Adoption of Renewable Energy Solutions by South Africa's Commercial and Industrial Businesses.

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ABSTRACT

The study addresses renewable energy adoption in South Africa's commercial and industrial sectors, beginning with the country's energy crisis as part of a broader global energy justice issue. It examines how the largest energy consumers adopt renewable energy solutions, a topic that has received limited theoretical focus in South Africa. Using a multipronged framework of status quo bias and diffusion of innovation theories, the research explores both internal drivers and external catalysts for adoption. Findings suggest that adoption is influenced not solely by technology costs and benefits but also by resistance to change, with a tendency to maintain the status quo. When political barriers are overcome, there is a strong demand for alternative energy to reduce costs and achieve carbon reduction targets. Qualitative research, with fifteen (15) participants from the renewable energy sector, reveals that adoption is a gradual process shaped by the policy environment. The study's insights are valuable for policymakers and scholars, highlighting the need for sensitivity to the nuanced processes that produce what is termed "lurching diffusion."

Keywords

Renewable Energy Adoption, South Africa, Commercial and Industrial Sector, Energy Transition, Sustainable Development

Plagiarism Declaration

I declare that this research project is my own work. It is submitted in partial fulfillment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Simphiwe Kulu

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Chapter1: Introduction to Research Problem

1.1 Research Problem

South Africa is notably among the most developed countries in Africa. It, therefore, comes as no surprise that it is the largest consumer of energy on the continent (Akinbami et al., 2021). This is attributed to the country's extensive built environment (Oguntona et al., 2021) and growing need for electricity generation and usage as a developing economy. The country's over-reliance on coal as a fuel source is however problematic as it has rendered the country among the top 10 greenhouse gas emitters worldwide (Akinbami et al., 2021).

The energy challenges in the country do not just confront the government. South Africa's commercial and industrial (C&I) companies face significant challenges due to the ongoing energy crisis characterised by frequent power outages and local and global pressure to reduce carbon emissions. C&I companies refer to businesses that operate within sectors focused on large-scale production, distribution, and services aimed at creating and maintaining economic activity. Commercial companies typically include businesses in retail, finance, and real estate, serving end consumers directly, while industrial companies are engaged in manufacturing, processing, and heavy industries that produce goods and services for both consumers and other businesses (Eder et al., 2015). As major contributors to greenhouse gas emissions, there is an increasing need and pressure for the C&I companies to actively contribute and adhere to climate policies and shift toward more sustainable energy practices (Eskom, 2023).

In recent times South Africa has made notable progress by initiating and developing the Renewable Energy industry as an alternative energy source and diversifying the energy mix (Department of Mineral Resources & Energy, 2024). Yet even with the introduction of renewable energy, fossil fuel remains the largest energy source in the country, over 85% (Akinbami et al., 2021). For South Africa to play a significant role in mitigating global climate change and addressing the energy crisis, large consumers of energy, the C&I companies, must play their part. Usman et al. (2024) suggest that integrating renewable

energy solutions into the industrial sector provides a platform for alleviating carbon emissions and achieving sustainability.

1.2 Purpose of Research

The primary purpose of this research project was to explore the processes in adoption of renewable energy solutions by South Africa's C&I companies. Engaging the scholarship on renewable energy adoption (Eder et al., 2015; Usha Rao & Kishore, 2010), the study aimed to identify the key factors influencing this transition, the potential benefits, and the obstacles that C&I companies face in adopting renewable energy technologies. It also sought to evaluate how renewable energy adoption could mitigate the energy crisis, reduce carbon emissions, and ensure compliance with international climate agreements.

1.3 Business Need for the Research

C&I companies in South Africa are at a critical juncture due to the ongoing energy crisis and increasing environmental concerns. The reliance on coal-fired power plants has not only led to frequent outages, disrupting operations and productivity, but also contributed significantly to CO_2 and global climate change. This situation presents a substantial *risk* to the business continuity of C&I companies. Aliyu et al. (2018) posit that some economies have realised the environmental and socioeconomic benefits of adopting renewable energy sources. Such recognition is evident in the focus on policy in regulating and giving strategic direction to renewable energy across the African continent (Adedoyin et al., 2021) and beyond (Dzwigol et al., 2023; Salari et al., 2021). Aliyu et al. (2018) add that the greater and broader benefit of RE, based on research, is the reduction in pollution at local and global level; they also emphasise the importance of affordable and reliable energy supply as an enabler for technological and economic growth. Affordability is particularly important for developing countries (Bashir et al., 2022) and for the purposes of this study, South Africa whose growing C&I sector requires reliable electricity supply. The adoption of renewable energy solutions to achieve this is vital and has been advocated for by scholars such as Aliyu et al. (2018)

who indicate that renewable energy sources can play a major role in energy generation in the African continent. Such advocacy is in part motivated by technological advances in renewable energy which suggest a raft of possibilities with benefits across economic, environmental and corporate spheres. Despite developments in the renewable energy industry, South Africa still faces the challenge of an energy deficit (Eskom, 2023).

Considering the dual dynamic which places immense challenges for South Africa but also great potential for the RE sector, a case for some research in the area was merited. There is substantial energy consumption and environmental impact emanating from the industrial sector (Usman et al., 2021), which although presenting immense challenges for energy generation and supply, is coupled by substantial advances in technology especially around renewable energy. Balancing the equation becomes a matter of technology adoption. Hence, the adoption of renewable energy solutions provided a business case for the research to complement the social and environmental research which has been registered outside of South Africa (Eder et al., 2015). The authors posit that by C&I companies adopting renewable energy solutions, a major role can be played in addressing climate change. Attending to the issues explored in the research added insight to business encounters with energy security and reliability; cost-saving and economic benefits; corporate social responsibility; and long-term sustainability.

1.3.1 Understanding adoption barriers and drivers

Yuen et al. (2021) used various theoretical frames in their research in assessing technology adoption particularly in autonomous vehicles. The authors applied the Technology Acceptance Model and Diffusion of Innovations models to determine the factors influencing the adoption of autonomous vehicles (Yuen et al., 2021). Although the research was unrelated to renewable energy, the theory used in their study is relevant considering the context of this study. The theories provide general frameworks but may not fully capture the unique challenges and drivers specific to renewable energy in the C&I context. The research applied the theories to industry-specific factors in the South African context, providing a more nuanced understanding of adoption dynamics.

1.3.2 Policy and Regulatory Impact

The role of policy and regulatory frameworks in facilitating or hindering renewable energy adoption is critical. This research contributed to the theoretical understanding of how government policies, incentives, and regulatory measures impact the decision-making processes of C&I companies. It also examined the effectiveness of existing policies and suggested theoretical models for improved policy design (Department of Environment, Forestry and Fisheries, 2019; Eskom, 2023).

1.3.3 Technological Integration and Innovation

Integrating renewable energy technologies into existing industrial systems presents significant challenges and opportunities. Theoretical insights into technological compatibility, innovation diffusion, and the role of technological advancements are needed to understand how these factors influence adoption rates. This research explored these aspects, contributing to the broader literature on technology integration and innovation in commercial and industrial settings (Omole et al., 2024).

1.3.4 Economic and Environmental Impact

The economic theories related to cost-benefit analysis, investment decision-making, and risk management are crucial for understanding the financial viability of renewable energy projects in the C&I space. Additionally, environmental theories related to sustainability and ecological economics were explored to assess the broader impact of renewable energy adoption on environmental outcomes (Adams & Acheampong, 2019).

1.3.5 Social and Organisational Factors

Theories related to organisational behaviour, stakeholder management, and corporate social responsibility were examined to understand how internal and external social factors influence renewable energy energy adoption. This includes the role of leadership, employee engagement, and stakeholder pressures in driving sustainable energy practices (Kitsis & Chen, 2021).

1.4 Theoretical Need for the Research

There is vast literature available on renewable energy and the factors that either enable or hinder the development of the industry including feasibility, viability, and desirability by both the public and private sector (Agyekum et al., 2021; Akinbami et al., 2021; Aliyu et al., 2018; Amir & Khan, 2022; Ayamolowo et al., 2022; Bjørner & Mackenhauer, 2013; Fleta-Asín & Muñoz, 2021; Salari et al., 2021; Steffen, 2020). The available literature is skewed towards the dynamics of other countries and often neglects the complexities of adoption in specific sectors such as commercial and industrial energy space. Where commercial and industrial concerns are incorporated, researchers eschew adoption of technologies and focus instead on supply and demand (Golmohamadi, 2022; Nwachukwu et al., 2014; Pielow et al., 2012; Scharnhorst et al., 2024) or conservation and efficiencies (Su & Fan, 2022; Train, 1988). Resultantly, sector-specific insights on adoption of renewable energy solutions are merited.

The relative neglect of sectoral approaches and behaviours to technology adoption (or resistance) contribute to missed opportunities in understanding how vital collectives behave in the face of frequently new technological advances. For the renewable energy sector in particular, such conceptual gaps have both operational and existential implications. Operationally, they culminate in missed chances to learn behavioural complexities across the board which might imply that a sense of collective vision is lost. Existentially, renewable energy is poised at the cusp of technological advancement and the fight against climate change. Failure to adopt useful technologies might mean going beyond the precipice in the effort to “save the planet”.

The theoretical framework for understanding the adoption of renewable energy solutions by C&I companies is multifaceted, encompassing economic, environmental, technological, and policy dimensions. Despite the increasing interest in renewable energy, there is a gap in the literature specifically addressing its adoption by South African C&I businesses. This research is essential for several theoretical reasons that extend beyond renewable energy but also provide insight into the factors that affect the

adoption of new technologies. The relevant theory for this research was built from the following elements: adoption barriers and drivers; policy and regulatory impact; technological integration and innovation; economic and environmental impact; and social and organisational factors.

Chapter 2: Literature Review

2.1 Introduction

The adoption of renewable energy solutions by South Africa's C&I companies is a crucial step towards addressing the country’s energy crisis and environmental challenges. This literature review builds on the identified business case and theoretical foundations, focusing on the benefits of renewable energy adoption for C&I companies, and the barriers and drivers of this transition. The Diffusion of Innovation Model and status quo bias provide the theoretical framework for understanding these dynamics, along with policy and regulatory impacts, technological integration, economic and environmental factors, and social and organisational influences.

Before addressing the theoretical literature, this section first offers a broad overview of renewable energy and the renewable energy industry in South Africa. As previously mentioned, there has been research on the adoption of renewable energy solutions in the C&I space, however, there is limited research that is focused on the South African context.

2.2 Renewable Energy Overview

Renewable Energy has been earmarked as a suitable alternative energy source solution for electricity production to enable the efforts to mitigate climate change, around the world. Though RE projects appear to be associated with high risk (Hain et al., 2018), there is a significant increase in electricity generation through renewable energy (IRENA, 2024). The increasing adoption of RE by many countries around the world is a clear indication of its development and implementation feasibility and viability.

Renewable energy refers to energy sources that are naturally replenished, such as sunlight, wind, rain, tides, waves, and geothermal heat. Unlike fossil fuels, which are finite and emit significant greenhouse gases when burned, RE sources are sustainable and environmentally friendly. The primary types of RE include solar energy, wind energy, hydropower, biomass, hydropower, and geothermal (IRENA, 2024).

