alluded to the fact that the region's many countries have distinctive national renewable energy policies; however, the regional implementation of these policies is difficult mainly because of the implementation approach that is not suitable,

or that does not favour the current prevailing environment. This goes to say that despite many RE policies developed in these countries, their adoption and implementation have remained very low because they are immature (Kariuki, 2018).

In addition, the adoption of renewable energy technology by the private sector in some African countries is hampered by the unavailability of policies that are well defined in regards to private investments, and the ever-increasing delays in giving authorisation of projects in the private sector (Eleftheriadis and Anagnostopoulou, 2015). Therefore, because huge RE projects need quite a substantial amount of capital injection to take off, the progress towards the implementation of renewable energy technologies by many countries is hindered by policy makers' inadequacy to come up with ways to lure private investors. (Lund et al., 2014).

South Africa's energy history is primarily dependent on low-cost coal in electricity production (Baker, Newell, and Phillips, 2014). This has proven to be a significant barrier to the adoption of renewable energy technologies (Baker, Newell, and Phillips, 2014). But over the past years' electricity prices have shot up drastically, and analysts have even projected that this will be the norm in the next coming few years (Khobai, Mugano, and Le Roux, 2017). Other countries such as South Korea and China have energy policies that encourage investors to tap into renewable energy technologies, while on the other hand, South Africa is seen to lag behind due to misaligned energy and environmental policies (de Jongh, Ghoorah and Makina, 2014; Walwyn and Brent, 2015). Even if the cost of renewable energies technologies has gone down in the past few years, South Africa's energy structure is still biased towards fossil fuels, leading to less attractive renewable energies (de Jongh, Ghoorah, and Makina, 2014; Walwyn and Brent, 2015).

Since renewable energy technologies are still fairly new in the market as energy supply platforms, they are usually not given proper attention than they should for installation in educational institutions (Nhamo and Ntombela, 2014). One of the reasons attributed to this is the lack of information concerning the applications and capabilities of renewable energy technologies (Nhamo and Ntombela, 2014). Nhamo and Ntombela (2014) state that one of the reasons this is so, is because of the reluctance of policymakers to move from the traditional practices that they have become accustomed to (Nhamo and Ntombela, 2014). They are at comfort with well-accepted and proven systems hence the reluctance to shift (Nhamo and Ntombela, 2014).

2.1.2 Technical barriers

Technical barriers to the implementation of renewable energy technologies include a lack of infrastructure as well as inadequate technology that will support RE technologies (Kariuki, 2018). Lack of infrastructure and inadequate technology can occur if the technology becomes outdated or if there is underperformance in the technology (Luthra, Kumar, Garg, and Haleem, 2015). But these new technologies are at a cost disadvantage compared to other sources of energy since they are still new in the market (Luthra et al., 2015). Technology was seen as one of the main hindrances to the adoption of wind-generated electricity from a study conducted in Canada (Luthra et al., 2015). These RE technologies will require skilled personnel to maintain, train, and operate, especially in areas where the level of education is low, and hence the lack of these skilled staff will cause investors to shun these technologies in fear of failure (Lund et al., 2014). The sheer high cost of these technologies will push investors of energy utility companies to go for coal-powered electricity-generated energy because of its low cost and availability (Kariuki, 2018). Coupled with this, some sub-Saharan countries lack physical facilities for the distribution and transmission networks in addition to the services and equipment required for energy companies (Eleftheriadis and Anagnostopoulou, 2015). Most of the equipment usually needs to be imported from developed countries since its usually not readily available in developing countries (Eleftheriadis and Anagnostopoulou, 2015). This leads to an imbalance of scale since most imported equipment is predominantly more expensive than the locally built equipment; hence the adoption of RE technologies becomes unaffordable (Kariuki, 2018). One of the RE technologies infrastructure barriers that have been stated by literature is the inadequacy connection to the already existing electrical grid (Aissa, Jebli, and Youssef, 2014). In such instances, energy is transported from the production station to the consumption stations in which so much energy loss is encountered (Eleftheriadis and Anagnostopoulou, 2015). This leads to investors losing confidence in RE technologies in fear of losing their investments (Kariuki, 2018).

Additionally, inadequate maintenance and servicing of structural equipment will affect customer confidence, which affects the adoption of RE technologies (Luthra et al., 2015). The availability of spare parts can also affect the servicing and maintenance of RE equipment since most of the parts will be imported (Kariuki, 2018). South Africa's inability to produce certain renewable energy technologies cheaply (e.g. wind turbines blades, concentrated solar panel equipment, solar panels) leads to an increase in the equipment cost that prevents investment in renewable energy technologies (de Jongh, Ghoorah and Makina, 2014).

Bennett (2008) argues that because of the limited manufacturing capabilities of the local plants, most of the renewable components in use in South Africa are imported. This is further compounded by the countries lack of research and development in renewable energy technologies due to Eskom's monopolistic tendencies of employing graduates that have been enrolled in energy faculties as well as supplying the lion's share of funds for research and development in the energy sector (Pegels, 2010). This leads to fossil fuel technology having some form of bias in relation to research and development (Pegels, 2010; de Jongh, Ghoorah, and Makina, 2014). Therefore, it is prudent to put measures and policies to increase funding towards innovation in the renewable energy sector and leverage this sector to be more competitive in relation to other industries in South Africa (de Jongh, Ghoorah and Makina, 2014).

A huge barrier that inhibits educational institutions from implementing renewable energy technologies is that the installation and maintenance staff will need to go for training in the use and maintenance of such systems (Jimenez and Lawand, 2000). Most of the people that deal which maintenance in such educational institutions don't have the experience and training to operate such kind of innovation (Jimenez and Lawand, 2000). While small renewable systems will need less training than the traditional energy systems, the training needs increase as the complexity of the system increases (Jimenez and Lawand, 2000).

2.1.3 Social-Cultural barriers

Social-cultural barriers, for instance, business entities or educational institutions unwilling to adopt RE technologies in fear of the unknown or unreliability, comprise some of the barriers that the society faces in developing countries adopting such technologies (Marshall, 2013). In some countries, the lack of awareness and knowledge on RE technologies, especially in rural areas, is another challenge faced in adopting RE technologies (Miller, and Spoolman, 2014). People are hardly unaware of the dangers fossil fuels have on the environment, and hence there is no push factor that drives them to embark on RE technologies (Alshehry and Belloumi, 2015). South Africa is on a different footing compared to other developing countries, since some communities have challenges affording the most basic cheap electricity (de Jongh, Ghoorah and Makina, 2014). There is also a limited amount of funding like grants and loans that can help these communities to access these energy sources in the South African environment (Msimanga and Sebitosi, 2014). The less fortunate of the population relies on

agriculture as a source of income which can also get affected due to changes in seasons and the effect of global warming (Mbuli, 2008). In the event of a bad harvest, these communities will not be able to afford any form of basic electricity due to their limited financial reserves (Mbuli, 2008). A vast proportion of rural schools in developing countries do not have access to simple amenities like toilets, lighting, or even running water; hence, these institutions find themselves on the bottom of the pecking order compared to the institutions located in urban areas. So when renewable energy technologies are being deployed, proper considerations are not given to these schools because of their location and cultural-historical background (Jimenez and Lawand, 2000).

2.1.4 Economic and Financial barriers

The preliminary cost of RE technologies is very high in comparison with the conventional energies causing the cost of renewable energy generation to be high (Eleftheriadis and Anagnostopoulou, 2015). Investors would love a scenario whereby the initial cost outlay of investment is low; hence if, for instance, this cost is high, they will tend to shun away (Kariuki, 2018). The overall production costs of renewable energy can be raised by the many transactional costs associated with this type of energy in the generation phase, which proves to be a barrier for most organisations (Mundaca, Mansoz, Neij, and Timilsina, 2013). Transactional costs can be referred to as the cost of time and resources that are required to set up an establishment and possible problems that the establishment would seek to solve (Mundaca, Mansoz, Neij, and Timilsina, 2013). It's a well-known factor that renewable energy developments are multidimensional in their establishment in comparison to coming up with a single fossil fuel plant (Ondraczek, 2013). This goes to say that more transactional costs are required in setting up RE technology plants because, whether the project is large or small, the procedures, activities, and products required are the same (Ondraczek, 2013). This poses a barrier to RE technologies installation since it becomes unaffordable to the producers and clients (Ondraczek, 2013).

One of the barriers that affect a country's adoption of RE technologies is the economic status of that country (Alshehry and Belloumi, 2015). For example, because of poor economic conditions in countries that are developing, especially in South Asia and Sub-Saharan Africa, some misrepresentation of RE technologies market has been seen (Alshehry and Belloumi, 2015). For instance, in Tanzania, rural communities earn low wages while the prices of solar

equipment are very high, making it unaffordable to some households (Richter, 2013). Insufficient credit facilities to purchase RE technologies can also be seen as one of the obstacles business entities or organisations face in pursuit of adopting these types of energies (Koua, Koffi, Gbaha, and Touré, 2015). A limited number of financial institutions are willing to offer credit facilities for loans to finance RE technologies initiatives (Koua, Koffi, Gbaha, and Touré, 2015). Exacerbating this is the subsidies that are given to fossil fuel energy initiatives by some governments that make renewable energy a difficult and/or expensive project to undertake (Stigka, Paravantis, and Mihalakakou, 2014).

In the South African context, the economic barriers in implementing renewable energy technologies are vast. They range from the initial high cost of investments, which deters investors, to having high financial leverage (Painuly, 2001; Pegels, 2010; de Jongh, Ghoorah and Makina, 2014). In addition to the high cost of solar energy equipment to set up solar farms in South African provinces with the most solar radiation, huge investments are required to set up transmission lines from those areas to consumer centres (Pegels, 2010). South African energy regulators can be tasked to construct these transmission lines, but due to financial constraints, thorough assessments are essential (Pegels, 2010). This then explains the main reasons why renewable energy technologies have not been explored to a large scale in the South African context (Pegels, 2010).

2.1.5 Market-related barriers

Market costs or prices for renewable energy technologies remain predominantly unaffordable and high to many clients, especially in developing countries (Mohammed, Mokhtar, Bashir, and Saidur, 2013). The main reason for this is that production costs for some RE technologies remain relatively high compared to other forms of energy, such as fossil fuels, leading to RE technologies market prices staying high (Mohammed, Mokhtar, Bashir, and Saidur, 2013). This is also true when investors choose to go for other energy sources that are available in the market that are heavily subsidised (Mohammed, Mokhtar, Bashir, and Saidur, 2013).

Other market-related factors that result in RE technologies being less competitive than other energy sources include the lack of well-tested or successful energy models to aid upcoming or small projects so that they are commercially viable (Stigka, Paravantis, and Mihalakakou, 2014). This is also characterised by the unavailability of the renewable energy market, with

prices that are always oscillating (Sen, and Ganguly, 2017). Most people or business entities, therefore, cannot afford these types of technologies because of their initial installation costs, which set their prices to be high (Sen, and Ganguly, 2017).

The current production cost of electricity using renewable energy technologies in South Africa is higher than fossil fuels due to initial investments required in renewable energy technologies (Nhamo and Ntombela, 2014). It becomes clear why renewable energy technologies have not been explored to full potential in South Africa because none of the technologies can compete with power stations that are coal-powered and that generate electricity at an average of EUR 0.03 per kWh (Pegels, 2010). Besides the existence of large coal fields, another reason for the low production price of electricity is that South Africa's most power stations were constructed between the period of 1970 to 1980 with very favourable exchange rates (Pegels, 2010). These have now fully depreciated, leaving only coal being one of the prime cost factors which will prove to be a considerable barrier to renewable energy adoption (Pegels, 2010).

The cost of renewable energy technologies has made some universities in the United Kingdom invest in such technologies at a slower rate than anticipated (Jimenez and Lawand, 2000). Renewable energies have several economic, environmental, and educational benefits for tertiary institutions, but it is a problem for some colleges or schools to get funding for such projects (Groenke, 2014).

2.1.6 Geographical barriers

The region's natural conditions and its geographic location can be a major barrier to the development of renewable energy (Kariuki, 2018). For instance, some countries or regions have sporadic solar exposure or where wind energy is irregular, causing limited renewable energy emitted (Zhang and Gallagher, 2016). This will affect the inhabitants of such regions for them to adopt RE technologies (Zhang and Gallagher, 2016). Stakeholders would need to think about the vast elements that affect RE technologies, for instance, hours during the day as well as the solar energy being emitted by the sun (Luthra et al., 2015). When a site inspection was carried out on Illinois State University for the erection of a solar plant, some buildings were found unsuitable due to the nature of the geographic area in which such building is located, whereby the aspect to the sun is limited (Jo, Ilves, Barth, and Leszczynski, 2017). A variety of geographical issues were accessed included the sun's intensity and the angle at which the rooftops are facing (Jo, Ilves, Barth, and Leszczynski, 2017). Some renewable facilities

may also be inaccessible due to terrain that can be difficult to access (Jordan-Korte, 2011). South Africa has got one of the best high solar radiation areas, with approximately 194,000 km^2, including the Northern Cape, which is considered to be one of the best places for solar projects in the world (Pegels, 2010). In the south African context, this saves as a motive for renewable energy adoption.