Solar energy harnesses sunlight through photovoltaic cells or solar thermal systems to generate electricity or heat. It is abundant and widely accessible, making it a cornerstone of renewable energy strategies worldwide (International Energy Agency, 2023). Wind energy captures kinetic energy from wind through turbines to produce electricity. It is one of the fastest-growing renewable energy sources and is particularly effective in areas with consistent wind patterns (GWEC, 2023). Hydropower uses the energy of flowing or falling water to generate electricity. It is a well-established renewable energy source that provides a significant portion of the world's electricity, especially in regions with large rivers and water resources (IRENA, 2024). Biomass energy is derived from organic materials, such as plant and animal waste. It can be used for heating, electricity generation, and as biofuels for transportation. Biomass is considered renewable if the resources are managed sustainably (IRENA, 2024). Geothermal energy utilises heat from the earth's interior to generate electricity and provide direct heating. It is a reliable and consistent energy source, particularly in geologically active regions (International Energy Agency, 2023).

The adoption of renewable energy, around the world, is driven by its potential to mitigate climate change, reduce dependence on fossil fuels, and enhance energy security. Additionally, advancements in technology and economies of scale have made renewable energy more cost-competitive with traditional energy sources (IRENA, 2020).

2.2.1 Renewable Energy In South Africa

South Africa has significant potential for renewable energy development due to its abundant natural resources, including solar, wind, and biomass. The country's renewable energy sector has gained momentum in recent years, driven by policy support, technological advancements, and the urgent need to address the energy crisis and environmental concerns (Akinbami et al., 2021; Department of Mineral Resources & Energy, 2019).

The South African government has implemented several policies and initiatives to promote renewable energy, such as the Integrated Resource Plan (IRP) and the Renewable Energy Independent Power Producer Procurement Program (REIPPPP). As some scholars have described it, the "REIPPPP was designed as a series of single, closed-bid (also known as sealed) tenders, initiated by the issue of a combined request for qualification and proposal (RFP)" (Eberhard & Naude, 2016, 3). Davies (2021) adds that the program could be understood as "a state-regulated, private sector delivered model with significant developmental impacts". In it, the program aims to increase the share of renewables in the energy mix, reduce carbon emissions, and create jobs in the green economy (Department of Mineral Resources & Energy, 2019). Mainly through the REIPPPP, South Africa has developed the renewable energy industry by harnessing six technologies namely, solar photovoltaic (PV), onshore wind; landfill gas; biomass; concentrated solar power (CSP); and small hydro. Solar PV and onshore wind technologies are the most developed renewable energy technologies in the country (Akinbami et al., 2021; Department of Mineral Resources & Energy, 2019). But as later chapters will reveal, the program is encumbered by recent challenges stemming from evolution of the industry and attendant shifts which have changed its structural makeup. At this stage of the study, affording attention to REIPPPP is motivated by a need to gain a grasp of the renewable energy operational framework in South Africa as well as set the tone for a concise discussion of changes away from largely state-led solutions to a more market-determined arrangement.

So, what then was the catalyst for adoption of renewable energy in South Africa? Some accounts suggest that four main spurs feature in the renewable energy progression in South Africa. These are that the:

- South African government recognises that *Eskom alone does not have the financial and technical capacity to meet the country's electricity demand and ensure energy security*
- development of renewable energy, along with the introduction of Independent Power Producers (IPPs), aims to ultimately *reduce the cost of electricity in South Africa*

- development of renewable energy is a clear priority of the South African *government's climate change mitigation and green economy strategies*
- creation of a renewable energy industry in the country is meant *to support local economic development objectives* (Montmasson-Clair & Ryan, 2014).

Despite significant progress, the adoption of renewable energy, South Africa faces several challenges, including regulatory uncertainty, grid infrastructure limitations, and financial barriers. However, the ongoing energy crisis and international pressure to reduce carbon emissions present opportunities for accelerated RE adoption. Strengthening policy frameworks, improving grid infrastructure, and fostering public-private partnerships are critical to overcoming these challenges and realising the full potential of renewable energy in South Africa (Department of Mineral Resources & Energy, 2019; Eskom, 2023).

The transition to renewable energy is pivotal for South Africa's C&I businesses. Given the country's reliance on coal and the resulting environmental concerns, there is a growing interest in sustainable energy solutions.

The renewable energy industry has developed from the broader energy industry whose legal basis starts in 1922 with the Electricity Act. According to Fineberg (2023), the founding statutory instrument made an allowance for private generation of electricity and this has persisted with various modification until today. Importantly for this paper, renewable energy was integrated into the legislative framework via the IRP. It is because of this plan that the current iteration of independent power production has surged. While IPPs include entities which are privately owned and predominantly concerned with production and distribution of energy, the structure of the industry has now evolved to include the C&I sector which is composed of firms operating in other economic sectors. Due to their high demand for energy, the firms from different sectors have begun to generate their own energy where surpluses are accumulated and can be distributed to the national grid at an agreed price or sold to other consumers via a wheeling agreement.

The available data on energy demanded by C&I suggests that the sector continues to be a leading energy consumer in South Africa. Table 1 below provides a non-exhaustive list of sectors with C&I businesses.

Table 1: Energy demanded by C&I

Sector	**Demand in 2019**	
	Megawatt Hours	Percentage
Industrial Sector	103,584,771	52.0%
Transport Sector	3,201,807	1.6%
Agriculture	5,968,000	3.0%
Commerce and Public Services	37,000,000	18.6%
Residential	48,522,999	24.4%
Non-specified (Other)	746,000	0.4%
TOTAL	199,023,577	100%

Source: (Kumba et al., 2023)

Evidently, the demand for energy is highest in C&I which collectively demands more than half of the energy available. The recent energy crisis (Bowman, 2020) wherein electricity supply proved to be either erratic or inadequate or both, has imposed pressure on the available resources and translated into heightened generation of energy by independent producers and the C&I entities themselves. Given this backdrop, the paper studied adoption of renewable energy solutions or technologies in South Africa.

2.2.2 Barriers and Constraints to Adopting Renewable Energy

There are common themes in the literature regarding the barriers to adopting renewable energy solutions both within the public and private sectors, despite the long-term benefits. These include and are not limited to, high upfront costs of renewable energy technologies, policy framework, and support mechanisms, and perceived or observed technical challenges (Duarte et al., 2020; Steffen, 2020; Usman et al., 2024).

Steffen (2020) highlights that the high costs of renewable energy are due to renewable energy technology being more capital-intensive than fossil fuel-based technology, requiring large upfront investment that must be financed. The author further indicates that these capital costs make up a significant part of the life cycle of renewable energy projects. These assessments sometimes discourage the initial investment. Duarte et al. (2020) mention that high costs associated with the development of renewable energy projects, particularly as good sources of renewable energy are often found in remote areas. This necessitates the construction of significant transmission lines and substations to connect to the grid. This is typically the case in the renewable energy industry in South Africa where most of the projects are in remote areas across the country (Department of Mineral Resources & Energy, 2024).

As mentioned previously, the South African government has implemented several policies and initiatives to promote RE in the country. However, these policies and initiatives have been focused on enabling the industry's development within REIPPPP, as provided in the IRP (Department of Mineral Resources & Energy, 2019). Although the IRP acknowledges the increasing number of private facilities that are installing renewable systems, there is little to no indication of how the government intends to support this initiative (Department of Mineral Resources & Energy, 2019). In addition to this, there have been policy and regulatory challenges within REIPPPP that have caused some uncertainty around renewable energy in South Africa. This is related to uncertainty on the sustainability of the program and issues associated with Eskom and the stability of the grid (Usman et al., 2021).

A major concern with renewable energy is related to technical issues as the technology is still new. Duarte et al. (2020) mention concerns such as the intermittent nature of renewable energy sources and the need for efficient energy storage solutions. The authors reinforce this by stating that the intermittent nature of RE presents the issue of low efficiency and variability which is significant enough to discourage private investment. This also presents the challenge of estimating the flow of capital particularly during the pre-investment phase of project development (Steffen, 2020).

2.2.3 Factors Influencing Adoption Renewable Energy

Sasol publicly announced the conclusion of its financial close process with Enel Green Power RSA, where they signed a deal to procure 330 MW of onshore wind, marking a significant milestone in the renewable energy and C&I space (Sasol, 2024). In the media announcement Priscillah Mabelane, Executive Vice President of Sasol Energy Business said "…This is significant progress towards Sasol's ambition to reduce its absolute scope 1 and 2 Greenhouse Gas (GHG) emissions by 30% off a 2017 baseline. Sasol is committed to pursue renewable energy procurement as a key lever for reducing GHG emissions, and the 690 MW procured with Air Liquide to date speak to that commitment." (Sasol, 2024). As major players in the C&I and renewable energy space respectively, this collaboration signifies the direction and potential of renewable energy adoption by C&I businesses.

Akinbami et al., (2021) mention that there is an increasing interest in developing renewable energy projects in South Africa, encouraged by the growing demand for clean energy production locally and globally. Usman et al. (2021) reinforces this by highlighting how the opportunities for cost-saving, innovation, and environmental benefits provide a strong case for the transition towards clean energy through renewable energy.

The adoption of renewable energy solutions is heavily influenced by economic factors. Initial investment costs for technologies such as solar PV systems, wind turbines, and biomass energy can be high. However, these costs are offset by long-term savings on energy bills and potential revenue from selling excess energy back to the grid. Studies have shown that companies are more likely to invest in renewable energy if there are clear financial incentives and a strong return on investment (Duarte et al., 2020; Usman et al. 2021). However, Su & Fan (2022) posit that technological improvements have significantly reduced the cost of renewable energy technologies. For instance, the cost of solar PV modules has decreased dramatically over the past decade, making it a more viable option for businesses. Additionally, advancements in energy storage systems,

such as batteries, have addressed issues related to the intermittent nature of renewable energy sources.

Environmental concerns are a major factor in the adoption of renewable energy. Companies are increasingly aware of their carbon footprint and the need to reduce greenhouse gas emissions. There is also growing pressure from stakeholders, including customers, investors, and regulators, for companies to adopt sustainable practices. Social responsibility and corporate image play a crucial role in the decision-making process (Zerrahn et al., 2018).

2.2.4 Benefits of Renewable Energy Adoption

Renewable energy sources, such as solar and wind, can provide significant cost savings in the long run. After the initial investment, the ongoing costs are relatively low compared to traditional energy sources. This is particularly important for industries with high energy demands, as it can lead to substantial reductions in operational costs (Steffen, 2020). More importantly, Eskom (2023) highlights the benefit of energy security particularly for C&I businesses with their high energy needs. Renewable energy can enhance energy security by diversifying energy sources and reducing dependency on energy produced from fossil fuels, currently the case in South Africa. This is particularly relevant for South Africa, which has experienced energy supply challenges in recent years (Department of Mineral Resources & Energy, 2019). By investing in renewable energy, companies can ensure a more stable and reliable energy supply (Usman et al. 2021) and mitigate the impact of climate change. Zerrahn et al. (2018) posit that environmental benefits of RE are well-documented. Renewable energy sources produce little to no greenhouse gas emissions, which helps mitigate climate change. Additionally, they reduce air and water pollution, contributing to better public health and a cleaner environment.