2.2 Motives to renewable energy adoption

A motive can be seen as a reason or an incentive on why something needs to happen or take place (Rakes and Dunn, 2010). As such concerning renewable energy, a motive can be described as a promoter or reason why tertiary institutions need to embark on renewable energy technologies. Literature sometimes uses words like drivers or potentials, or benefits in reference to motives (Pegels, 2010; Zahedi, 2011). In the context of this literature review, these terms have been used interchangeably (Verbruggen et al., 2010). Estimating the benefits of renewable energy is a complex task that demands a comprehensive understanding of different facets of natural resources by politics, human behaviour, economics, region, technology, etc., requiring the inputs of different expects (Laitner, John, Ehrhardt-Martinez, and Knight, 2009). Estimating any energy application needs an analysis of the required energy service and the total energy needed to satisfy the demand, which varies in relation to magnitude (Laitner et al., 2009). The major motives for the adoption of renewable energy by different organisations in the south African context relate to power outages or the energy crisis currently affecting the country coupled with the depletion of fossil fuel reserves as well as climate change awareness campaigns (Mezher, Dawelbait, and Abbas, 2012). Several factors promote the adoption of renewable energy sources that include geographical conditions and different energy policy hindrances that different countries have (Mezher, Dawelbait, and Abbas, 2012).

The literature addressing the motives for implementation is far less substantial than the literature that addressed the barriers to implementing renewable energy (Ahlborg and Hammar, 2014). Zahedi (2010) classifies the drivers for the implementation of renewable energy as social, political, technological, economic, and environmental motives (Zahedi, 2011). Hence these are the principles that this literature review is going to be based upon.

2.2.1 Social Motives

Organisations and businesses have been affected by climate change, and this has raised a lot of social awareness (Pachauri et al., 2014). The relationship between energy use and degradation of the environment caused by CO_2 emissions has led governments around the world to address environmental concerns (Haar and Theyel, 2006). Realising this shift, organisations have responded by coming up with products that will be both environmentally friendly and profitable (Bang, Ellinger, Hadjimarcou, and Traichal, 2000). The increasing knowledge of governmental and public programs on the damaging effects of fossil fuels in the production of energy has also led to the drive for organisations to adopt renewable energy technologies (Baker, 2015).

Renewable energy has often been mentioned that it contributes to the sustainable development of particular territories by offering them a wide range of socio-economic benefits; for instance, improved rural development initiatives, diversification of supply of energy as well the creation of employment opportunities (Rio and Burguillo, 2009). Vast employment opportunities have been created by renewable energy projects in developed countries (Devine-Wright, 2014). Communities and firms that have installed RE technologies can form partnerships in the event that the communities goal is to lower greenhouse gas emissions and be driven towards environmental sustainability (Devine- Wright, 2014). The socio-economic features of some countries prove to be suitable for reaping the rewards from RE technologies investments, for instance, populations that are dispersed, dependent on the failing agricultural sector, and very high levels of unemployment (Río and Burguillo, 2009).

The adoption of renewable energy technologies can aid in the provision of electricity to South African communities that have long been marginalised (Pegels, 2010). But the provision of electricity to such communities has been hampered by the slow progress of these technologies' adoption (Pegels, 2010). The South African government continues to have programs or initiatives that seek to provide electricity for all and with some initiatives aligned to the adoption of renewable energy technologies (Pegels, 2010).

The University of Birmingham City has identified the need for creating employment opportunities as well as promoting the universities brand as drivers on why they embarked on renewable energy technologies (Ernst and Young, 2012). Ernst and Young (2012), also state that one of the drivers on why there is a need to embark on renewable technologies as an institution is to achieve carbon neutrality because it relates to the University's objective of attaining corporate social responsibility goals. The University of Edinburgh's Professor Joan

Stringer states that the university's carbon footprint and environmental credentials have become a priority for the institution (Nhamo and Ntombela, 2014). This is because the ability to attract funding for the university and the university's reputation depends on how the university takes steps to address such issues (Nhamo and Ntombela, 2014).

2.2.2 Political Motives

Liberalisation of the energy sector is a mechanism that is used to create energy efficiency through the regulation of the market competition (Painuly, 2001). Examples of policies that can be used are to allow the private sector to enter the market economy and contribute to the production and distribution of electricity (Painuly, 2001). Policy planning and scoping should be based on the motives and potentials that have been well researched (Verbruggen et al., 2010). Another motive for renewable energy adoption is the tendency for the political leaders to move in line with the trends currently taking place in their institutional spheres (Masini and Menichetti, 2013).

In the South African context, mechanisms and different policies have been put in place to promote the renewable energy sector (Sebitosi and Pillay, 2008). Government policies that encourage RE technologies are characterised by price-setting policies that show the strategies the government of South Africa is willing to follow (Msimanga and Sebitosi, 2014). A decrease in the cost of investment policies that can lead to cheaper investments in RE technologies is one of the ways in which structured government policies can encourage RE (Msimanga and Sebitosi, 2014). The Talloiries Declaration, which is a carbon management strategy established in 1990 in France, puts emphasis on University leaders to incorporate sustainability in teaching, environmental literacy, outreach, and operations (Nhamo and Ntombela, 2014). In South Africa, five Universities, namely the University of the Western Cape (UWC), the University of Cape Town (UCT), Rhodes University, University of Witwatersrand, and University of KwaZulu-Natal (UKZN), become signatories to this declaration (Nhamo and Ntombela, 2014).

2.2.3 Technological Motives

The advancements in the technological sector have led to an improved output of solar panels, which in turn has helped to drive the costs down of installing renewable energy technologies

(Kabbara, 2018). The price of these panels is expected to continually decrease due to further improvements in solar cell technology and the storage mechanisms of solar power (Kabbara, 2018). The technical capabilities of RE technologies play a pivotal role in attracting investments compared to any policies that are in existence (Masini and Menichetti, 2013). This shows that for any investment to take place, technology has to be improved, and it has to be of top quality, while appropriate policies can then be used to align policies and markets (Masini and Menichetti, 2013). In the past 20 years, RE technologies have tremendously advanced, which has drastically lowered the costs of RE technologies giving rise to the adoption of these projects (de Jongh, Ghoorah and Makina, 2014; Walwyn and Brent, 2015).

Renewable energy technologies have proven that they are capable of producing the same power output that can be produced by fossil fuels while at the same time keeping the environment carbon-free (Walwyn and Brent, 2015). Walwyn and Brent (2015) give an insight on the reliability of RE technologies, which has increased over a period of time which in turn has attracted a lot of investors willing to invest in these kinds of technologies (Walwyn and Brent, 2015; de Jongh, Ghoorah and Makina, 2014). Reliability of the service and the improved quality of the power output, is another motive why power stations are implementing renewable energies (Zahedi, 2012). This is because renewable energy farms or power sources are now closer to load centres making it simpler to control the voltage (Zahedi, 2012). In South Africa, solar power and wind power are becoming more established compared to other forms of renewable energies, for instance, geothermal energy (de Jongh, Ghoorah, and Makina 2014). This has begun attracting several investors to invest in such renewable energy projects (de Jongh, Ghoorah, and Makina 2014).

Renewable energies will offer lower operating costs to educational institutions that decide to embark on them due to better advancement of the technology and improved power output (Jimenez and Lawand, 2000). This will provide future long-term benefits that, if fully taken advantage of, will prove to be a better technology in the provision of energy to tertiary institutions compared to other sources of energy (Jimenez and Lawand, 2000).

2.2.4 Economic Motives

One factor that has led many organisations to adopt renewable energy technologies has been its long-term growth capabilities that would attract many investors (Tate, Mbzibain, and Ali, 2012). Many government bodies globally have created initiatives as a means to aid

organisations financially so that they invest in RE technologies (Painuly, 2001). Initiatives that can be considered include credit facilities, tax exemption, provision of subsidies for installation as well as third-party financing (Painuly, 2001). When environmental externalities are considered regarding producing electricity using coal in the South African context, it can be seen that producing electricity using coal has suddenly become expensive compared to RE technologies (Walwyn and Brent, 2015). Power stations using renewable energy technologies will see the need to eliminate transmission lines as they will only be using distribution networks because they will be located closer to the buildings, hence cutting costs (Zahedi, 2012). The overall cost of RE technologies has decreased substantially over the past few years, and this trend is predicted to continue until the year 2030, which is the direct opposite of what is to be expected with fossil fuels like coal (Walwyn and Brent, 2015).

Executing financial measures efficiently can play a substantial part in lessening renewable energy initiatives and commercial costs (Halff, Sovacool, and Rozhon, 2014). Aspects that could lead to a reduction in cost in business include capital costs (in the form of subsidies that promote sustainable energy solutions), reduction of operating costs (in the form of tax credits), the improvement of revenue due to financial support obtained through guarantees, loans, and tax credits (Halff, Sovacool and Rozhon, 2014).

Renewable energy technologies play a vital role in schools (Jimenez and Lawand, 2000). Schools can be vital sites for the erection of renewable energy technologies due to higher fossil fuel energy costs compared to the low operating costs of renewable energy technologies (Jimenez and Lawand, 2000). Educational institutions can also find themselves lowering their energy bill and saving a substantial amount of money if they embark on technologies that are friendly to the environment, such as renewable energy as their prime source of energy (Kats, 2006).

2.2.5 Environmental Motives

An environmental motive or driver can be described as an element that has an effect on biodiversity (Globio, 2015). These drives are sometimes referred to as direct drivers, and they influence ecosystems in different ways (Millennium Ecosystem Assessment, 2005). Examples of drivers that directly impact the ecosystems include habitat change, overexploitation, pollution, climate change, and invasive species (Millennium Ecosystem Assessment, 2005).

Mitigation of carbon gases is another environmental driver that has been promoted extensively by different organisations (Zahedi, 2012).To minimise the effects of greenhouse gases and CO_2 in the acceleration of global warming, business and organisations have opted to use renewable energy and at the same time solve power outages that are currently affecting the country (Mezher, Dawelbait and Abbas, 2012).

The challenge of changing whole economies is enormous, especially for countries that are fossil dependent for energy generation, such as South Africa (Nhamo and Ntombela, 2014). However, with the world economies pushing for carbon awareness in all countries and South Africa already suffering from climate change impacts, the country is faced with enormous tasks of reducing greenhouse gas emissions decisively and speedily through renewable energy projects (Nhamo and Ntombela, 2014). The South African energy sector is an important division of the country's economy but with most contributions to the problems of greenhouse gas emissions (Pachauri et al., 2014). Though South Africa's contribution towards global emissions is still low with about 1,1% in 2005, its per capita emission rate which is in the range of about 8 to 9 tonnes CO_2 emissions per person in the same year was over the world's average that had an average of 5.8 tonnes per person and also more than six times higher than the sub-Saharan average (Pegels, 2010).

When tertiary institutions embark on cleaner sources of energy, it means CO_2 emissions will be lower due to the non-burning of fossil fuels that causes extensive damage to the environment and human health (Kats, 2006). With institutions embarking on renewable energy technologies, approximately 585 000 pounds of CO_2 will be reduced annually (Kats, 2006). In a school setup, renewable energy technologies offer reduced pollution to the environment as well less CO_2 emissions compared to energy derived from fossil fuels (Jimenez and Lawand, 2000). If a university is capable of decreasing its carbon footprint, then it will be able to bring down its day-to-day running cost and thus forecast the university's future cost (Nhamo and Ntombela, 2014). Birmingham City University, in its 2012 report, argues that there are potential opportunities and financial opportunities in capping carbon emissions by the education sector (Nhamo and Ntombela, 2014).

2.3 Underpinning theory

In the pursuit to mobilise the resources and processes for the adoption of clean energy in tertiary academic institutions, the premised theory that can be used is the Resource-Based Theory and the Natural Resource-Based View Theory (NRBV). According to the Resource-Based Theory, an organisation's capability to grow and expand is anchored on the organisation's capabilities and resources that are unique, valuable, and not easily substituted (Barney, 1991; Wernerfelt, 1984). Hence the growth and survival of any organisation can be attributed to the acquisition and efficient use of resources (Schroeder, Bates and Junttila, 2002). Undeniably, in the pursuit of sustainability, organisations have reformed the manner in which they view their processes, business models, technologies, and products (Nidumolu, Prahalad, and Rangaswami, 2015). The adoption of renewable energy by organisations is not necessarily influenced in the same manner in which other types of innovations influence organisations (Nameroff, Garant, & Albert, 2004). For an organisation to have a competitive advantage compared to other organisations, certain specific internal features must be considered as well as external factors that emanate from social, environmental, as well as market factors (Del Rio Gonzalez, 2009). Hart (1995) suggested that the current resource-based theory omitted a serious factor in that as much as it addressed a wide spread of the firm's potential resources in efforts to address that firm's competitive advantage, it omitted how the firm and the natural environment interact. The natural environment could create a huge obstacle for the firm in its efforts to create a competitive advantage (Hart, 1995). This gave rise to the establishment of the NRBV theory (Hart, 1995).