2.2.5 Renewable energy technologies/solutions

For the purposes of this paper, renewable energy solutions and renewable energy technologies are used interchangeably. This is partly a result of the colloquial use of

“solution” as a preferred term among practitioners and because technology is a much more versatile concept with more extended use in the scholarship. The focus is however firmly on renewable energy technologies which are common in South Africa. Since 2012, South Africa has made significant strides in diversifying its energy mix, incorporating renewable energy as part of its broader strategy to reduce dependency on coal and address energy security. The key renewable energy solutions/technologies currently implemented include solar power, wind power, hydropower, biomass energy, and concentrated CSP. Each of these solutions has unique characteristics in terms of generation capacity, adoption conditions, and performance.

South Africa's geographic location, with high levels of solar radiation, makes solar power an abundant resource. Largely through investors who operate as IPPs, South Africa has invested heavily in both solar PV systems and solar water heating technologies. Major projects such as the Jasper Solar Energy Project in the Northern Cape contribute significantly to the grid, giving the country total installed solar capacity of approximately 2.5 GW in 2023 (Department of Mineral Resources & Energy, 2024), with ongoing expansions. Solar power is widely adopted both on a utility scale and at the residential level, particularly in off-grid and rural areas. The government, through its REIPPPP, has for some time promoted the growth of solar energy, ensuring a favourable policy environment that supports its continued expansion.

Wind energy plays a significant role in South Africa's renewable energy portfolio, with major wind farms located in coastal areas, particularly in the Eastern Cape, Western Cape, and Northern Cape provinces. Projects like the Jeffreys Bay Wind Farm and Kangnas Wind Farm contribute significantly to the grid, providing consistent energy due to the favourable wind conditions in these regions. Wind energy is well-positioned for further growth under South Africa’s IRP (IRP 2019), which targets a significant increase in wind power capacity to address energy shortages and transition to cleaner energy. The main challenges to wind power adoption include land-use competition and occasional community resistance, as well as the need for significant grid upgrades to support distributed generation.

Hydropower in South Africa remains a smaller portion of the renewable energy mix, due in part to limited water resources and inconsistent rainfall patterns. Large-scale hydropower plants, such as those located at the Gariep Dam and Vanderkloof Dam although they constitute small fraction of the total energy mix. There is some potential for small-scale hydropower developments, particularly in rural areas. Hydropower remains a stable and established technology, though its growth is constrained by geographical limitations and competing demands for water in agriculture and urban supply.

Biomass energy, generated from organic materials like agricultural residues and waste, is an underutilised resource in South Africa but holds significant potential. The country has witnessed limited but impactful projects, such as the Tzaneen Biomass Project, which focuses on converting waste from agricultural activities into power. Biomass contributes to decentralised energy solutions, particularly in rural areas. While biomass energy is renewable and sustainable, it is constrained by logistical challenges in collecting and transporting biomass feedstock, as well as the cost-competitiveness compared to other renewable energy sources.

CSP technology is a unique component of South Africa's renewable energy strategy, offering the advantage of energy storage, which allows for power generation even when the sun is not shining. Projects like the Kathu Solar Park, have demonstrated CSP's potential to provide baseload energy. CSP is particularly suitable for regions like the Northern Cape, which experience long hours of intense sunlight. However, the high upfront costs of CSP projects and the relatively slower rate of adoption compared to PV systems limit its expansion. Despite these challenges, CSP remains a key part of South Africa's long-term strategy to provide reliable and sustainable energy.

In terms of overall adoption and generation capacity, solar and wind power lead the way in South Africa's renewable energy landscape, with strong government support driving their integration into the national grid. Hydropower, while reliable, is limited by natural water resources, and biomass energy remains underdeveloped despite its potential. CSP offers promising advancements in energy storage but is hindered by high costs.

Collectively, these renewable energy solutions represent South Africa's commitment to transitioning to a more sustainable and diversified energy future. However, scaling these technologies further will require ongoing investment, policy support, and infrastructure upgrades.

2.3 Theorising technology adoption

Concerning adoption of technologies, the scholarship is replete with theories and models. Some of the most prominent in the scholarship include:

- Unified theory of acceptance and use of technology (Momani, 2020; Shahzad et al., 2022).
- Innovation diffusion theory, the Concerns-Based Adoption Model, the Technology Acceptance Model, and the United Theory of Acceptance and Use of Technology (Straub, 2009).
- Theory of Diffusion of Innovations, the Theory of Reasonable Action, Theory of Planned Behaviour, Decomposed Theory of Planned Behaviour, and Technology Acceptance Models (Hsu & Chiu, 2004; Pakravan & MacCarty, 2021)
- Status quo bias theory (Shirish & Batuekueno, 2021)

From a review of the literature on adoption models and theories, Taherdoost (2018) identifies the adoption models in Figure 1 below. The figure reveals that while models are plentiful, some of them serve as foundational models to more refined perspectives. In this sense, it is evident that the models and theoretical claims are in some form of conversation, adding new insights and shedding some views over time.

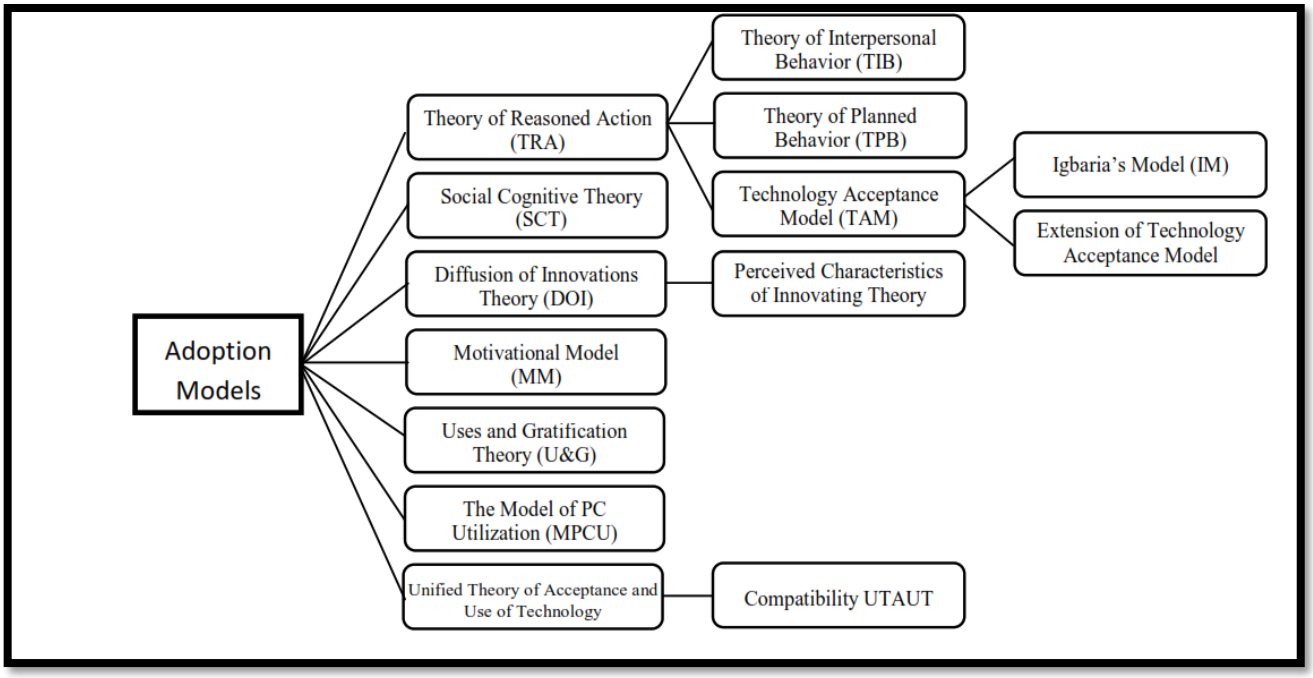

Figure 1: Adoption / Acceptance Models

Source: Taherdoost (2018, p. 962)

In the following subsections, a brief sketch of theories and models is presented before articulating the study's theoretical framework. However, even as the theoretical sketch evolves, it is worthwhile to remember that although each of the below-discussed theories offers valuable insights into the adoption of renewable energy solutions, none provides a complete picture on its own. Diffusion of Innovation excels at explaining the social dynamics of adoption but oversimplifies individual decision-making. TAM and UTAUT offer clear, technology-specific frameworks but may overlook broader behavioural factors. TPB provides a comprehensive behavioural model but lacks the specificity needed for technology-focused studies.

2.3.1 Theory of Planned Behaviour

The theory of planned behaviour (TPB) comprises of four key constructs: attitude, subjective norm, perceived behavioural control and intention. It is a widely recognised as a social psychological theory that serves to enhance and complement the Theory of

Reasoned Action (TRA) in predicting human behaviour (Ajzen, 1991) and is premised on the notion that an individual's behaviour is influenced by (i) their thinking and (ii) the external context in which they are situated.

Scholars have used this prominent theory to understand and predict human behaviour in diverse areas such as exercise, condom use, smoking cessation, education, recycling, food consumption decisions, women's decision to stay or leave abusive relationships and tourism as well as anticipated behaviour in adopting or accepting technologies or change (Ajzen, 2020; Tonglet et al., 2004).

Attitudes are a key determinant of Intention and behaviour (Ajzen, 1991). The attitude that a subject holds towards a technology is considered to be a likely key factor in how the person behaves in either adopting or rejecting the technology. This relationship is direct.

Subjective norms are a person's perception of what is socially acceptable and desirable behaviour, based on their social group. Individuals are more inclined to participate in a particular behaviour if they hold the belief that it is both socially acceptable and desirable (Ajzen, 1991). Understood within renewable energy solutions, socially accepted behaviours would allow for adoption of technologies which do not threaten the social norm. In this sense, the theory recognises what (Rogers, 2003) has also taken note of in his theory of diffusion, albeit without using the same conceptual terms.

Perceived behavioural control pertains to an individual's assessment of the degree of ease or difficulty linked to the execution of a specific behaviour. This perception can differ from one situation to another, or one action to another, leading to varying perceptions of control in different circumstances (Ajzen, 1991). How a person assesses the ease of adopting a technology plays a role in how they may or may not embrace the technology. Where a person ascertains that they have the wherewithal to adopt and be competent in the technology use.

Intention refers to an individual's inclination to partake in a particular behaviour, influenced by their attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991).

Applied to the "real world", A C&I business may have positive attitudes toward adopting solar panels (attitude), and its industry peers may encourage renewable energy adoption (subjective norm) but concerns over high initial costs or uncertain government support (perceived behavioural control) could inhibit their adoption decision.

The following is an overview of the TPB model, including its primary constructs and their interconnectedness.

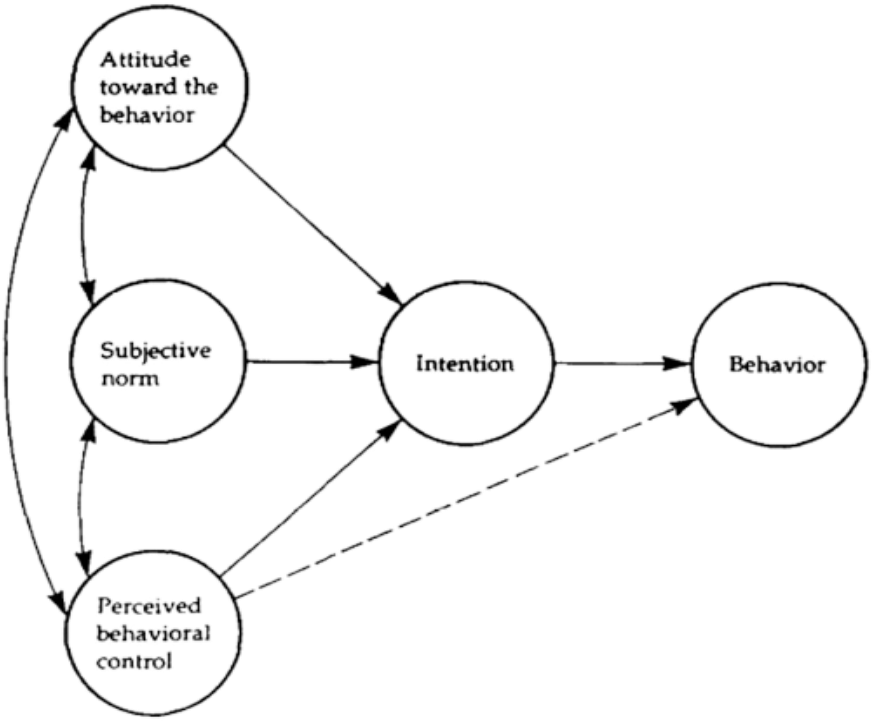

Figure 2: The Theory of Planned Behaviour.

Source: Ajzen (1991, p.182)

In presenting critiques of TPB's supposed shortcomings, some scholars have added alternatives to the debates such as Model of Motivation and Personality (Asebedo et al., 2019) which they deem to be a much more incisive theoretical lens for understanding behavioural change. This model's main concern relates to personal characteristics

which influence or shape behaviour, a perspective which appears to represent the dominant logic in the field. Börsch--Supan & Stahl (1991) extend their analysis using the extended life cycle hypothesis to incorporate the elderly while Kanimozhi & Selvarani (2019) have taken a similar stance in their rendition of a decomposed theory of planned behaviour.

Even after some stern criticism around shortcomings, limited reach and applicability, TPB continues to garner support as a perspective that underpins many new theories, a theory that is powerful despite its simplicity and a theory that has sufficient room for flexibility in application (Conner, 2015). Beyond the concepts are debates around appropriate models to deploy using TPB. Earlier work by Rhodes & Courneya (2003) deployed two modelling techniques. The first model examined past behaviour as either a causal influence or as an "autoregressive influence on current behaviour" while the second model "demonstrated a novel approach to including past behaviour and current behaviour" (p.57). In this sense, the theory has been engaged both as an explanatory retrospective lens as well as to gain a sense of its predictive rigour.

Despite the aforementioned critiques, the utility of TPB is reaffirmed by Conner (2015) who suggests that it not only shows correlations but also causality of behaviour; in this sense, the theory is most valuable in contemporary analyses of savings behaviour. The implication is that the theory is much broader than some critics are willing to admit. Its conceptual and practical rigour remains intact long after some scholars have read out obituaries.

2.3.2 The Theory of Reasoned Action

The theory of reasoned action builds on rationalist scholarship which construes people as rational beings capable of determining optimal solutions under given constraints. In this sense, the theory of reasoned action advances cognitive components in anticipating how technology is adopted. Three specific cognitions are incorporated: "including attitudes (unfavourableness or favourableness of person's feeling for a behaviour), social norms (social influence), and intentions (individual's decision do or don't do a behaviour)" (Taherdoost, 2018). It serves as a predecessor to the theory of planned behaviour and hence could be understood as deficient in some respects, only bettered

with the formulation of TPB. Importantly, the key components of the theory were intention/motivation as well as actual behaviour. Simply presented, the theory suggests that predictors of actual behaviour are intentions or motivations (Langdridge et al., 2007; Thompson et al., 2012). As such, the theory is useful for its predictive slant (Marangunić & Granić, 2015) which makes it possible for researchers to anticipate adoption or rejection depending on a group's characteristics. However, it is nonetheless problematic because there are many more factors than intention, which determine actual behaviour. Situating this critique within technology adoption particularly in contemporary times, it is easy to recognise that access, availability of resources and regulations pose structural challenges to adopting technology. If approached as a subjective matter, the theory of planned behaviour makes clear that subjective norms, attitudes and perceived behavioural control all play mediating roles to intentions which then affects behaviour. Even then, not all relationships are direct. As a result, the theory of reasoned action is a very simplistic with an overly deterministic approach to understanding behavioural outcomes such as technology adoption. To give the theory some practicality, in the context of renewable energy, a business may have a positive attitude toward solar power and feel social pressure from other firms in its industry to adopt it (subjective norm). However, without consideration of external barriers such as the cost or regulatory complexities, TRA falls short in fully explaining why adoption does not occur.

Given such an examination, alternative perspectives are worth considering as part of an excavation of the theoretical input and debates around behavioural approaches to technology adoption. The status quo bias, technology acceptance model and diffusion theory avail insights which are useful to consider.

2.2.2 Status Quo Bias

The status quo bias theory is a cognitive theory which explains the evaluative judgment of the end user (Lee & Joshi, 2017) when faced with the choice to either persist with a familiar pathway/tool/technology or switch to an alternative. In summing up the theory, one scholar has observed that often, "individuals have a strong tendency to remain at the status quo, because the disadvantages of leaving it loom larger than advantages" (Kahneman et al., 1991, 197-198). The costs of adopting a new technology, innovation,

intervention or idea may initially be deemed to be too high when an already existing solution is in operation. Under such circumstances, the choice may often be to persist with the familiar and perhaps over time, slowly switch to the new solution. To account for this behaviour, numerous cognitive factors are deemed important in accounting for the individual's eventual decision.

Applying status quo bias to renewable energy, large industrial firms in South Africa may be hesitant to transition to renewable energy due to entrenched investments in existing infrastructure. Despite rising electricity prices, status quo bias can explain the reluctance to switch to renewable energy due to concerns over the upfront cost and perceived risks. More broadly, the theory is not just cognitive but entails cognitive misperception, psychological commitment, and rational decision making (Wu, 2016). In this sense, the cost-benefit analysis helps account for the rationality while failure to comprehend an innovation may represent misperception. Resorting to a change made by Coca-Cola Company in 1985, Nebel (2015) presents a practical veneer to shed light on how status quo bias plays out. Despite offering a new product which was meant to be sweeter than the original, reception from the American market was hostile, resulting in retention of the original formula. The key point here which is relevant for the theory discussed and the research presented here is that where a new product or solution is introduced, there may be uptake but for many, resistance to the intervention is widespread with preference for the familiar persisting. Given the established scholarship on adoption of technology in the renewable energy sector (Agrawal et al., 2024; Chi et al., 2023; Shahzad et al., 2022; Su & Fan, 2022), the processes and pace of adoption could be accounted for by the status quo bias. It is inconceivable that all producers have adopted innovations and technology at the same pace if at all. The pace of technological change is itself rapid such that some producers and consumers will most likely have missed out on some innovations.

2.3.3 Technology Acceptance Model

In a quest to predict factors which best combine to result in adoption of technology, two theories (the technology acceptance model and unified theory of acceptance and use of

technology) stand prominently as both mutually supportive and widely referenced (Marikyan et al., 2023). Importantly, as predictive theories, both identify various stages to the adoption *process*. That is, adoption is not an event but constitutes a series of steps which include individual or collective assessments of attitude, consideration of intention and then eventual use behaviour. Marikyan & Papagiannidis (2023) add that in the unified theory of acceptance and use of technology, besides the subject-specific predictive features, 'performance expectancy, effort expectancy, social influence and facilitating conditions' also account for adoption or rejection of a technology. In this sense, there are individual, social as well as contextual factors which influence the technology adoption process.

The Technology Acceptance Model's simplicity and focus on individual perceptions make it a popular model for studying the adoption of renewable energy technologies at the consumer level. For example, if consumers perceive solar panels as beneficial and easy to maintain, they are more likely to adopt them. However, TAM's limitations become apparent in its failure to account for broader contextual influences, such as environmental concerns, policy incentives, and social pressures, which are often crucial in the renewable energy sector. In practical terms, a firm may view solar panels as useful in reducing electricity costs (perceived usefulness), but if they perceive the technology as too complex or difficult to integrate into their existing energy system (perceived ease of use), they may hesitate to adopt it despite its potential benefits. The theory asserts that two primary predictors perceived ease of use (EU) and perceived usefulness (U) and the dependent variable behavioural intention (BI) (King & He, 2006, 740).

2.3.4 Diffusion of Innovation

Writing on diffusion as a general concept, Rogers (2003, 5) states that it is "process in which an innovation is communicated through certain channels over time among the members of a social system." His insights have spawned into diffusion theory which explains why the introduction of new technologies is not met by widespread adoption; instead, a period of lethargic uptake ensues before either adoption or redundancy of the technology. The Diffusion of Innovations (DoI) Theory posits that technological adoption

occurs through a social process where innovations are communicated over time among participants in a social system. It categorises adopters into five groups namely, innovators, early adopters, early majority, late majority, and laggards based on their willingness and speed to adopt new technologies. Four features (compatibility, complexity, trialability, and observability) are considered essential in adopting technology. In addition, when appreciating a technology's adoption, diffusion theory considers, each innovation's set of pros and cons, or attributes; the characteristics of adopters, especially potential adopters' perceptions of opinion leaders' reactions, or social influence; and the larger social and political context, including the salience of issues related to the innovation, how proponents and opponents frame the meaning of the innovation, and the timing of its introduction (Dearing & Cox, 2018, 185).