The premise of the NRBV theory is anchored on the firm's relationship with its natural resources (Hart, 1995). Three key strategic capabilities are addressed by the NRBV, and these are product stewardship, pollution prevention, and sustainable development (Hart, 1995). Each of these contributes differently to environmental stewardship with varying sources of competitive advantage and with different key resources being used (Hart, 1995). Hart (1995) proposes that while product stewardship and pollution prevention may lead to greater environmental stewardship, addressing the problem of global sustainability will need organisations to reduce energy consumption as well as reduce the harmful material used in the production of energy in developed countries while markets are being established in the developing countries. This led to the evolution of the NRBV theory, with Hart and Dowell

(2011) emphasising the need for firms to integrate clean technologies in the pursuit of competitive advantage. Strategies that can be used in pursuit of clean technology look at the way in which organisations form new competencies and place themselves for competitive advantage while they evolve (Hart and Dowell, 2011). Hart and Dowell (2011) go on to note that under NRBV, firms can pursue clean technologies that cater for the needs of human beings without putting pressure or strain on the planet's resources. In relation to NRBV, the main clean technology concerns seek to understand which company resources and capabilities can be linked with effective clean technology undertaking (Hart and Dowell, 2011). This involves two aspects of NRBV to look at, firstly the firms focus on investing in innovation that looks at clean technologies following the work of (Hart 1995, 1997, 2007; Schmidheiny and Zorraquin, 1998), and secondly, the firm developing capabilities that are able to deal with the knowledge that is constantly evolving and very complex (Aragon-Correa and Sharma, 2003; Hart and Sharma, 2004). The NRBV is used as the underpinning factor of the relationship between renewable energy utilisation and the organisation's performance, as well as assessing strategic advantages of the firm's corporate social responsibility development (Escobar and Vredenburg, 2011).

2.4 Chapter summary

The chapter looked at the barriers and motives for renewable energy adoption in general as well as in tetiary institutions. Literature provided 6 barriers that related to the adoption of renewable energy and these barriers were political and regulatory barriers, technical barriers, social-cultural barriers, financial and economic barriers, market-related barriers, and geographical and ecological barriers. Literature went on to provide the following motives for renewable energy adoption by tertiary intistutions: social, political, technological, economic, and environmental motives. Chapter 3 highlights the processes that were done in the research in relation to how data was collected and how it was analysed.

Chapter 3 – Methodology

This chapter gives the details of how data was collected and analysed by the researcher as well as the methods and procedures that were done during the research. This is of importance to ascertain the usefulness and validity of the research results. The matters addressed include data collection methods, data analysis methods as well as data validity and reliability.

3.1 Aims and Objectives of the research

This study aims to contribute and give insight into issues that are affecting South African tertiary institutions. The study sought to address reasons why tertiary institutions need to implement renewable technologies on their campuses, as well as challenges the institutions might face in the implementation of such technologies with a focus on Technical and Vocational Educational and Training colleges.

The sub-objectives of this research can be outlined as follow:

i. Identify and discuss the current and possible barriers to adopting and implementing renewable energy technologies-related projects at tertiary institutions.
ii. Identify and discuss current and potential motives behind the adoption and implementation of renewable energy technologies-related projects at tertiary institutions.
iii. Make recommendations for improved adoption and implementation of RE-related projects at tertiary institutions.

3.2 Research Paradigm

The paradigm for this research is post-positivism (Guba and Lincoln, 1994). This view is based on the "posture of proponents that claims about reality must be subjected to the widest possible critical examination to facilitate apprehending reality as closely as possible" (Guba and Lincoln, 1994, p. 110). Post-positivism can be interpreted as the deferred accomplishment of logical positivism acknowledged subordination of viewpoint to science, the admittance of epistemology (Zammito, 2004). This goes to say that the post-positivism paradigm concedes that the researcher strives to be as neutral as ever, and with acknowledging the researcher's own

biases, an idea of having an objective outcome can be accomplished as closely as possible (Guba, 1990).

3.3 Research method

The qualitative research method was mainly used for this research, although some quantitative questions were included in the questionnaire. Qualitative research is used to explore the potential backgrounds and factors of which little has been explored and known (Strauss & Corbin, 1998).

Three tertiary institutions were sampled due to their geographical location in the province of Gauteng. For the sake of anonymity, the three institutions were labelled as Institution 1, Institution 2, and Institution 3. Some of these institutions had more than one campus participating in the research, and the number of academic campuses in this study totalled five. For anonymity, these five campuses (from three different institutions) are labelled as Campus A, Campus B, Campus C, Campus D and Campus E. Campus A and Campus B are from Institution 1, Campus C and Campus D are from Institution 2, and lastly, Campus 3 falls under Institution 3.

3.4 Data collection and sampling method

The sampling method used is the purposive sampling technique. The purposive sampling technique is a type of non-probability sampling used when one needs knowledgeable experts within an entity to study a certain cultural domain (Tongco, 2007). Purposive sampling is central to the quality of data gathered; hence reliability and proficiency of the informants/respondents must be ensured (Tongco, 2007). This sampling method is very effective when exploring circumstances where the discovery of meaning can be of use when one is looking at it from an intuitive approach (Bridges and Lau 2006). Through the sustained practice of methods, the researcher will learn how to select the candidates wisely and efficiently and to be able to ascertain the level of analysis needed to address certain objectives (Bernard 2002).

The respondents selected to participate in this research hold prominent positions in the institutions they are attached to, or their line of work coincided with the infrastructure development of the institution. Also, some of the respondents selected had prior knowledge about renewable energy technologies; hence they were deemed suitable to participate in the

research. The total number of respondents that took part was 30. There were five to eight respondents per institution. The interviewed personnel included college principals, college vice principals, human resources personnel, maintenance heads, lecturers, buyer or storemen, institution board representatives, and information technology technicians. As already mentioned, these were selected due to their proximity or knowledge on the subject of renewable energies or due to the type of work they do.

Each campus provided different personnel in responding to the interview given, and the job title of each person is given a code as in the following Table 1.

CODE	JOB TITLE	NUMBER OF RESPONDENTS
1	Principals	2
2	Deputy principals	3
3	Finance Heads	2
4	Human Resources	2
5	Maintenance Heads	3
6	Lecturers	10
7	Buyer/ Storeman	1
8	Institution board	2
9	IT technicians	2
10	Other	3
TOTAL		**30**

Table 1: Campus personnel who took part in the research

To provide anonymity to participants, they were numbered and named according to the above codes. For example, Respondent A1 will refer to the principal of Campus A and B1 will refer to the principal of Campus B. This applies to all the other campuses.

Data was collected using questionnaires. Questionnaires have been widely used in qualitative research methods in collecting data (McLeod, 2018). Questionnaires offer an efficient, cheap and quick method of getting a substantial amount of information from a large sample of people.

(Rowley, 2014). Some aspects of the quantitative research methods were also used in this research in the form of Likert scales and frequency tables. Likert scale questions were included in the questionnaire to derive a better understanding of the respondent's perceptions of RE technologies. The Likert scale makes it possible to evaluate a certain qualitative features through responding to certain questions posed in the questionnaire (Foryś and Gaca, 2016). Likert scale offers an unsophisticated scale for evaluation (Joshi, Kale, Chandel, and Pal, 2015) and the ability to quantify the strength of the respondent's answers, and they are very effective (Joshi, Kale, Chandel, and Pal, 2015). They also provide an easily understood and predictable scale in which services and products are evaluated (Joshi, Kale, Chandel, and Pal, 2015). Frequency tables compress and summarize different data by grouping the data into different classes (Foryś and Gaca, 2016)..

The questionnaire developed is included in Appendix 1. These were sent by email to the respondent's sample, but some requested that the researcher come to the institution and administer these questionnaires face-to-face. Considerations were given to Covid 19 concerns, such as putting on masks, sanitising, and adhering to social distance. Some questionnaires were not fully completed hence follow-up questions were posed telephonically. Respondents were given room to elaborate on some issues not listed on the questionnaires.

3.5 Data analyses

Data analysis was done through the framework analysis where stages such as identifying a thematic framework, coding, charting, and interpretation was carried out (Sutton, 2015). Thematic analysis was used due to its inherent nature of illustrating data in great detail and dealing with various themes through interpretations (Boyatzis, 1998). Thematic analysis is seen as the most appropriate for any research that aims at discovering matters using interpretations (Boyatzis, 1998). It gives the researcher an allowance to associate analysis of the frequency of a given theme with the whole content. This will lead to the accuracy and intricacy of the research and enrich the researcher's final output (Marks and Yardley 2004). Namey et al. (2008, page. 138) mentioned that "thematic analysis goes beyond counting explicit words or phrases and focuses on identifying and describing both implicit and explicit ideas. Codes developed for ideas or themes are then applied or linked to raw data as summary markers for later analysis, which may include comparing the relative frequencies of themes or topics within a data set,

looking for code co-occurrence, or graphically displaying code relationships". The following codes were identified in the questionnaires and were used in the analysis of data:

Codes that relate to Climate Change	Codes that relate to the nature of Energy	Codes that relate to Cost	Other Codes picked up
• Carbon Emissions • Greenhouse gases • Climate change	• Cleaner Energy • Cheaper Energy • Energy independence • Low risk of renewable energy technologies • Lack of Information of renewable energy technologies • Lack of incentives for renewable energy technologies • Uncertainties About renewable energy technologies	• Solar panels cost • Wind Energy Cost • Initial Cost Outlay • Cost to install • Price of electricity • Expensive Equipment • Buying of renewable energy technologies • Financial risk	• Location of colleges • Transition Process • Eskom-Load Shedding • Lack of Policy • Changing to renewable energy technologies • Knowledge of RE

Table 2 Codes derived from questionnaires

The analysis of data showed the comparison of all five campuses and the prevalent barriers and motives per each campus.

3.6 Ethical considerations

The researcher was not part of any of the 3 institutions that were surveyed in the research, nor did the researcher have any personal interest whatsoever in any of the institutions that took part in the research. Consent and ethical clearance letters were obtained from the participating institutions to guard against unethical practices. The university gave ethical clearance for the research to be conducted, and the participating institutions also gave consent letters allowing the researcher to conduct the study. An institution consent form (see Appendix 2) was used to obtain each institution's consent in the research after obtaining ethical clearance from Rhodes University's ethics committee. The ethical considerations that the researcher considered were obtaining permission. The identity of the respondents that took part in the research will not be revealed. The institution names will not be revealed during data analysis; hence it won't be possible to view any institutional response.

3.7 Research credibility

To ensure that the research was credible, dependability and realibilty were considered. Chapter 2 formed the theoretical basis of the development of the questionnaire that was used in data collection. This goes to say that the barriers and motives found on the questionnaire came from literature. Also, people with influential positions or who had job titles that were aligned to the research topic took part in this research. The participants took part on their own accord, and no one was coerced to be part of the research. Nothing was amended in the completed questionnaire by the researcher during data analysis; hence the responses are the original responses from the respondents. The researcher made sure to engage with the data as much as possible and intensely to derive links between the data and the analyses derived. Consistent deliberations were held and amendments were made in line with recommendations and suggestions.

3.8 Chapter summary

The chapter looked at the ways in which data was collected and analysed. Data analysis was done by identifying certain codes that were embedded in the data collected so as to derive meaningful analyses. The chapter further expounded on the ethical issues that were considered during data collection as well as how the data collected remained relevant to the research at hand. Chapter 4 looks at the findings that came out from the data collected and what these findings ascertain.

Chapter 4 – Findings

The results and findings of each campus are analysed in this chapter. From the data that was derived from the institutions, most respondents strongly agreed that renewable energy technologies are too costly to install coupled with the high maintenance of these technologies once installed. This is also evident in respondent A1's response when the participant strongly agreed to the statement that '*The cost to install renewable energy technologies is a hindrance to most institutions'*. Respondent A1 stated:

"I strongly agree because most institutions require capital investments in order to install renewable energy as it may be costly to them, however without investments the institutions may not be able to build and install the renewable energy technologies.

This is further compounded by Respondent B2, who responds to the same question and states that

"Due to the current pandemic, institutions budgets are currently stretched hence it's expensive to install renewable energy to the college"

Frequency tables were also used to derive a better meaning in the data collected. The barriers to renewable energy adoption were ranked in order of importance (see Appendix 1), with 1 being the *most important* barrier and 5 being the *least important* barrier. The barriers that were listed in the questionnaire as identified by literature in Chapter 2 (section 2.1) were 'Cost to Install', 'Risk of Renewable Energy Technologies', 'Geographic Location', 'Government Policies', and 'The Transition Process'.

4.1 Results on the barriers to renewable energy adoption

Five possible barriers ('Cost to Install', 'Risk of Renewable Energy Technologies', 'Geographic Location', 'Government Policies' and 'The Transition Process') came out vividly from literature (as discussed in Chapter 2, Section 2.1), and these barriers were included in the questionnaire to investigate their relevance for these local institutions. The barriers to renewable energy were ranked in the order of importance, with '1' being the most important barrier and '5' being the least important barrier. If a barrier was given a rank of '1', it meant that the respondent strongly agrees that the highlighted barrier can be said to be a significant

hindrance in the adoption of RE technologies. The order in which the barriers were ranked is shown in the table below.

Rank	Barrier Strength (Most Important to Least Important)
1	Strongly Agree
2	Agree
3	Disagree
4	Strongly Disagree
5	Don't Know

Table 3 Barrier weightings

Figure 2 below shows the response of all five campuses whereby the most important barrier recorded by all the five campuses is the 'Cost to Install' the RE technologies while the least recorded barrier is the 'Risk' associated with renewable energy. This is further compounded by Respondent B1's response who stated:

"The procurement of conversion material and equipment is a financial challenge as well as reaching the breakeven point that might take time to reach".

Respondent C9 further stated:

"I do not foresee risk but only a financial challenge to kick start the project".

Each Campus's perceived barriers are outlined below, in Figure 2.

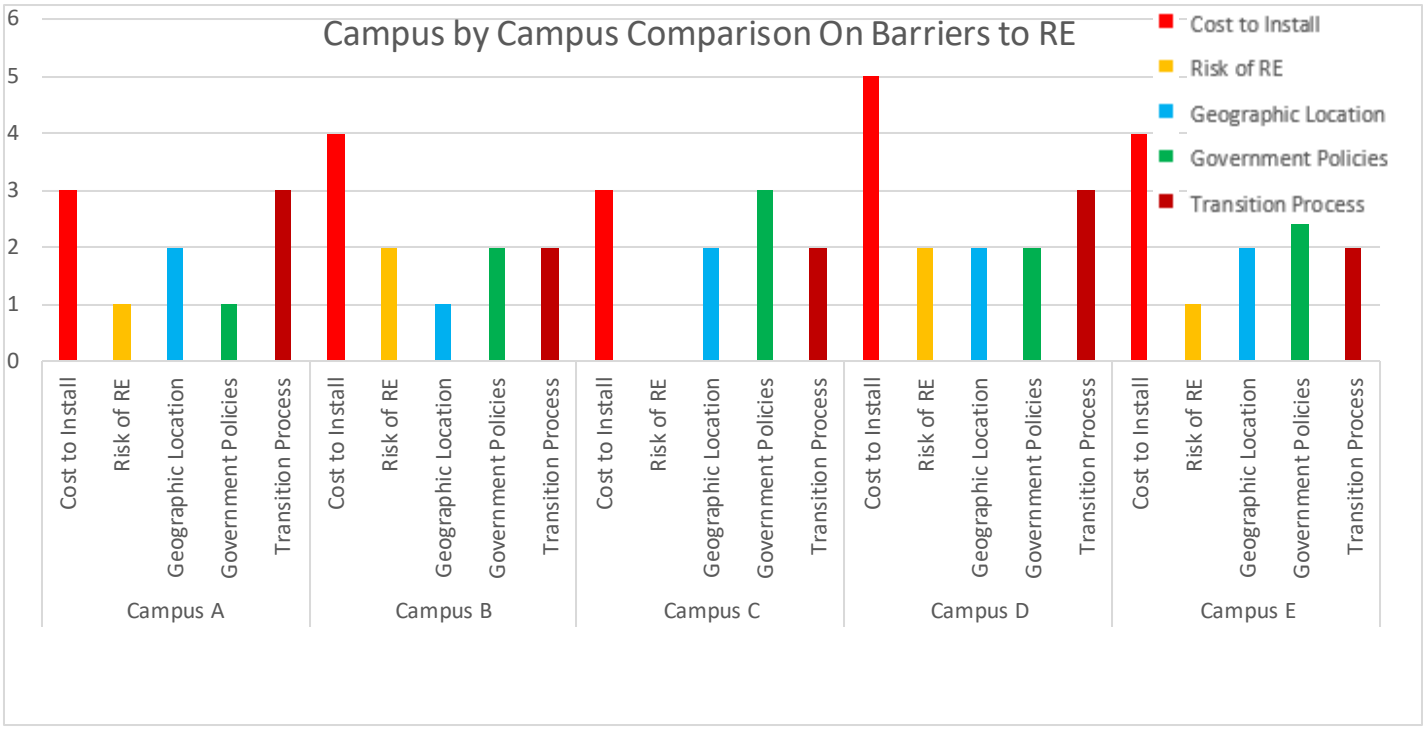


Figure 2: Frequency distribution bar graph: Campus by Campus Barriers to Renewable Energy Adoption Comparison

The figure above shows the perceived barriers of the five campuses in the implementation of renewable energy technologies. A campus-by-campus comparison of the barriers that are affecting individual campuses is discussed below.

4.1.1 Campus A barriers to adoption of RE technologies

Results for this campus, on the perceived barriers, are visually presented in Figure 3. The responses from Campus A showed that respondents are more concerned about the 'Cost to Install' as well as the 'Transition Process' from the Eskom grid to the RE technologies.

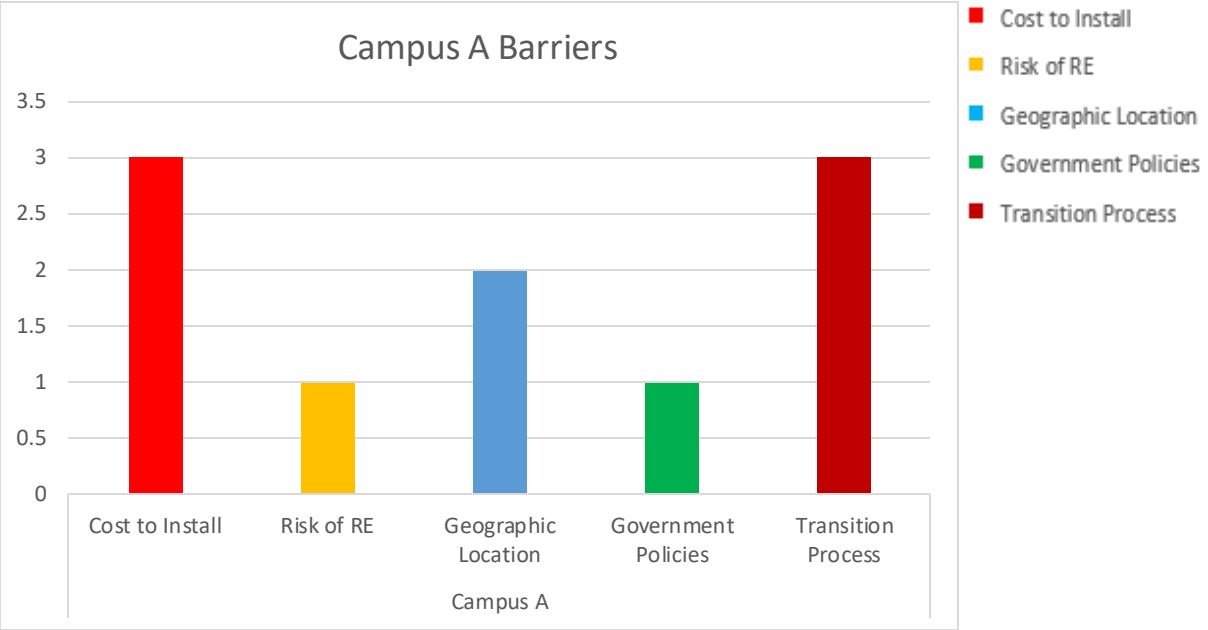


Figure 3: Frequency distribution bar graph: Campus A Barriers

These findings are further supported by statements from the respondents and highlighted by the following quotes. The 'Transition Process' can be seen as a barrier shown by Respondent A5's response who stated that:

"*The process is complex because if we are to install solar energy, for example, we will have to first of all purchase solar panels. Secondly, we will have to look for the location on the buildings where these panels would be installed and lastly look for competent technicians who can do the installation and do the switching from Eskom*".

Respondent A6 further alludes that:

"There isn't much technology and information available about renewable energy making it difficult for the institution to embark on renewable energy technologies".

'Geographic Location' is not a problem looking at Respondent A6's response which stated that

"*My institution is located where there is enough sunlight that can be used to power solar panels".*

Minimal risks associated with RE technologies were recorded in Campus A. This data comes from questions 3 and 4 of the questionnaire.

4.1.2 Campus B Barriers to the adoption of RE technologies

Results for this campus, on the perceived barriers, are visually presented in Figure 4. This data comes from questions 3 and 4 of the questionnaire. The responses from Campus B show that the most significant barrier in the adoption of RE technologies is the 'Cost to Install'.

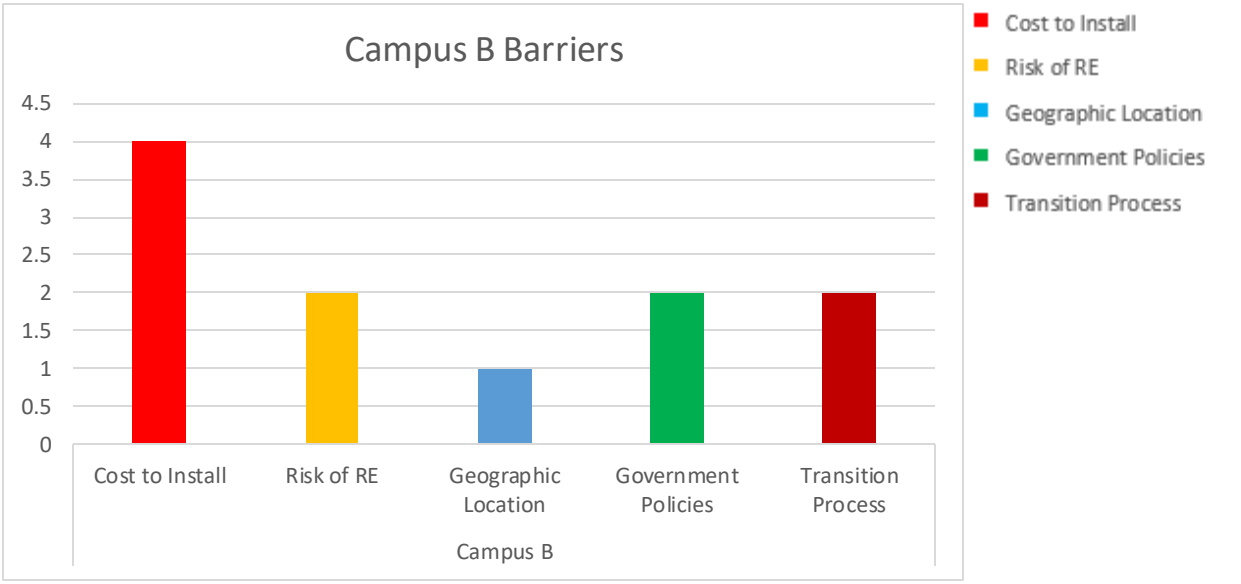


Figure 4: Frequency distribution bar graph: Campus B Barriers

Respondent B5 further stated that:

"the equipment for setting up a renewable energy plant is usually expensive and small academic institutions cannot afford it. My institution may have challenges in installing equipment for all its campuses".

Unlike in Campus A, the least significant barrier stated for this campus in the adoption of RE technologies is the 'Geographic Location'. Respondent B5 stated that:

"where my institution is located there is enough sunlight that can be used to power solar panels".

4.1.3 Campus C Barriers to adoption of RE technologies

Results for this campus on the perceived barriers are visually presented in Figure 5. This data comes from questions 3 and 5 of the questionnaire. Unlike Campus A and Campus B, the 'Cost to Install' and 'Government Policies' are the barriers that have been identified as a hindrance in the adoption of renewable energy technologies.

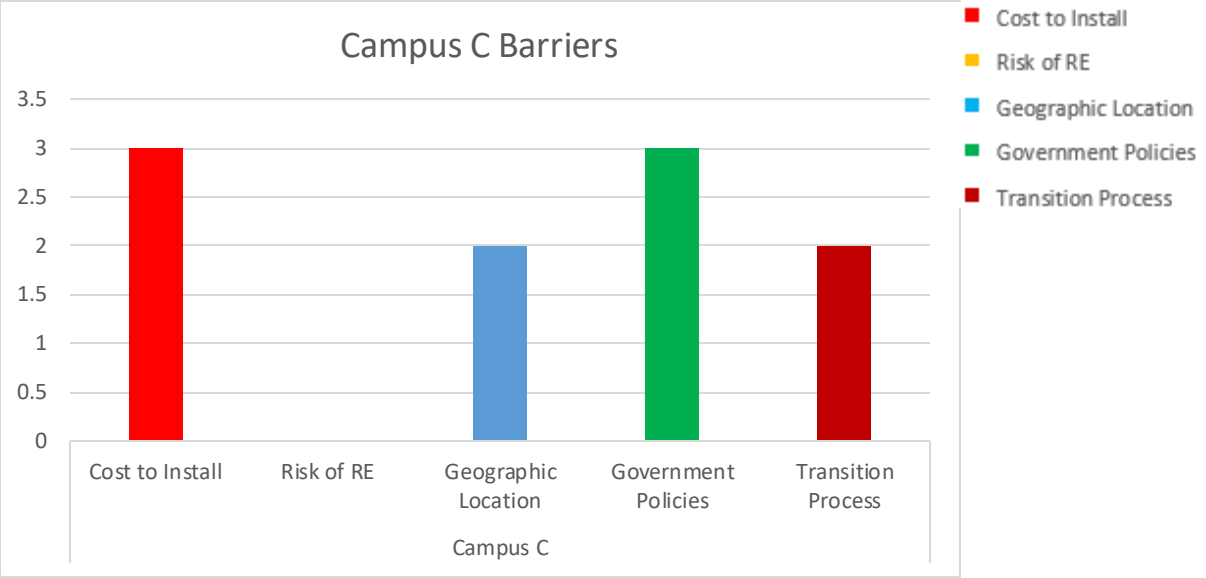


Figure 5: Frequency distribution bar graph: Campus C Barriers

Participants have stated that the high cost to find raw materials as well their transportation are some of the hindrances or barriers that have led to the institution not embarking on RE technologies. 'Government Policies' have also been noted as barriers to the implementation of renewable energy technologies as participants have highlighted the lack of incentives or policies that would promote the adoption of RE technologies. Respondent C7 notes that:

"If the South African government can come up with policies that will favour the adoption of renewable energy, it will make it easy and cheap."