There is therefore contingency which determines whether, when or how technology is adopted. This perspective contrasts with theories, such as theory of reasoned action, which largely emphasise subjective factors in technology adoption. Since adoption is not a single widespread activity due to individuals being 'heterophilous' (Eder et al., 2015), there are numerous stages which account for the multiple stages of group adoption. These adopter categories are (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards (Rogers, 2003). The graphic representation of the stages is as follows:

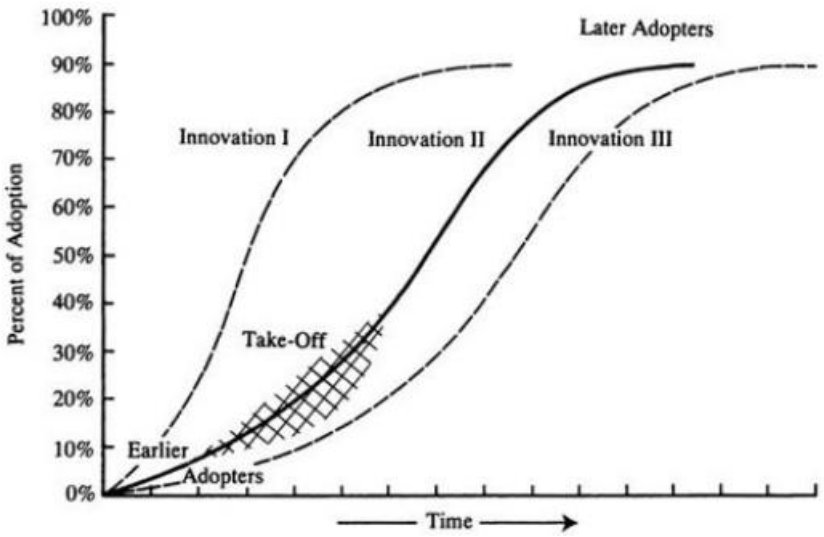

Figure 3: The Diffusion Process

Source: Rogers (2003, 11)

Diffusion of Innovation's focus on the social process contrasts with TAM and UTAUT's more individual-centric models. While TAM and UTAUT emphasise personal perceptions (usefulness, ease of use, social influence), Diffusion of Innovation provides a more collective viewpoint but may oversimplify individual decision-making processes. Moreover, Diffusion of Innovation and TPB intersect in acknowledging the importance of social influence, but TPB delves deeper into the psychological aspects, such as perceived behavioural control, that Diffusion of Innovation overlooks. This makes TPB more suitable for understanding why some individuals resist adopting renewable energy technologies even when their social environment is supportive. If deploying DoI as a lens to decipher practice in renewable energy, an intervention which employs solar PV systems might suggest relative advantage (lower operational costs) and observability (visible installations). However, their perceived complexity and lack of trialability (since they require upfront investment) have slowed diffusion among certain demographics or industries.

2.3.5 The Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) integrates elements from multiple models, including TAM, to explain user intentions to adopt technology and their subsequent usage behaviour. It includes four key constructs: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions.

UTAUT is particularly useful for studying the adoption of renewable energy technologies in organisational and policy-driven contexts. By incorporating factors like social influence and facilitating conditions, it recognises the complex interplay of individual perceptions, social pressures, and external enablers that drive technology adoption. However, UTAUT's complexity can be a double-edged sword; while it captures a broader array of influences, it can be cumbersome to apply and may require simplification for practical use.

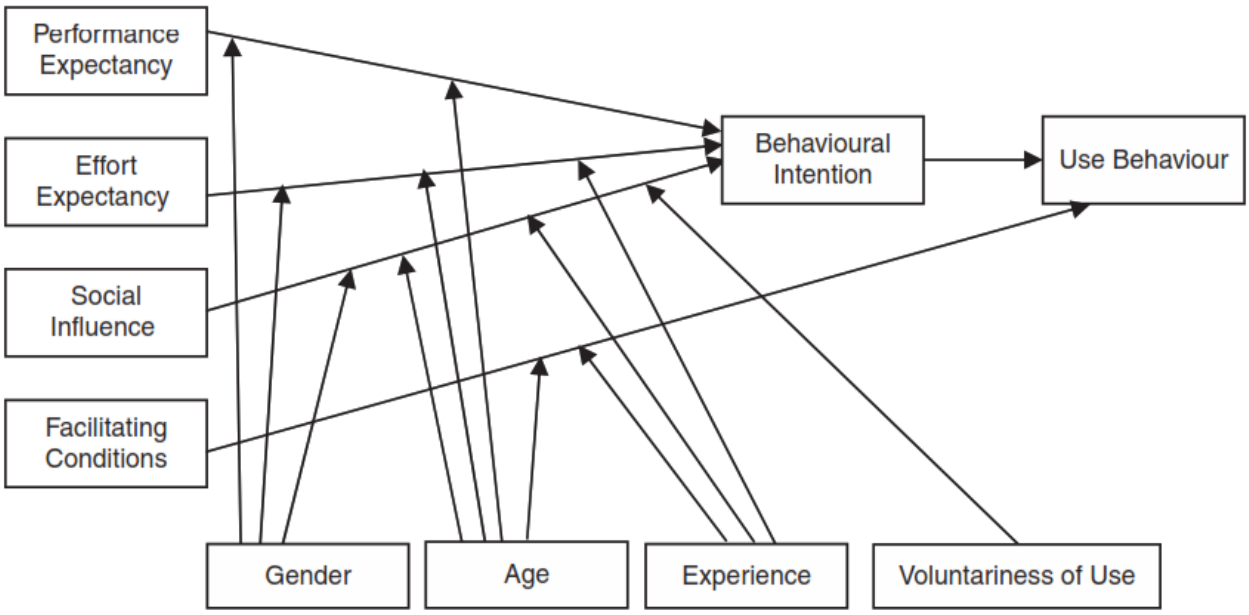

Figure 4: Model representation of the Unified theory of Use of Technology (UTAUT)

Source: Williams et al. (2015)

In relation to the technology acceptance model, UTAUT offers a more nuanced understanding by expanding on TAM's basic premises. Where TAM focuses narrowly

on usefulness and ease of use, UTAUT introduces social and contextual factors, making it better suited for the multifaceted renewable energy sector.

When considered, the theory of planned behaviour, UTAUT and TPB both consider social influence and perceived control, but UTAUT is more technology-specific, while TPB is broader and can be applied to any behaviour. In the renewable energy sector, UTAUT might be more directly applicable to technology adoption, while TPB could be used to understand broader behavioural intentions, such as the willingness to engage in pro-environmental practices. However, in application in renewable energy, UTAUT's focus on individual performance expectancy may not fully capture organisational motivations, such as corporate sustainability goals or risk mitigation strategies that are critical in adopting large-scale renewable energy systems.

For a holistic understanding of renewable energy adoption, it is essential to integrate these theories, recognising that adoption is driven by a complex interplay of individual perceptions, social influences, behavioural intentions, and external conditions. The renewable energy sector, with its unique challenges and opportunities, demands an approach that combines the social insights of Diffusion of Innovation, the individual focus of TAM/UTAUT, and the behavioural depth of TPB. By synthesising these perspectives, stakeholders can better design policies, incentives, and interventions that facilitate the widespread adoption of renewable energy solutions, ultimately contributing to a more sustainable future. Developing a framework in this light, the study sketches its theoretical framework which will inform analyses in subsequent sections of the paper.

2.4 The study’s theoretical framework

In attending to the dynamic of technology adoption, the study acknowledges the status-quo bias as a useful theoretical model to account for inertia as well as diffusion of innovation model in accounting for instances of adoption of technologies. A fusion of the two theoretical perspectives recognises the stop-start nature of technological adoption both at individual and corporate level. The logic in acknowledging the two is partly influenced by the study’s ontological grounding. As a qualitative study which is interpretivist, the study recognises that there is unlikely to be a single, stable truth or

reality in how and why technology is either adopted or foregone. Rather, there are likely to be numerous dynamics at play, giving rise to adoption in some instances and aversion in others.

The theoretical approach adopted in this paper draws inspiration from Shirish & Batuekueno (2021) who formulate a theory called user resistance model. The theory is a hybrid comprising of the status quo bias theory, the theory of planned behaviour and the equity implementation model. Merging theories was deployed to harness core strengths of available perspectives which then reduces the shortcomings of individual theories. The study recognised the possibility for technology adoption by some participants while others may have resisted new technologies. As such a balanced theoretical approach sufficed too fully capture dynamic behaviours in the field.

2.5 Conclusion

The adoption of renewable energy solutions by South Africa's C&I companies is influenced by a complex interplay of economic, technological, environmental, and social factors. While there are significant benefits, including cost savings, energy security, and environmental protection, challenges such as high initial costs and regulatory barriers need to be addressed. Continued technological advancements and supportive policy frameworks are crucial for facilitating this transition.

Chapter 3: Research Questions

3.1 Purpose of Research

South Africa's C&I businesses are critically dependent on a stable and reliable energy supply to sustain operations. However, the country is currently facing a severe energy crisis. The coal power stations not only contribute significantly to CO_2 emissions and global climate change but also jeopardise the environmental sustainability of the country. As South Africa is committed to international agreements aimed at reducing greenhouse gases, there is an urgent need to transition to cleaner and more sustainable energy sources (Department of Environment, Forestry and Fisheries, 2019; Eskom, 2023).

Despite the clear environmental and economic imperatives, the adoption of RE solutions within South Africa's C&I businesses remains limited. Renewable energy adoption is faced with multiple barriers, including high initial capital costs, technological challenges, and regulatory uncertainties. These obstacles hinder the widespread adoption of renewable energy technologies such as solar, wind, and biomass, which are crucial for reducing dependence on coal and mitigating environmental impacts. Continued reliance on coal-based power not only exacerbates the environmental crisis but also threatens the sector's long-term economic viability due to potential future regulatory penalties and market shifts towards greener practices. This scenario underscores the need for a comprehensive understanding of the factors influencing renewable energy adoption within the C&I space, as well as the development of strategic interventions to facilitate this transition.

3.2 Research Question

This research seeks to address the critical question: **What are the key factors influencing the adoption of renewable energy solutions by South Africa's C&I businesses**, and how can the adoption be enabled to promote a sustainable energy transition?

This study explored the various dimensions of renewable energy adoption, including the economic, technological, and policy-related challenges faced by C&I companies. It also examined the potential benefits of renewable energy, such as cost savings, enhanced energy security, and reduced environmental impact. By providing a detailed analysis of these factors, the research offered practical recommendations for policymakers, C&I business leaders, and other stakeholders to accelerate the adoption of renewable energy solutions in South Africa's C&I sector. Before attending to the actual findings however, the framework in which the study was structured is presented. The starting point in presenting this framework is in highlighting the literature it engaged and the theoretical debate in inserted itself into.

Chapter 4: Research Methodology

4.1 Choice of Methodology

The study made use of an interpretivist philosophy which is hinged on the study of social phenomenon in its natural settings as advised by (Saunders & Lewis, 2018). Tracy (2019) argues that interpretivists believe that knowledge is built and manifest through communication and practice, thus knowledge about reality is mediated through the researcher. In this regard, this study contributes to the knowledge on the factors influencing the adoption of renewable energy solutions by South Africa's C&I companies. This is achieved by interacting with data and the empirical secondary evidence from the study area, which was undertaken within the natural environment of the participants.

Some recent scholarship has focused on adoption of technology from quantitative methods. These include the following:

Table 2: Methodologies of some select studies on technology adoption in renewable energy

Author(s)	**Methods**
Mishra et al. (2022)	Exploratory Factor Analysis.
Ayaz & Yanartas (2020)	Structural equation modelling.
Osunmuyiwa & Kalfagianni (2017)	Fuzzy set qualitative comparative analysis.
Higueras-Castillo et al. (2019)	Structural equation modelling.
Dato (2018)	Bivariate probit model
Salim & Rafiq (2012)	Fully modified ordinary least square (FMOLS), Dynamic ordinary least square (DOLS), and Granger causality

The tabulated studies point at mainly quantitative approaches in the study of technological adoption. The current study avoided such a methodological direction to

focus on qualitative dimensions to the same phenomena. Its focus was also unique in that the context was South Africa which has received limited attention and more importantly, on a population of practitioners with some level of expert knowledge.

4.2 Population

For Saunders & Lewis (2018) a population comprises of the comprehensive set of group members that a sample may be extracted. Overall, these are the people, events or things that are the universe of the interest of the study, which cannot be studied as a whole. Such a universe of interest is the source where the researcher picked the sample from. The population of the study comprised of professionals working for IPPs companies in South Africa, that interface with the key stakeholders involved in the process of C&I businesses adopting renewable energy solutions.