A case to note on Campus C is the fact that participants have interestingly noted that there are no risks associated with the installation or adoption of RE technologies. This is further compounded by Respondent C4's response who stated that:

"There are absolutely no risks involved in the adoption of renewable energy technologies. It has advantages only".

4.1.4 Campus D Barriers to the adoption of RE technologies

Results for this campus on the perceived barriers are visually presented in Figure 6. This data comes from questions 3, 4, and 5 of the questionnaire. The 'Cost to Install' is seen as the most prevalent barrier in the adoption of RE technologies on Campus D.

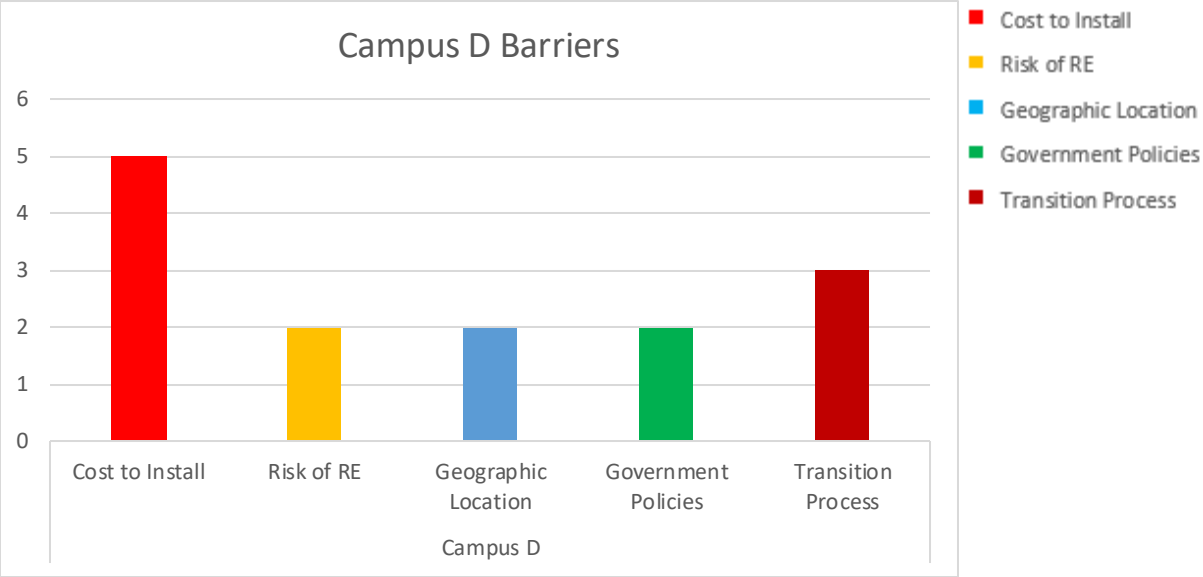


Figure 6: Frequency distribution bar graph: Campus D Barriers

Respondent D7 stated that:

"The initial cost associated with setting up the necessary components may prove to be a challenge in our institution".

This is the same sentiment that has been seen on all campuses.

The 'Transition Process' can be viewed as a barrier to the adoption of renewable energy technologies in this institution. This is also the same view echoed by Respondent D3 when the respondent stated that:

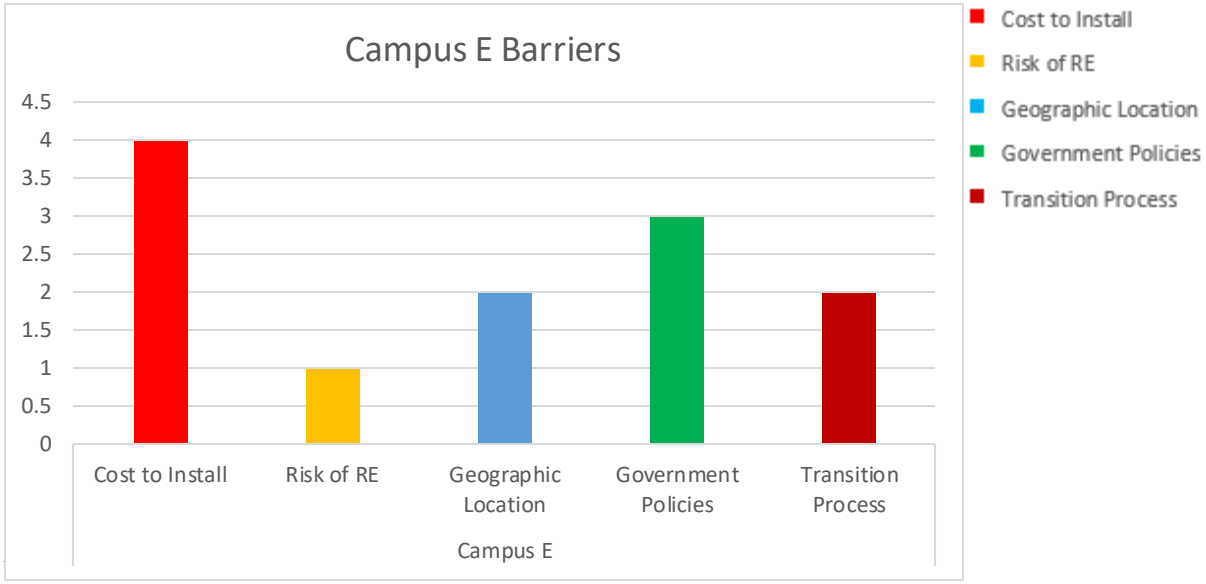
"As much as fossil fuels are detrimental to the environment; they are relatively still cheaper compared to renewable energy sources. Hence the move from fossil fuel energies to renewable energies is difficult because of the cost factor."

This respondent further stated that the cost of operating is a hindrance to the adoption of RE technologies. 'Risk of RE', 'Geographic Location' and 'Government Policies' are seen as

having the lowest impacts on the adoption of RE technologies. The graph shown is almost similar to the one derived from Campus B's data.

4.1.5 Campus E Barriers to the adoption of RE technologies

Results for this campus on the perceived barriers are visually presented in Figure 7. This data comes from questions 2, 3, and 7 of the interview questionnaire. As in the case of all the other Campuses, the 'Cost to Install' RE technologies is seen as the most significant barrier to Campus E's endeavour to adopt RE technologies. 'Government Policies' have also been highlighted as barriers worth noting in this institution's endeavour to adopt renewable energy technologies.



Respondent E6 notes that:

"There are no clear policies or incentives that promote the adoption of renewable energy in business as well as in South African as a whole".

The risks associated or noted on this campus relate to cost as envisaged by Respondent E3, who stated that:

"my institution will face financial risk if it adopts renewable energy as it is costly to implement and maintain. This poses a challenge to the institution which is facing post-Covid effects and in dire financial stress".

4.2 Questionnaire Results on the Motives of renewable energy adoption

A motive can be defined as a reason or intention to undertake something (Rakes and Dunn, 2010). In the quest to find the motives why Tertiary Institutions would want to adopt renewable energy technologies, several motives were stated by literature. The motives that were discovered in the literature include 'Employment Creation', 'Reduction in Carbon Emissions', 'Cleaner Sources of Energy', 'Cheaper Energy', and 'Energy Independence'. The motives for renewable energy adoption were ranked in the order of importance, with '1' being the most important motive and '5' being the least important motive.

The motives for renewable energy were ranked in the order of importance, with '1' being the most important motive and '5' being the least important motive. If a motive was given a rank of '1', it meant that the respondent strongly agrees that the highlighted motive can be said to be a significant driver in the adoption of RE technologies. The order in which the motives were ranked is shown in the table below.

Rank	Motive Strength (Most Important to least Important)
1	Strongly Agree
2	Agree
3	Disagree
4	Strongly Disagree
5	Don't Know

Table 4 Motive weightings

Figure 8 below shows the response of all five campuses whereby if a motive was given a rank of '1' or '2' it was considered to be the most important motive in the adoption of RE technologies. As it can be seen from the weightings, the most important motives recorded by all the five campuses will be a 'Reduction in Carbon Emissions', 'Cleaner Source of Energy' as well as 'Energy Independence'. Most of the delegates interviewed in all five campuses strongly agreed to the question posed in the questionnaire which asked if *"Renewable energy installations will reduce carbon emissions and hence curb climate change"*.

An example of this is from Respondent E3, who specifically stated that:

"with renewable energy, there is little or no carbon emission into the atmosphere".

Each campus's perceived motives are going to be looked at below.

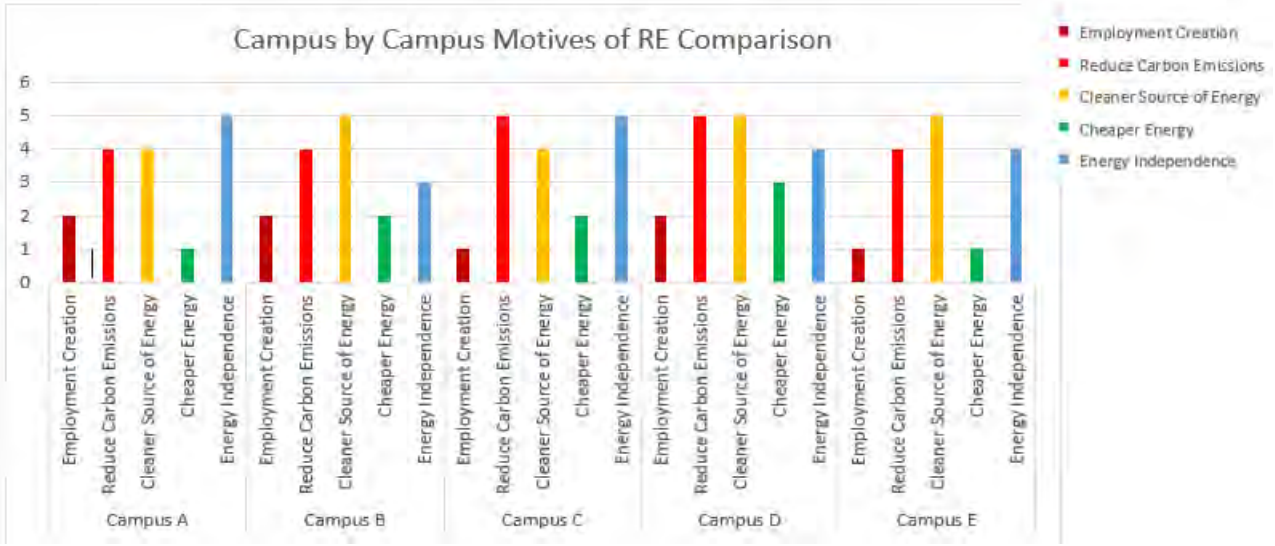


Figure 8: Frequency distribution bar graph: Campus by Campus Motives to Renewable Energy Adoption Comparison

4.2.1 Campus A Motives to the adoption of RE technologies

Results for this campus on the perceived motives are visually presented in Figure 9. The motives behind the installation of renewable energy technologies on Campus A included the 'Reduction of Carbon Emissions', 'Cleaner Source of Energy' as well as 'Energy Independence'.

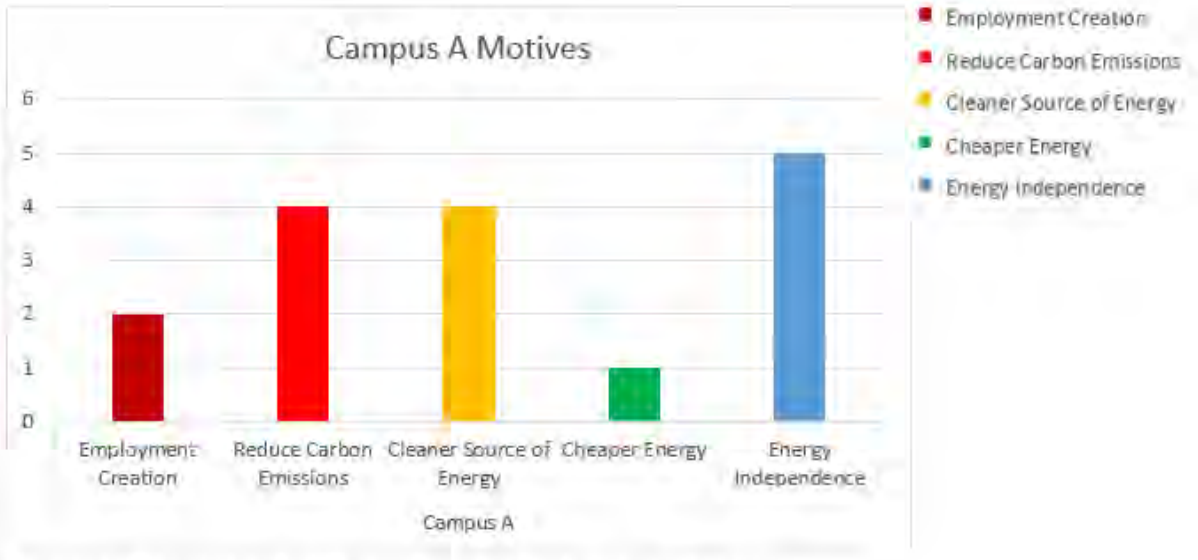


Figure 9: Frequency distribution bar graph: Campus A Motives

'Energy Independence' was ranked a bit higher than the other two motives selected. This is seen as well in Respondent A1's comment when the respondent stated that:

"Renewable energies are now of importance due to the ongoing load shedding happening all over South Africa, which has affected lots of our student's progress in terms of exams and curriculum. The ever skyrocketing price of electricity also is a motive for our institution to embark on renewable energy technologies and hence we won't be dependent on Eskom to supply us with power".