4.3 Unit of Analysis

Chan & Clarke (2021) describe a unit of analysis as that aspect that shows the central or emphasis of any research. Furthermore, Bell et al. (2022) have understood the unit of analysis to denote the critical and core aspects of a research that all the processes and related procedures all focus on. Thus, such is the cardinal and key feature of any study, and the realisation of the study's objectives is dependent on that unit of analysis. Therefore, the unit of analysis in the study was professionals, particularly those involved in business development, working for Independent Power Producers (IPPs) in the South African renewable energy industry. This choice was guided by the exposure of these professionals in the renewable energy space, obtained through research and development and engagement with C&I businesses and other key stakeholders within the renewable energy value chain.

4.4 Sampling Method and Size

The study used a non-probability sampling approach of judgemental sampling. Sekaran & Bougie (2016) describe judgmental sampling as a method that involves the choice of

subjects who are in the best position to provide the information required. This is when the researcher uses their own discretion and knowledge of the population to select the units that are going to be representative of the population in a study. Additionally, Tracy (2019) posits that, judgmental sampling is used when the researcher is not worried much about the probability of getting everybody in the population having an equal chance of being included in the sample. Overall, sampling as a process is premised on feasibility since it is costly, impractical, and time-consuming to study an entire population (Sarker & Al-Muaalemi, 2022). Thus, the sample size of the study comprised of respondents which include professionals working for IPPs operating in South Africa involved in the process of assisting C&I companies adopt renewable energy solutions. Foremost, the sample made efforts to reflect representativity in terms of race, gender, and other demographic parameters. The researcher used personal contacts and referrals obtained through their experience working in the renewable energy industry for over 10 years. Because of the researcher's long-standing experience in the renewable energy industry, gaining access to most of the participants was not difficult. The researcher knew many of the firms which employed participants. Resultantly, reaching out to people in these firms was relatively easy. Some potential participants were people known to the researcher in professional and personal/social circles and so the researcher deliberately avoided engaging them for fear of importing some bias into the interviews.

4.5 Measurement Instrument

The measurement instrument for the study was a semi-structured interview guide. An interview is a guided, purposeful conversation between two or more people on an agreed theme or topic (Solarino & Aguinis, 2021). Interviews are a method of gathering data that gives the researcher an option to directly interact with the study's participants and ask questions and engage in structured discussions (Weeks & Schaffert, 2019). The study used a semi-structured interview in which, according to Saunders & Lewis (2018), all respondents are asked the same set of uniform questions with little variations depending on the theme, with their responses being captured or recorded. The choice of this instrument was informed by the research design, explained in detail in the previous sections. In the study, the researcher prepared one interview guide for

professionals working for IPPs. This was conducted to ensure that the study gathers data from individuals that have insight from various stakeholder including decisions makers in C&I company, that have adopted or are looking to adopt renewable energy solutions, government officials and other key stakeholder. Regarding secondary data, organisational reports, news reports and coverage of renewable energy transition, just energy transition and C&I developments in South Africa were considered. The news articles covered in mainstream media particularly with a national and provincial profile were privileged. As such, smaller publications and coverage in less prominent and obscure platforms was omitted.

4.6 Data Gathering Process

The study collected both primary and secondary data to ensure that the trustworthiness of the findings is improved in the research. Primary data were collected using interviews while secondary data were be collected using a desktop literature or secondary documentary analysis. The researcher had an option to ask follow-up questions and participants can seek clarity on any of the questions. The capturing of data was done using an audio voice capturing device, while the researcher was taking down handwritten notes to summarise the processes and empirical data. As mentioned in the sample size section, the research made use of contacts within the industry to obtain the information through interviews. The potential interviewees were contacted and sensitised to this research upon approval of this study.

A consent form was issued prior to each interview. Prospective research participants read, understood, and signed before the commencement of data collection sessions. The form contained a clause that disclosed to them that their answers were captured using an audio voice capturing device, giving them an option to withdraw at any time. In the dissemination of research findings, no identifiable information was disclosed. Data was presented in aggregate form or with anonymised quotes to ensure that individual respondents cannot be identified. Any data shared with third parties (e.g., for peer review) was redacted or de-identified. This process was also part of the commitment to

improve the trustworthiness of findings. The study further collected and analysed secondary data that was gathered using a desktop research approach.

4.7 Analysis Approach

The study used thematic and content analysis to analyse data. With the former, focus was on primary data while the latter was for secondary data. Kiger & Varpio (2020), define thematic analysis as the use of various interrelated themes to group like data together and deriving meaning out of data. While content analysis is a method that is used to methodically evaluate the representative contents of all forms of recorded communications. In the same context, content analysis can be used to analyse newspapers, websites, advertisements, and reports (Kiger & Varpio, 2023). Thematic analysis of primary interview data took the shape of the textual categorisation of responses based on themes that the researcher had derived from the empirical data itself, the research aims, the purpose statement as well as the interview guide. The study made sure that in the data analysis chapter, there was a section on the analysis of the empirical data as well as another one that focussed on the secondary data analysis.

Within the primary data findings section, the study offers the theme descriptions, provides a highlight of what the researcher asked the participants, and offers some selected interview excerpts showing the respondents of the research participants. This is followed by the analysis which infuses empirical research with literature arguments to substantiate this data including findings by previous researchers on the topic. The researcher also cross-references data with discussions elsewhere in previous chapters of the research project to support the empirical data. At the end of each theme, the researcher discusses the findings deriving of the empirical data analysis before moving to the next theme. Some of the themes that this analysis has include, the aspect of the various factors influencing the adoption of renewable energy solutions by C&I companies thus providing the barriers and constraints against adoption and the perceived benefits for adoption. The secondary data analysis section includes the titles of documents and key arguments contained therein.

4.8 Approach Selected

The study uses an inductive approach which is hinged on reasoning that researchers observe specific phenomena and, on this basis, arrive at general conclusions. They, therefore, build from the more specific phenomena to the more general. In the study, the researcher first collected data on C&I companies, in its current form, looking at their interest or aversion to adopting renewable energy solutions in South Africa. This was undertaken to understand and build knowledge based on the company's observed practices provided in the public domain.

4.9 Methodological Choices

This study was a qualitative methodology paradigm. Qualitative research is premised on the approach that seeks to explore and understand the meaning individuals or groups attribute to an observed real-life societal issue (Saunders & Lewis, 2018). The study explored the factors that influence the adoption of renewable energy solutions by South Africa's C&I companies. To obtain further detail on this, the sample included professionals working for IPPs to gain insight on the industry and what their observed influence is from engagement with C&I companies and the renewable energy industry in general.

4.10 Time Horizon

The study was cross-sectional in its nature. According to Saunders & Lewis (2018), a cross-sectional study refers to a 'snapshot' study targeting a particular event of timeframe. In the study, this time horizon is used because once-off data collection at one point in time was deemed sufficient, therefore the use of a cross-sectional time horizon.

4.11 Quality Controls

There are various measures of quality data that this study used. Foremost, there was the objective construction of research instruments with the help of the research

supervisor to ensure that the research instruments are scientific and are not biased. Secondly, there was the collection of adequate data and the inclusion of both experts and other categories of respondents in the sample. Such ensured that the in-depth and experts' insights are infused with the laymen ones to balance the quality of the study. Also, the researcher was neutral and avoided inciting emotions in the study. Furthermore, the study used the quality controls of qualitative studies which include credibility, transferability, dependability, confirmability, and crystallisation to ensure that the data and findings are trustworthy and believable. Credibility can be realised through prolonged engagement with research participants to make sure the transcripts from the interview recording are authenticated (Terrell, 2016). The quality benchmark of transferability was realised through comparing one's results in other similar contexts. This ensured that the researcher also compared their findings and data theme with those of other related and previous researchers to make sure there is congruency and synchrony.

4.12 Limitations

Diamantidis & Chatzoglou (2018) noted that, limitations of a study are the factors that can act in influencing the findings of the study. The study's limitations entailed a methodology which did not provide an in-depth focus on qualitative aspects of the phenomenon under study. However, this limitation did not impact on findings because the focus of the study was to qualitatively explore the adoption of renewable energy solutions by South Africa's C&I companies. Secondly, the study did not have a huge sample because the study was for a short-term academic research project. This was not entirely problematic as the research did not attempt to generalise findings; neither did it seek full representation of all actors in C&I companies. Also, the use of secondary data aided in making sure that the findings of the study were more reliable, believable and authentic.

Another limitation of the study related to the time-consuming nature of using interviews, which left the researcher to undertake approximately fifteen interview sessions or until saturation was reached. In the same vein, the use of interviews is anchored in the

assumption that the interviewees are honest and answer questions as truthfully as possible, and the researcher does not have control on any biases or subjectivity that the respondents might have. Lastly, the study faced the limitation of being a cross-sectional study where data were collected once-off thereby leaving a longitudinal analysis of the research study topic.

Chapter 5: Findings

5.1 Introduction

The preceding chapters laid out the research agenda, literature around the subject of interest, and methodological matters. This chapter shifts focus from conceptual and empirical debates and justifications for the study to actual findings made during research. As such, it spotlights the study's own empirical contributions prior to analytical input. The findings are drawn from fifteen participants who took part in semi-structured interviews which were held on Microsoft Teams. The profile of the participants is provided in the table below.

Table 3: Profile of Participants

Respondent	Job Title	Organisation	Location
SSI 1	Snr. Planning & Control Officer	Enel Green Power - IPP	Johannesburg
SSI 2	Project Manager	Pele Green Power - IPP	Johannesburg
SSI 3	Project Developer	Aced - Developer & IPP	Cape Town
SSI 4	Project Developer	Pele Green Power - IPP	Johannesburg
SSI 5	Wind Engineer	Red Rocket - IPP	Cape Town
SSI 6	Project Developer	Aced - Developer & IPP	Cape Town
SSI 7	Business Owner / Entrepreneur	In Pursuit Africa - IPP	Johannesburg
SSI 8	Head of Commercial	Enertrag - IPP	Johannesburg
SSI 9	Snr. Grid Engineer	Sola Group - IPP & Developer	Johannesburg
SSI 10	Business Developer	Enel Green Power - IPP	Johannesburg
SSI 11	Snr. Project Development Manager	Juwi Renewable Energies - EPC/ IPP	Cape Town
SSI 12	CEO/ Entrepreneur	Mesama Investment	Johannesburg

SSI 14	Business Development Director	Fortescue - Iron Ore Producer	Cape Town
SSI 13	Business Developer Officer	Enel Green Power - IPP	Johannesburg
SSI 15	Managing Director	Sturdee Energy	Johannesburg

The table reveals a diverse professional composition of the participants. It also sheds light on the organisational affiliation as well as geographic distribution. Participants self-reported years of experience which were just as broad as their occupations. Some participants had worked for three years while others had experience spanning to the early inception of renewable energy in South Africa. As such, their insights have levels of depth which varied.

The gender distribution is presented in the graphic below where 60% identified as male while 40% were female.