4.2.2 Campus B Motives to the adoption of RE technologies

Results for this campus, on the perceived motives, are visually presented in Figure 10. The common motives behind the adoption of renewable energy technologies on Campus B were to reduce carbon emissions as well as to have a 'Cleaner Source of Energy'.

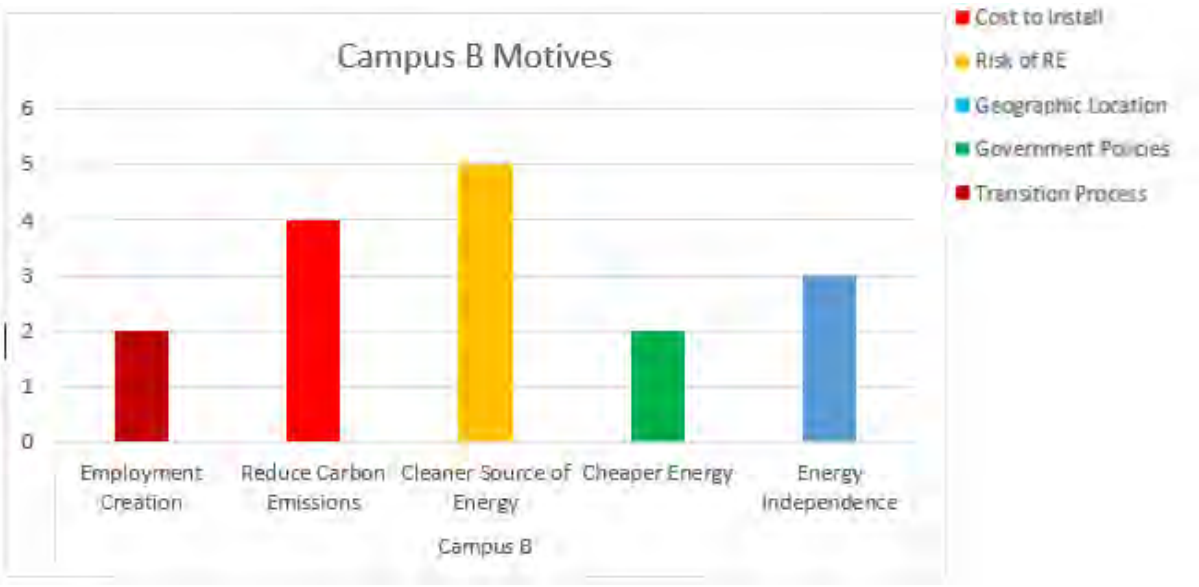


Figure 10: Frequency distribution bar graph: Campus B Motives

Just like Campus A, this campus data shows that 'Employment Creation' or 'Cheaper Energy' cannot be regarded as motives the campus can embark on in the quest of installing renewable energy technologies. The respondents have called for the installation of renewable energies because they reduce carbon dioxide emissions and help to mitigate climate change. This is evident in Respondent B4's response, stating that:

"There is a need for colleges like ours to install renewable energies like solar because these types of energies are clean and they don't cause pollution. Renewable energy will also help to reduce carbon dioxide and harmful smoke being released into the atmosphere which is opposite to what Eskom is doing. This will control climate change and global warming. Some of our staff might also be employed in this sector".

4.2.3 Campus C Motives to the adoption of RE technologies

Results for this campus, on the perceived motives, are visually presented in Figure 11. Campus C results show quite a number of motives coming up on why the institution would opt to adopt renewable energy technologies.

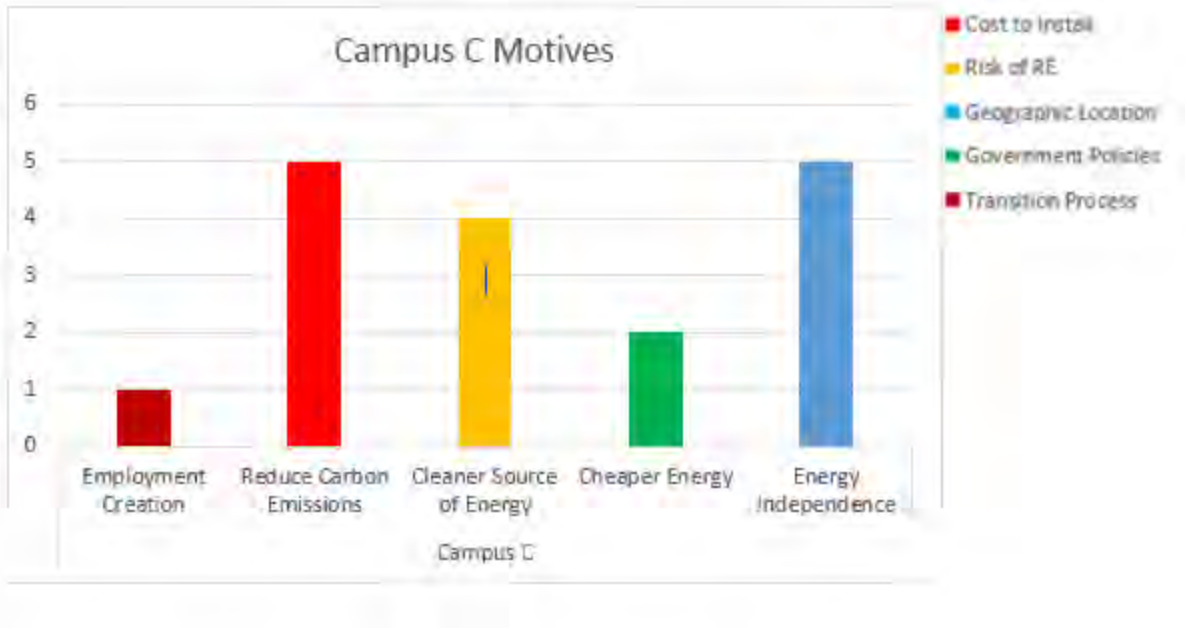


Figure 11: Frequency distribution bar graph: Campus C Motives

Three distinct motives ('Reduction of Carbon Emissions', 'Cleaner Source of Energy', and 'Energy Independence') stand out when the data is plotted. This is further compounded by the Respondent C3's response, stating that:

"Carbon dioxide coming from fossil fuel stations is causing harm to the ozone layer and having effects on climate change. Embarking on renewable energy will reduce carbon emissions into the atmosphere as well as aiding our society especially our campus to have a cleaner source of energy. This will also alleviate the campus which is over-reliant on Eskom's energy which is not reliable due to load shedding issues".

4.2.4 Campus D Motives to the adoption of RE technologies

Results for this campus, on the perceived motives, are visually presented in Figure 12. Respondents on this campus noted that the major motives for the adoption of renewable energy technologies were the 'Reduction of Carbon Emissions' and 'Cleaner Sources of Energy'. This is also evident when Respondent D6 stated that:

"The advantages of having renewable energy in our campus is that it will help the South African government in its push to reduce on carbon emissions as well as it is also good to our environment to cut on emissions".

And Respondent D3 alludes to the fact that:

Renewable energy acts as a cleaner source of energy compared to other sources of energy that we have been having. It is clean because no smoke or fog is being pumped into the atmosphere just like what Eskom is doing.

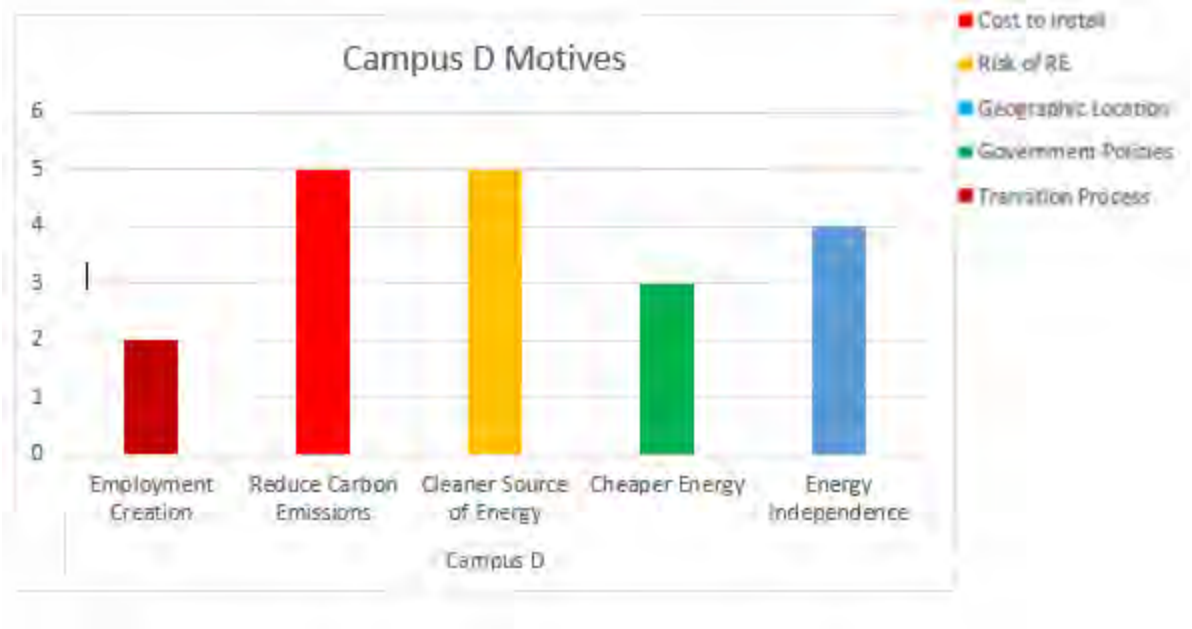


Figure 12: Frequency distribution bar graph: Campus D Motives

It should also be noted that 'Energy Independence' as a motive is still being echoed on this campus, though with a lower ranking than the other two motives which are 'Reduce Carbon Emissions' and 'Cleaner Source of Energy'. A case to note is that 'Cheaper Energy' was regarded as the most important motive in relation to how the same motive was placed on the other three campuses that have already been discussed.

Respondent D8 comments that:

"To have our own energy is good for our campus because it helps us to regulate our budget and control whatever we consume. It also helps us to run away from Eskom problems whereby there is always load shedding".

4.2.5 Campus E Motives to the adoption of RE technologies

Results for this campus, on the perceived motives, are visually presented in Figure 13. The data for Campus E tells the same story that has been told by the other four campuses preceding it. Just like Campus B, the motive why this institution would embark on renewable energy is the fact that it is a cleaner source of energy.

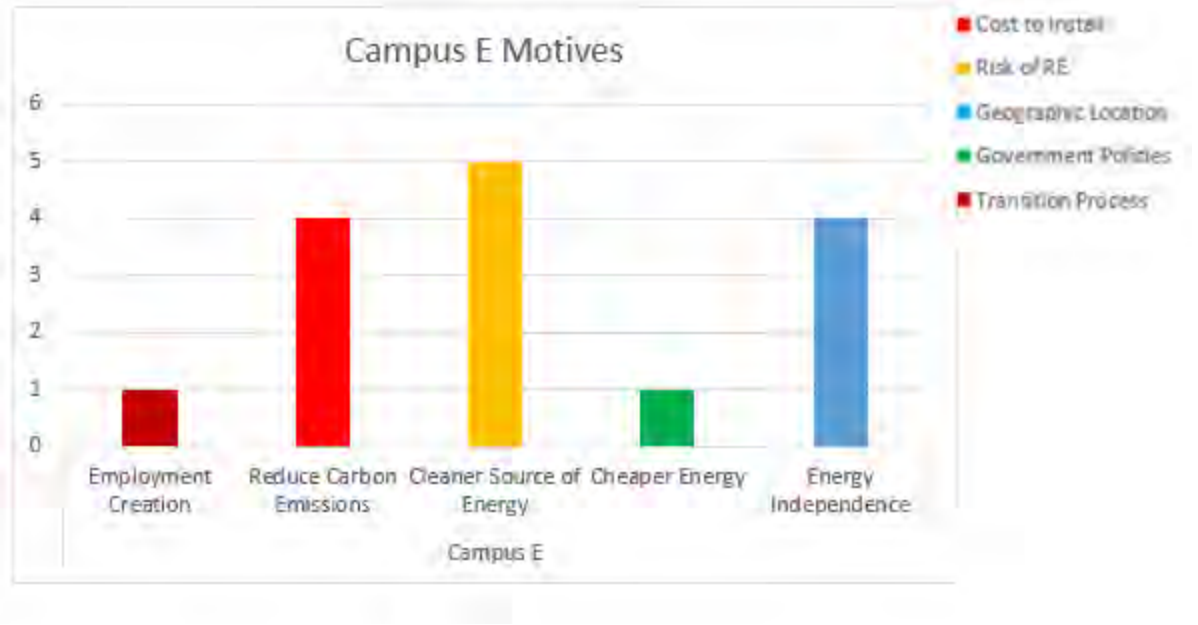


Figure 13: Frequency distribution bar graph: Campus E Motives

The 'Reduction of Carbon Emissions', as well as 'Energy Independence', can be seen as the other most important motive on why the institution would embark on renewable energy technologies. This is supported by Respondent E6 who stated that:

"We have been experiencing a lot of load shedding as of late and with us having our own electricity we won't be affected by it anymore. The problem also is that electricity is becoming expensive to buy, so having our own electricity will aid us as a college to monitor and regulate our own usage of electricity. Coupled with that, renewable energy is a clean source of energy with less harm on to the environment hence this move to adopt renewable energy will also help our campus to be environmental stewards".