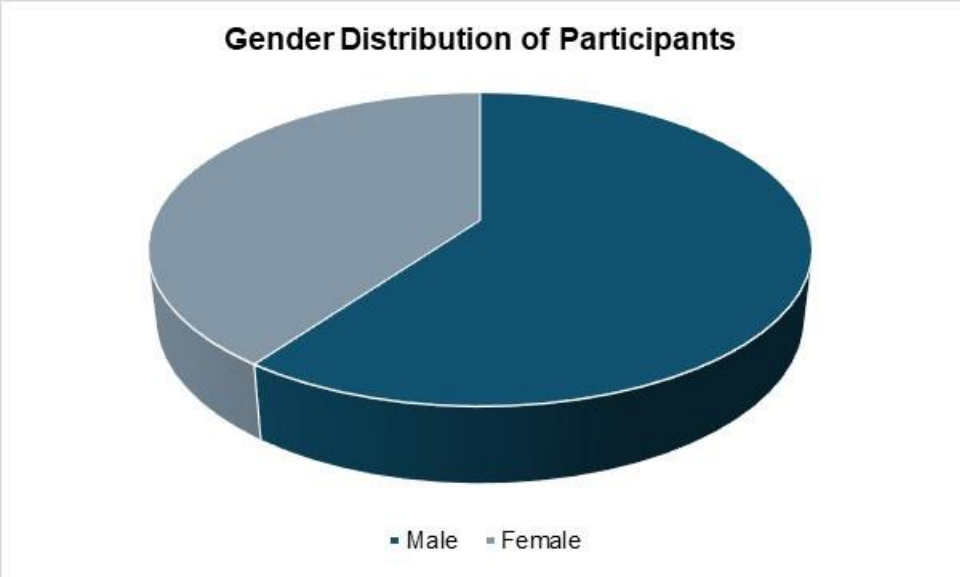

Figure 5: Gender distribution of participants in the study

The gender distribution was not intentionally meant to be representative of South African employment distribution but nonetheless reveals a male-dominated composition of the sample.

Importantly for this chapter, the findings presented respond to the study question: **"What are the key factors influencing the adoption of renewable energy solutions by South Africa's C&I businesses, and how can the adoption be enabled to promote a sustainable energy transition?"** As such, the chapter attends to the factors identified by participants, the perceived levels of adoption and measures available and deployed to promote a sustainable energy transition.

The figure below provides a conceptual model that summarises the business need and theoretical framework that this research is built on. It also provides the findings from the semi-structured interviews conducted to answer the research questions detailed in chapter three.

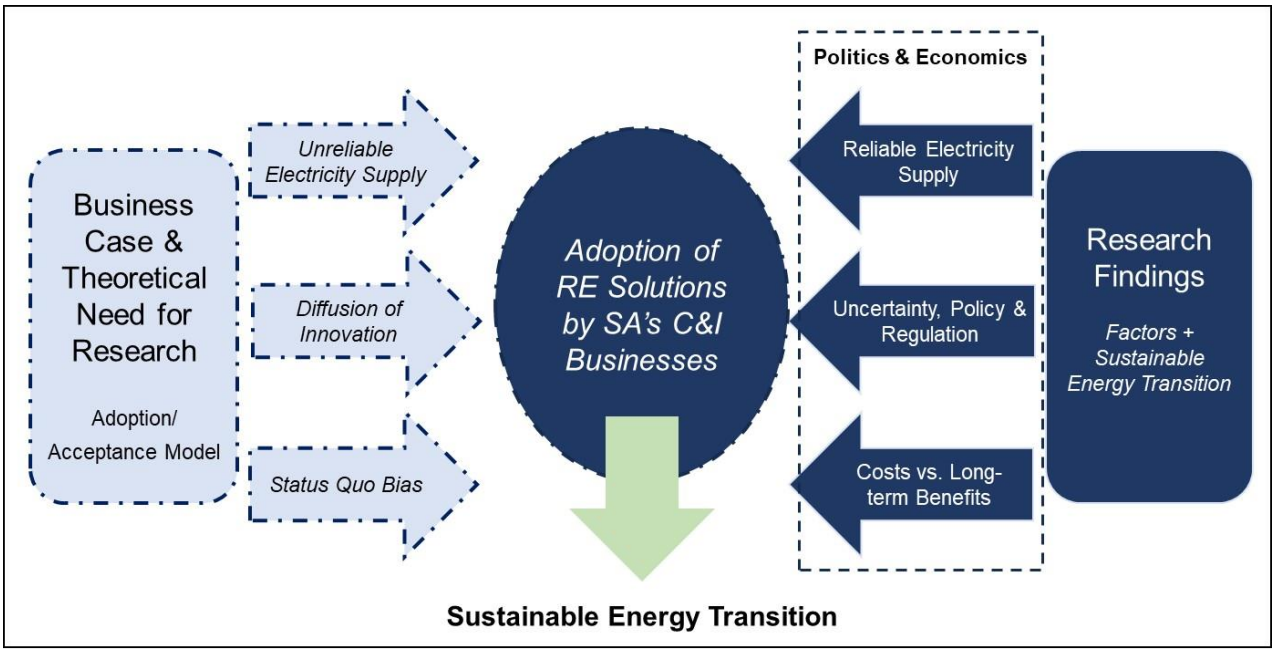

Figure 6: Conceptual Model Summarising Research Findings

5.2 Factors in Renewable Energy Adoption

To explore factors which were key in renewable energy solutions, the study considered both the adoption of renewable energy and potential influences which serve as real or perceived barriers. As a starting point, the section attends to findings on the adoption of renewable energy solutions by C&I businesses. In some, the adoption of RE solutions

by C&I businesses in South Africa is influenced by several interrelated factors, including load-shedding, increasing electricity prices, energy unreliability, and time-consuming regulations. These challenges collectively shape the decision-making process for companies considering a transition to renewable energy, affecting both the pace and feasibility of adoption.

5.2.1 Adoption of renewable energy in C&I businesses

Common challenges which were identified in the interviews include energy unreliability, time-consuming regulations, inconsistent supply, load-shedding, increasing prices of electricity and an erratic market characterised by instability of supply and demand. For businesses in C&I, such challenges contributed to an operating environment which was deemed difficult to plan for. As such, finding solutions for the medium and long term was an option of some importance. A major starting point was in dealing with load-shedding via RE solutions.

The adoption of RE in South Africa can be understood as a development which is marked by two distinct yet related eras. The first phase started around 2008 and was largely led by government efforts to usher in RE as a viable dimension to the country's energy mix. The second and more recent phase started around 2017/8 and accelerated during the latter parts of the COVID pandemic. A key feature of this second phase was the heightened application of power supply interruptions, colloquially and now officially known as load shedding. This load shedding which represents an energy crisis was variably understood by participants. This complex appreciation is best captured in the words of one participant who noted that

> *"*the crisis did a good thing and all that on the other side, it also kind of did a bit of a bad thing in in the sense where. These green creatures think that renewable imaging is a silver bullet, which is not." – SSI 2.

The implications for households and corporates were generally negative and, in some instances, dire. However, for participants who work IPPs, the energy crisis represented a major turn in their prospects. Narrating this dimension from a broad political and economic standpoint, one participant indicated that:

there was legislation, but of course you know the shortage in supply and the growth in population and industrialisation in the country has had direct effect on how much is available and the country as a whole has had to look at other means and that's when someone in in 2010, 2011 we start seeing the emergence of the RE program and over the years you know it's moved with the times and also led to the birth of private initial development and procurement through the C&I market" – SSI 3

SSI 5 concurred with this sentiment, acknowledging that the energy crisis was generally positive for IPPs; so too did SSI 9 who added that "renewable assets are generally faster to develop and to build than non-renewable assets" - SSI 9. Detail on how the crisis was positive can be drawn from responses on the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).

Although attended to as a discussion on the evolution of the renewable energy sector in South Africa, an evident dimension to the factors affecting renewable energy adoption was the progressive demise of REIPPPP. As one senior grid engineer indicated,

> Most of the companies basically because of the uncertainties in the public procurement program, they have basically pivoted into C&I space and in direct access into the mining companies. So those that actively participated in the public programs are now active in the C&I space as well. So, we're seeing a lot of companies competing in that space for sure, yeah – SSI 9

The reference to uncertainties in the public procurement program casts light on C&I responses to a shaky REIPPPP. The REIPPPP was government-initiated in 2011 on the back of prior efforts dating back to white paper on energy policy (1998) and white paper on renewable energy (2003). At the time of inception, the program was placed under the guidance of the Department of Energy, National Treasury and Development Bank of South Africa with an IPP office responsible for power purchasing agreements in the Department of Energy (now Department of Mineral Resources and Energy – DMRE). In the intervening years since 2011, projects have covered an energy mix incorporating wind, solar PV, CSP, hydroelectricity, landfill gas and biomass all amounting to more

than 90 projects valued at more than R50 billion and garnering a reputation as a reputable template for renewable energy modelling. Although the program had a developmental slant resulting from its 70:30 split between economic justification and economic development impact, it nonetheless has suffered a decline in appeal due to a competitive tendering model whose bid windows have however resulted in some winning contractors failing to deliver on their projects for various reasons. It is in this context that there was a greater opportunity for C&I businesses, the shine of REIPPPP has waned.

5.3 Energy transition

In engaging the possibilities of an energy transition, the study primarily considered the role of C&I businesses as well as that of government. The climate change agenda which is also understood as decarbonisation featured among responses offered. Equally prevalent were socio-economic factors as well as grid reliability. Barriers to adoption of renewable energy solutions by C&I firms were engaged. In South Africa, the transition is largely from coal-powered energy.

5.3.1 Factors

A key spur for the adoption of renewable energy was identified as grid reliability; reliability of electricity supply; capital; know-how or right the skill set; governments regulations; pricing; energy demand; energy security; policy related obligations; targets to meet; and greenhouse gas emission.

Grid reliability was a euphemism for loadshedding. Load-shedding, which refers to the controlled shutdown of electricity supply to prevent grid overloading, presents a significant operational disruption for many businesses. For C&I businesses, frequent power cuts mean lost productivity, increased costs, and potential damage to equipment. As a result, the instability of the national grid forces businesses to explore alternative energy solutions, such as solar or wind, to maintain uninterrupted operations. However, the unpredictable nature of load-shedding adds complexity to planning renewable

energy projects. Firms may find themselves needing to invest in costly storage systems, such as batteries or backup generators, to mitigate the risk of power cuts, which complicates the adoption process.