4.3 Chapter summary

This chapter looked at the findings that were picked from the respondents in relation to barriers and motives to the implementation of renewable energy sources in South African tertiary

institutions. The most important motives recorded by the five campuses that took part in the study were 'Reduction in Carbon Emissions', 'Cleaner Source of Energy' as well as 'Energy Independence'. The most important barrier recorded by all the five campuses was the 'Cost to Install' the RE technologies while the least recorded barrier is the 'Risk' associated with renewable energy. Chapter 5 goes further to discuss what came out from the study versus what was found in literature.

Chapter 5 – Discussion

Aligned with the research aims and objectives, the first section of this chapter will look at the motives behind the implementation of renewable energy technologies in tertiary institutions, while the second section will look at the barriers associated with the implementation of renewable energy technologies in the tertiary institutions.

After the comparisons, recommendations will then be put forward on what tertiary institutions need to do to optimise the motives and potentially address the barriers.

5.1 Institutions key barriers for adoption of renewable energy

The key barriers that were identified in the implementation of renewable energy sources in the tertiary institutions were 'Cost to Install', 'Transition Process', and 'Government Policies' as seen in Chapter 4 (section 4.1). These key barriers are going to be discussed below.

5.1.1 Cost to Install

Some of the respondents alluded to the fact that the barriers affecting the implementation of renewable energy installations in tertiary institutions relate to the high amount of renewable energy components and the amount of financial assistance needed to install those components. This is evident in Respondents A5 and B5 responses (highlighted in section 4.1.1 and section 4.1.2 respectively) when they commented on the high capital investment needed to install renewable energy technologies. A case to note is Butterfield Elementary School, and Libertyville's Highland Middle school in Chicago, which installed solar panels on the rooftops of their buildings, and the cost of the project was a massive $3.2 million (Groenke, 2014). This is the sentiment echoed by De Jongh et al. (2014), where they attribute the high cost of renewable energy technologies, lack of capital and the lack of private investment as a massive barrier to the adoption of renewable energy technologies. Abdullahi, Suresh, Renukappa, and Oloke (2017), go on to state that the high cost of renewable energy technologies might be attributed to prior research and development work on these technologies that are needed. Bennet (2008) states that because there is limited manufacturing capacity in South Africa of renewable energy components, most of those components are imported, which causes these components to be expensive, a sentiment shared by Respondent D7 (see section 4.1.4.), who notes the high initial cost required to install renewable energy projects prove to be one of the barriers that need consideration. Shefrin (2001) states that renewable energy projects are prone to foreign exchange exposure which leads to an increase in the risk profile of such projects.

The increase in risks profile will make investors expect more in their investments making such investments unviable (Shefrin, 2001). This is further supported by Kline (2010), who stated that there is a need for tax-based incentives that could help provide funding to renewable energy projects. This is the case for countries such as Japan, Australia, China, and the USA, where there are energy policies that offer incentives so as to promote cleaner sources of energy (De Jongh et al., 2014).

Respondent E3 (section 4.1.5.) noted that one of the reasons why the institution is not able to adopt renewable energy technologies, is the cost required to implement and maintain such technologies. This challenge aligns with what Jimez and Lawand (2000) state when they acknowledge that universities in the United Kingdom adopt renewable energy technologies at a very slow rate, because of the cost of these technologies. But such costs can be offset by gains that institutions might have when they adopt renewable energy technologies. The response by Respondent E3, who stated that *"with renewable energy, there is little or no carbon emission into the atmosphere",* is one of the advantages that could be used to offset the initial cost of renewable energy technologies. This is the view shared by Nhamo and Ntombela (2014) when they stated that the cost of buying and installing renewable components could be offset by the gains obtained concerning carbon emissions reduction. Reduction of Carbon Emissions can be a cost-saving measure with future benefits guaranteed in South African tertiary institutions (Nhamo and Ntombela, 2014). If an institution can reduce carbon emissions, it is in a strong position to reduce its cost and to predict the future cost the university could face (Nhamo and Ntombela, 2014). As Mohammed et al. (2014) have alluded, market costs or prices for renewable energy technologies remain predominantly unaffordable and high to many clients (especially in developing countries), but these high costs can be indirectly negated by the gains that these institutions get when the technologies are running.

5.1.2 Transition Process

The 'Transition Process' from the Eskom grid to renewable energy platforms is another barrier that has been identified by some of the respondents. The respondents have highlighted some of the factors that make the 'Transition Process' to be regarded as a barrier in the implementation of renewable energy technologies in tertiary institutions. Respondent A5 (section 4.1.1) noted some of the factors as the high costs of renewable energy technologies, the need for competent people to install as well as the process of getting on to the Eskom grid. This aligns well with

Ogihara, Gueye, King, and Mori (2007), who stated that the high cost of RE technologies, installation procedures and uncompetitive energy prices are some of the factors that impede a transition to renewable energy technologies.

The transition from fossil fuels to renewable energy technologies is further hampered by the low prices of fossil fuels compared to renewable energy, according to Respondent D3 (section 4.1.4). This view affirms what Ogihara, Gueye, King, and Mori (2007) said, stating that renewable energy faces stiff competition from a market that is heavily aligned to fossil fuels. The sole reason for this is because of laws, policy frameworks, and systems that have been in existence in the last century that were primarily designed to cater for fossils (Ogihara, Gueye, King and Mori, 2007). This is also a view that has been raised by Nhamo and Ntombela (2014), who stated that the 'Transition Process' of South African tertiary institutions from fossil fuel energy to renewable energies had been inhibited by the country's heavy reliance on fossil fuels (especially coal), corruption, inadequate policy, lack of infrastructure as well as lack of integrity. It supports the similar perceptions found in this study. But on the other hand, de Jongh et al. (2014) state that there should be policies that must be put in place to help organisations and firms that adopt renewable energy technologies so that they can be competitive when compared with other organisations that are using fossil fuel energy. This view is emphasised by Von Moltke, McKee, and Morgan (2004), who state that the existing markets in the energy sector, for example, do not take into account the value of social and environmental benefits that go with renewable energy installations; hence adequate policies and schemes must be looked at so as to promote the adoption of such technologies.

Other factors concerning the 'Transition Process' as a barrier that has been noted in the study relate to the inadequacy of technology and information about renewable energy technologies (Respondent A6, Respondent C3 in section 4.1.1. and 4.1.3 respectively), making it difficult for an institution to embark on renewable energy. Ogihara et al. (2007) affirm this view when they state that there aren't many established technological models for renewable energies and very limited information about renewable energy compared to fossil fuels. The same view is shared by von Moltke et al. (2004), when he states that there is a lack of credit and financial facilities to buy needed technological components and to research more on renewable energy technologies, making it difficult for institutions and business entities to adopt renewable energy. Jimenez and Lawand (2000) further state that most personnel that are employed at educational institutions are ill-equipped to deal with renewable energy technologies; hence there is a need to up-skill these people and invest in technologies of such nature.

5.1.3 Government Policies

The lack of 'Government Policies' concerning renewable energy adoption is another barrier that has been noted by respondents. Respondent E6 (section 4.1.5) specifically notes that there are insufficient policies or frameworks that make it easy for tertiary institutions to adopt renewable energy projects on their campuses. This is also a sentiment that has been raised by Nhamo and Ntombela (2014) when they state that there are limited policies that address the adoption of renewable energy technologies by South African tertiary institutions or businesses. Lack of alignment and support policies means that renewable energy technologies cannot be further developed with no suitable enforceable policies on the horizon (Bode and Michaelowa, 2003). In this regard, no suitable subsidies or funding can be sourced for these types of technologies.

The notion mentioned by Respondent C7 (section 5.1.3.) addresses some of the measures in relation to a policy framework that can be implemented for the adoption of renewable energy technologies. The lack of policies addressing renewable energy technologies is echoed by Jongh, Ghoorah, and Makina (2014) when they state that the current policy that is in existence in South Africa is set on coal dependency, not on renewable energy dependency. Lund et al. (2014) go further and states that there needs to be a clear articulation on the amount of renewable energy to be supplied to the feed-in tariffs. In Germany, for example, companies are mandated to buy electricity from renewable sources and pay those producers a yearly fixed feed-in tariff (Jenner, Groba, and Indvik, 2013). The price of electricity produced by renewable energy sources was set at 90% discount in relation to the average electricity rate per kWh (Jenner, Groba, and Indvik, 2013).

Literature also notes that while the world is seeing a significant boost or shift in the growth of the RE industry, South Africa seems to be at a standstill because of misaligned energy and environmental policies (Sebitosi and Pillay, 2008). There needs to be a stable policy that can lure investors, and without any stable policy, investors will tend to shun away from investing in such countries (Karagöz, 2010). A 2011 report by the Global Competitiveness issued by the World Economic Forum ranked South Africa 76 out of 139 other countries in technological readiness (Schwab, 2010). Most of the countries ranked above South Africa are way ahead in renewable energy technology and policy (Schwab, 2010).

But it's not all doom and gloom on the South African front concerning energy policy. An energy policy called "White Paper on Renewable Energy" was introduced in South Africa in 2003 with

the aim of having 4% of the energy supplied be renewable (Langeveld, Dizon and van Keulen, 2014). This policy serves as a foundation on which South Africa and especially tertiary institutions must build upon to promote renewable energy adoption.

5.2 Institutions Key Motives for the adoption of renewable energy

The key motives that have been identified on why tertiary institutions would embark on renewable energy sources are a 'Cleaner Source of Energy', 'Reduction of Carbon Emissions' as well as 'Energy Independence'. The motives are discussed in detail in the following sections.

5.2.1 Cleaner Source of Energy and Reduction in Carbon Emissions

The two highest-rated motives on why Tertiary Institutions would embark on renewable energy technologies as suggested by the data (as presented in Chapter 4, section 4.2) are:

(i) 'Cleaner Source of Energy'

(ii) 'Reduce Carbon Emissions'

These two motives have some degree of overlap between them; hence they will be discussed together. The overlap is also evident in literature when Beck and Martinot (2016) stated that a clean source of energy like renewable energy will lead to a decrease in carbon emissions. Jo, Ilves, Barth, and Leszczynski (2017) go on to state that organisations and business entities must aim to embark on renewable energy projects which are a 'Cleaner Source of Energy' with a very minimal output of carbon emission.

Some respondents from all the campuses highlighted that the motives that can drive the institutions to embark on renewable energies are to reduce carbon emissions and thus migrate to cleaner sources of energy (Respondent B4, section 4.2.2 and Respondent C3, section 4.2.3). This affirms what the literature states when Pegels (2010) states that the reason why many educational institutions will embark on renewable energy technologies is a desire to cut on carbon emissions and migrating to cleaner sources of energy. This is also the same view shared by Nhamo and Ntombela (2014), who states that South Africa is already feeling the impact of climate change hence there is a need to embark on initiatives to reduce greenhouse gas emissions through renewable energy initiatives. Nhamo and Ntombela (2014) go on to state

that globally higher tertiary institutions are supposed to play a critical role in the provision of solutions caused by climate change through embarking on renewable energy initiatives. A study in 2008 has revealed that 83% of the universities in the United Kingdom had started initiatives to reduce their carbon footprints, and one such initiative was to implement renewable energies on campuses (Nhamo and Ntombela, 2014).

With more emphasis going out on environmental awareness and climate change issues, most of the respondents in the three institutions noted the need for cleaner sources of energy and mitigating factors when it comes to the 'Reduction of Carbon Emissions'. Some of the responses derived from the participants emphasised the need for tertiary institutions to embark on renewable energy technologies. Comments from Respondent D3 (section 4.2.4.) and Respondent C3 (section 4.2.3), highlight the need on why cleaner sources of energy can be highlighted as a motive on why tertiary institutions need to embark on renewable energy technologies. These are the same sentiments highlighted in literature when Jo, Ilves, Barth, and Leszczynski (2017) state that small scale schemes that focus on renewable energy will play a pivotal role when it comes to achieving environmental goals, addressing climate change as well as cubing CO_2 emissions (2017). Respondents highlighted the damage fossil fuels are doing to the environment. A case in point is the sheer amounts of coal by-products and smoke plumes that are seen in areas that are characterised by coal mining, especially in the Mpumalanga province as was noted by some respondents. Tate, Mbzibain, and Ali (2012) allude to the fact that curbing greenhouse gases and having a substitute for fossil fuels can be seen as a huge motive towards organisations embarking on cleaner sources of energy.

Different authors have echoed the same sentiments shared by respondents when looking at cleaner sources of energy and curbing greenhouse gas emissions as motives on why tertiary institutions need to embark on renewable energy technologies. Nhamo and Ntombela (2014), note that the University of Cape Town started the Green Cleaning Initiative in 2009. Among the issues addressed by this initiative was to have renewable energy on the compass for some buildings so as to minimise greenhouse gas emissions (Nhamo and Ntombela, 2014). A study in the energy costs of the South African educational sector noted that a reduction of almost 78 tons of CO_2 emissions per year could be envisaged if educational institutions embark on renewable energy and clean energy schemes (Gerber, Rix, and Booysen, 2019). The University

of Cape Town, the University of South Africa, and Rhodes University are leading higher educational institutions in South Africa that are addressing climate change and reducing greenhouse gas emissions in the form of renewable energy promotions and awareness (Nhamo and Ntombela, 2014).

According to Respondent B4 (section 4.2.2), tertiary institutions can gain important lessons and save costs when it comes to cleaner energies and carbon emissions if they embark on renewable energy technologies. Jimenez and Lawand (2000) note that a solar system on the rooftops of school buildings creates an impression of clean energy use and forward-thinking institutions for visitors, students, and even faculties. Solar and wind energy are becoming more and more integrated into the electrical grids, and educational institutions can provide a potential benefit of having clean sources of energy and having their peak electricity output being supplied back onto the grid (Stellenbosch Municipality, 2018), so this aligns well with what was found in this study's results.

5.2.2 Energy Independence

'Energy Independence' is one of the motives that has been picked up across all five campuses as a motive on why educational institutions can embark on renewable energy technologies. Respondent C6 notes that due to load shedding that has been crippling South Africa, some institutions were negatively affected because some of the courses and programs needed a reliable power connected for them to run smoothly. Donnelly (2015) argues that organisations will flourish when they get off the Eskom grid and install renewable energy technologies in the wake of unending load shedding being experienced throughout the country. Kyle Durham, who is the head of alternative sources of energy at First National bank business says because of load shedding, the organisation's alternative energy solution sector has come across an increase in the demand for other sources of energy, especially renewable energy sources with solar energy being the most prevalent (Durham, 2020). The need for 'Energy Independence' has also been echoed by Respondent E6 (section 4.2.5), who notes the high cost of electricity as a motive on why the campus needs to be energy independent by adopting renewable energy technologies. This thought is also held by Lokailwe (2021), who states that in the wake of the hard lockdown period imposed by the South African Government in the year 2020 due to the Covid pandemic, the Cape Peninsula University of Technology electricity bill was almost half

compared to what the university normally pays when it is open. This shows that the electricity was still being used when the campus was not in use which shows a waste of financial resources (Lokailwe, 2021).

'Energy Independence' in the form of renewable energies has seen many educational institutions flourish in current economic circumstances crippling the world (Nhamo and Ntombela, 2014). As noted in the literature, energy independence can also be seen as a way of educating the students as well as the stakeholders on cost-cutting measures (Nhamo and Ntombela, 2014). Students and administrators can also have input or learn when the campus is shifting towards energy independence (Nhamo and Ntombela, 2014). This is also a view raised by some respondents (for example, Respondent E6, section 4.2.5 and Respondent D8, section 4.2.4) who stipulates the need for educating the upcoming generations on self-sufficient solar systems either in tertiary institutions or in their households.

Some respondents also spoke of the need for tertiary institutions to move towards 'Energy Independence' since the location of South Africa paves the way for such projects to be undertaken. The UN Environment Program alludes to the fact that South Africa is ranked third in the world when it comes to electricity generation using solar energy, which makes it a good and better area for organisations to install solar energy.

5.3 Recommendations

South African Institutions must push for better policies that are going to support the adoption of renewable energy technologies (Sebitosi and Pillay, 2008). These policies must be tailored and context-specific to the unique economic, social, and political circumstances of the South African environment (Msimanga and Sebitosi, 2014). Policies should be able to promote mechanisms such as net metering and feed-in tariffs. Policies must be able to complement each other, building on previous policies that have already been put into effect. Tertiary institutions must be given incentives or quota systems to address the challenges faced in the RE technologies implementation. These will help institutions forgo some of the cost implications usually faced during the implementation phase or during the first few years of RE projects (Msimanga and Sebitosi, 2014).

Renewable energy projects must be heavily subsidised by the government so that organisations won't shun away from embarking on them. The South African government must carry the initial

cost outlay of RE installation since it is considered to be one of the barriers that inhibit the adoption of renewable energy (Msimanga and Sebitosi, 2014). The tertiary institutions have a case to take to the stakeholders including the department of education to put forward the advantages of having renewable energy on campuses as well as the cost implications both on the purchasing and installation as well as on the day to day running of such institutions that will lead to cheaper education because of reduced energy cost in the long run.

As a means of managing the energy transition effectively, it is recommended that the South African Government monitors the adverse impacts of policies that are already in existence and thus promote a partnership alliance between municipalities and tertiary institutions (Nhamo and Ntombela, 2014).

More awareness on business entities by various stakeholders needs to be done on the effects of carbon emissions into the atmosphere mainly due to fossil fuels (Zahedi, 2012). This awareness will help to shift the focus to renewable energy technologies with environmental groups taking the lead in the lobbying of better and cleaner energies for South Africa's educational institutions. More emphasis needs to be put on the 17 sustainable development goals as well as the effects of climate change. The emphasis on climate changes and the 17 SDGs will help to rekindle the awareness about the effects of fossil fuels on the environment as well as the goal that South Africa is set to achieve by 2030.

Chapter 6 – Conclusion

This research aimed to address three main objectives. These objectives were to: (i) identify main barriers that are faced by tertiary institutions in the adoption of RE technologies, (ii) identify the motives on why tertiary institutions would embark on renewable energy technologies, and (iii) make some recommendations for improved adoption of renewable energy in tertiary institutions. Through the detection of different motives and barriers to RE implementation in South Africa's tertiary institutions, their perceived significance to the sector and the country was evaluated. Higher tertiary institutions play a pivotal role not only in encouraging and changing students and staff members but also in communities and countries in which they are based through initiatives that encourage green initiatives (Jo, 2017). Such initiatives must be sufficient in addressing CO_2 emissions, climate change as well as going green for the sake of the environment (Letete et al., 2011).

This research has pointed out key aspects of why South African tertiary institutions would implement renewable energy technologies. The findings highlighted two environmental aspects as well as a political aspect that can lead to tertiary institutions embarking on renewable energy technologies. The environmental motives that have been identified are a drive for cleaner sources of energy as well as a need to reduce carbon emissions. With South Africa going through load shedding over the past years, it has hit hard on institutions, with the normal way of running things in a campus environment being affected when Eskom goes through load shedding (Goldberg, 2015). This has prompted some institutions to embark on renewable energy initiatives to abate the impacts of load shedding. Another factor that has been highlighted in migration towards energy independence by tertiary institutions is the cost of electricity in South Africa that has become expensive to most businesses. Although in the immediate term embarking on renewable energy technologies might prove to be a daunting calling especially looking at the cost, benefits are assured in the future when compared to the energy coming from fossil fuels (Mohammed et al., 2014).

The barriers to renewable energy adoption in tertiary institutions showed less variation between respondents meaning that these institutions faced the same barriers on why educational institutions couldn't implement renewable energy technologies. These barriers are also in line with what the literature had stated. Tertiary institutions in South Africa have lagged behind cpmpared to other business entities in the implementation of renewable energy sources in their day-to-day running. The main findings of this research have pointed out key aspects on why

South African tertiary institutions have found it a daunting task to implement renewable energy technologies in their campuses. The barriers that have been identified are the 'Cost to Install' renewable energies, 'Government Policies' that do not promote the adoption of renewable energies as well as the 'Transition Process' required to migrate to the Eskom grid. These findings were also supported by literature, for example Nhamo and Ntombela (2014), who stated that the transition process of South African Tertiary institutions from fossil fuels to renewable energy sources is inhibited by the country's heavy reliance on fossil fuels.

As the world is firmly addressing the issues of sustainability, higher educational institutions have found themselves thinking more and more about carbon management matters (Rogers, 2005). If the topic of carbon management is brought about, climate change and global warming are automatically unearthed. South Africa is already feeling the impact of climate change; hence there is a need to embark on initiatives to reduce greenhouse gas emissions through renewable energy initiatives (Pegels, 2010). Although South Africa has laid down the path to move to a low carbon development, higher tertiary institutions are still ambiguous about their role in minimising their carbon footprints (Nhamo and Ntombela, 2014). This is a direct opposite to what's is happening in the United Kingdom whereby tertiary institutions are mandated to implement their carbon management initiatives (Nhamo and Ntombela, 2014).

The barriers and drivers to renewable energy in tertiary institutions will always be dependent on the location of the institution as well as the environmental situations that are prevalent in that area. Some institutions will be exposed in areas where the conditions are favourable for a certain type of renewable energy but not favourable to a certain type of renewable energy.

6.1 Limitations of the study

The study concentrated on tertiary institutions that are based in the province of Gauteng; hence it is difficult to develop conclusions on all other tertiary institutions that are based throughout the country. The existence of the COVID 19 protocols made it difficult for the researcher to interact more with the research participants so as to get more insights on the subject matter being investigated. Using purposive sampling also limited the study results because the research participants may manipulate the data being collected in order to suit what the researcher is anticipating.

6.2 Recommendations for further study

Due to the geographical limitations of this study, future research could look at educational institutions in all nine provinces of South Africa and conclusions drawn. It could be interesting to see a nationwide study and compare results to see if they tally with the results found in these three institutions. It is also prudent to see if the same barriers and motives will also surface in a couple of years since the world is increasing its cognizance on issues of sustainability as well as corporate social responsibility. More research needs to be done on South African schools and universities since this research mainly focused on Technical and Vocational Educational and Training colleges.

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APPENDIX 1: Questionnaire sent to prospective respondents

Good Day

My name is Siya Sibindi, an MBA student from Rhodes Business School (part of Rhodes University). I'm currently looking at my research component for this degree, focusing on investigating the barriers and motives around the adoption and implementation of renewable energy technologies at South African Higher Educational Institutions.
I have obtained permission from your institution for you to be part of my research and your role or the type of work that you have in the institution is key to this research.

You are invited to participate in an interview session on motives and barriers for the adoption of renewable energies technologies in South Africa higher educational institutions.

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

Your participation in this study is completely voluntary. There are minimal to no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the process at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential, and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. I have obtained ethical approval from my institution (Rhodes University) for me to go ahead with this research and you can at any stage contact my supervisor Leticia Greyling at L.Greyling@ru.ac.za or Siya Sibindi at 0832384120 or by email sibindisiya@gmail.com if you have any queries.

Thank you very much for your time and assistance.

We will start our interview by asking general questions about renewable energy technologies.

What do you understand by renewable energy? Is it similar to what was explained above?

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What risks do you think your institution face if it adopts renewable energy?

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What financial challenges do you think there are if your institution adopts renewable energy?

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Do you think your institution's location is good for renewable energy installation in relation to weather? Please provide some insights on your answer above

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Do you think to consider the process of changing from Eskom electricity to renewable energy a complex process? Please explain your answer.

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The cost to install renewable energy technologies is a hindrance to most institutions.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above

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What other barriers to renewable energy in tertiary institutions do you perceive?

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Please rank the following barriers to renewable energy adoption in order of importance 1 being the most prevalent barrier and 5 being the least prevalent barrier.	
RE Barrier	Rank
• Cost to install	
• Risk of RE	
• The geographic location of the Institution	
• Government policies	
• Transition process	
• Other (Please state…….)	

What benefits do you think your institution will get if it adopts renewable energy?

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Are there any government incentives that you know of that promote the installation of renewable energy? If so which are they and if not do you think policies can be used as a means to promote renewable energy technologies?

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Please describe your level of agreement with the following list of commonly perceived public benefits to renewable energy technologies in higher tertiary institutions.

Renewable energy installations will help to create employment.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above

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Renewable energy installations will reduce carbon emissions and hence curb climate change

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above……
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Renewable energy is a cleaner source of energy compared to fossil fuels.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above

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Renewable energy is cheap compared to other energy sources.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above

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Renewable energy provides individual energy independence and therefore fewer operation disruptions due to load shedding

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above

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What other benefits do you perceive to be why Institutions should adopt renewable energy?

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Please rank the following motives to renewable energy adoption in order of importance 1 being the most prevalent motive and 5 being the least prevalent motive.	
RE Motive	Rank
• Employment Creation	
• Reduce Carbon Emissions	
• Cleaner Source of Energy	
• Cheaper Energy	
• Promotes Energy independence	
• Other(State……)	

Do you agree that South African higher education institutions must opt for renewable energy in the near future?

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Don't Know

Please provide some insights on your answer above

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Please provide any additional thoughts or comments on the benefits and barriers of the adoption of renewable energy technologies by South African higher tertiary institutions.

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Appendix 2 – Request letter for permission to conduct research

Dear Ms/Mr

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am a registered Master's student in the Department of Rhodes Business School at the Rhodes University. My supervisor is Leticia Greyling

The proposed topic of my research is: Motives and Barriers to the implementation of Renewable Energy Sources in South African Tertiary Institutions.

The objectives of the study are:

(a) Identify and discuss current and potential motives behind the adoption and implementation of renewable energy technologies-related projects at tertiary institutions;
(b) Identify and discuss the current and possible barriers to adopting and implementing renewable energy technologies-related projects at tertiary institutions.
(c) Make recommendations for improved adoption and implementation of RE-related projects at tertiary institutions

I am hereby seeking your consent to use your Institution as my area of study. The individuals participating in the study will be anonymous as well as the institution name.

Upon completion of the study, I undertake to provide you with feedback

Your permission to conduct this study will be greatly appreciated.
If Permission is granted can it be a formal Letter on the Institution Letterhead.

Yours sincerely,