Energy unreliability, characterised by frequent outages, added another layer of complexity to the energy landscape for C&I businesses. When power supply was inconsistent, a feature which was especially consistent during the latter part of President Cyril Ramaphosa's first term in office, businesses tend to experience operational disruptions that can lead to downtime, reduced productivity, and equipment malfunctions. To counter this, many small and large firms are increasingly turning to renewable energy sources to achieve greater energy self-sufficiency. As responses by numerous participants indicate, solar and wind power have proven to be excellent sources of power for generators seeking to avoid or reduce their reliance on the national grid. Participants indicated that the major actors in embracing wind and solar energy were mining companies such as South 32, Anglo American, Sibanye Stillwater and Exxaro. Equally present among commercial and industrial entities seeking either solar or wind (or both) were hospitals, agricultural concerns such as AgriSA as well as data centres and shopping malls. One participant's response is particularly striking for its focus on actors involved and the ploy taken by some businesses. Responding to a question on which C&I companies are taking up renewable energy solutions in South Africa, he said:

> if you look at shopping centres like shopping malls or most of those so it might. I think they'll probably be managed by some property investment companies, kind of they already looking into the space a lot more. shopping malls. I've seen hospitals, even private hospitals. I've seen lots of them as a result. I think the main challenge there as you know is they require constant supply of electricity. And when we had the massive load shedding issues, they needed support from renewables to be able to keep up some of their machines running and now what we're seeing because of the challenges with the intermittencies of renewables we're seeing now most clients looking for a hybrid solution of either wind, wind and base or PV and base kind of solutions to support their industries – SSI 9

The response cited above highlights two salient features of the C&I response to energy unreliability. The first is that a diverse array of firms has begun to enter the C&I space as part of their effort to mitigate against energy deficiencies from the main traditional supplier, ESKOM. The second and particularly interesting feature is that C&I firms are incorporating a blend of solutions in their adoption of alternative energy sources. In other words, considering solar alone or wind alone is proving to be a pathway which some businesses are not committed to. Instead, they prefer to augment wind to solar or solar to base or variations of such options.

C&I firms are also understood to be firmly driven by the decarbonisation agenda which is not unique to South Africa. The decarbonisation agenda is tied to climate change. However, it represents commitments and obligations made by businesses and governments to reduce their carbon footprint/emissions before a specified time has elapsed or been attained. SSI 7 made reference to this in noting that with respect to C&I firms in South Africa,

> “we've had to, you know have this discussion on advising them on how to procure green energy because they are pressing funding terms with their international investors, which they've been given a deadline by when they should start injecting a portion of green energy in their power supply”. These sentiments reflect a deliberate ploy to incorporate green energy by firms due to pressure from their international partners. Failure to adopt or embrace green technologies will most likely culminate in failure to secure contracts and eventual closure as competitors step in.

Equally vital among the factors discussed by participants was price. Rising electricity prices have further incentivised businesses to consider renewable energy options. As the cost of grid electricity continues to climb, energy-intensive operations are becoming increasingly expensive, prompting businesses to seek long-term solutions that offer cost savings. Renewable energy, particularly solar power, can provide a more predictable and lower-cost energy supply after the initial investment is made. However, despite the

potential savings, many businesses face financial barriers, as the upfront capital required to install renewable energy systems can be prohibitively expensive. This is particularly true for small and medium-sized enterprises (SMEs), which may struggle to secure financing or absorb the initial costs of transitioning to renewable energy.

5.3.2 Barriers

While adopting RE is a boon given the prevailing energy challenges, some barriers militated against its adoption. Among the barriers noted were lengthy timelines related to policy, cumbersome regulation, limited financial backing, as well as politics and society (readiness of a market to adopt a solution). In addition to these were barriers which played out in terms of differences in the time horizons of businesses. Here, C&I businesses were deemed to be “looking for shorter term PPAs as opposed to the long term PPAs and the IPP needing to sort of justify commercially on our side is also proving a bit difficult.”

With regards to costs and capital demands, one participant indicated that the high up-front costs; "we import a lot of our material from Europe and China, which makes it costly.” Moreover, “building your own power station is really capital intensive” implying that few entities were capable of promptly entering the market with solutions of their own. The initial capital outlays needed to sustain a renewable energy solution for large business was addressed by some participants by pointing out the longevity of contracts as well as the period it takes before profits can be realised. Although cost is easily understood in direct relation with adoption of energy, there is a layered conception which can be extracted as well. One participant’s contribution makes this dimension especially clear. With regards to C&I businesses, the sheer amount of energy required meant that the cost of installation was more than likely to be immense. She said,

> if you are talking about the C&I space and the energy requirements of some of these C&I customers, we're not talking about just a rooftop installation we're talking about multiple megawatts of supply. So, for smaller businesses, yes you can [instal small units]. You can certainly implement a solar solution with a battery. But the amounts of megawatts that are required to feed the

starving energy system is much bigger; this grid infrastructure is lacking" – SSI 8.

The point made here is that costs are likely to be high due to the sheer demands required by C&I businesses. As such, when and where they opt to generate their own energy, punitive costs stand in the way of the firms. In addition to cost and operational challenges, time-consuming regulations present significant barriers to renewable energy adoption. The regulatory environment in South Africa is often marked by lengthy approval processes, complex legal frameworks, and bureaucratic delays. These factors can significantly slow down the installation and integration of renewable energy systems into the grid. For many businesses, navigating these regulatory hurdles is a time-consuming and resource-intensive process, discouraging the adoption of renewable solutions, particularly for businesses that require more immediate energy alternatives. The secondary data on renewable energy regulatory processes is replete with multiple stages which each take different time frames to clear. An indication of some of the processes which encompass meeting regulatory demands is best presented by a graphic (see Figure below) from the Department of Environmental Affairs. The graphic highlights the multiple steps which are followed on a technical level as well as in the public participation process.

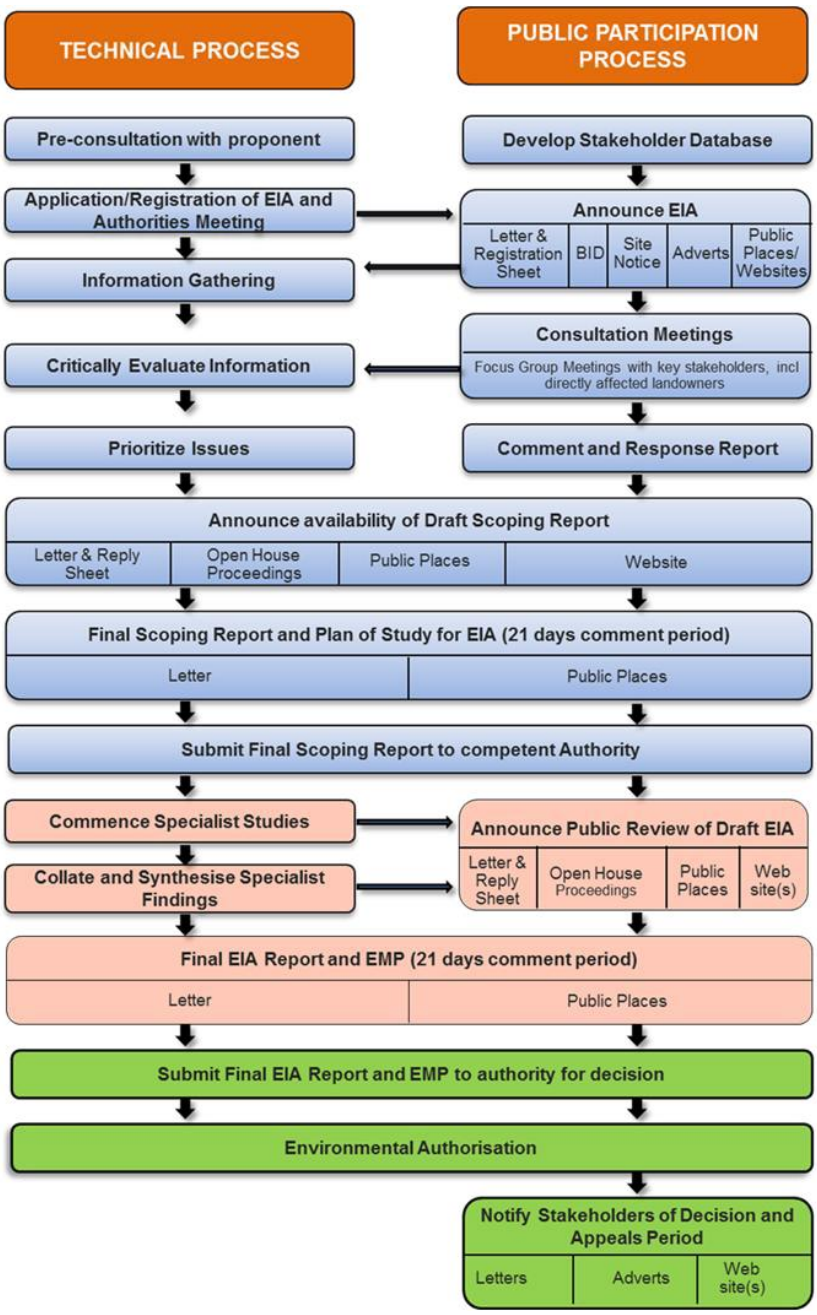

Figure 7: Regulation of renewable energy in South Africa's Department of Environmental Affairs

Source: (Department of Environmental Affairs [Republic of South Africa], 2013, 64)

The multiple stages which are outlined in the graphic above are generalised. Where the technology is photovoltaic, the requirements are slightly modified to incorporate

additional demands in solar energy regulation; just as well, where wind energy is concerned, the regulations also increase to reflect the specific demands of regulation on wind technology.

A challenge facing C&I businesses is the limitations related to grid and infrastructure accessibility and availability of skills within C&I businesses to confidently adopt renewable energy solutions. The grid capacity was the subject of intense competition between emerging C&I entities, those IPPs operating under the projects devised by REIPPPP as well as ESKOM. With ESKOM struggling to meet demand, the fierce competition for the grid was between IPPs and C&Is as well as among each other. Commenting on the challenges relating to the grid, one participant noted that,

> access to the grid is a challenge, apparently because there's a queuing system with the grid and because of that you can't just simply build upon in and access the grid. So, a lot of consumer and industrial businesses realise that that's a complication that some are not willing to navigate as well as there's limited expertise and knowledge within the space – SSI 1

Getting access to the grid meant joining a queue which was not always the most enticing of prospects where a C&I firm sought to use the grid or grid infrastructure to meet its immediate goals. It was not clear how this complexity would fare out in a context where wheeling was a popular solution to the infrastructure challenges.

The matter of knowledge and skills is very key in understanding the limitations which C&I businesses encounter. Here a distinction is important between users and generators. With respect to C&I clients or users, one insightful contribution offered suggested that:

> With clients that are trying to procure new open power, they don't necessarily understand all the inputs that go into the whole concept of renewable energy, they know that they want renewable energy as an alternative supply to ESKOM. But the inner workings of it, and how everything comes to having your megawatts being generated, they are not familiar with it. So, there's still a lot of that. I don't know…. It's late adoption from the C&I space that could

> also be like a hindrance in terms of how they are quickly adopting renewables because they need to 1st build that knowledge. It's the same thing with us. When we started with the renewable energy program. We did not know what we were doing? In 2011, when they were awarded, it was the first time for all of us. We had to learn everything. So now it's 20… Sorry, it's 12/13 years later. We know how the rules turn, whereas they've only started like two years ago. So, they are still learning this whole process and you must also remember C&I, people when you talk about people in their mines etcetera, they are old school people. – SSI 5

The participant added that knowledge shortcomings also featured with respect to regulations and policy. The key insight overall is that knowledge gaps prevail in the renewable energy sector for C&I players. However, underlying the knowledge gaps are issues to do with path dependency, stage of market development as well as conceptualisation of renewable energy. In the latter case, the participant indicates that although one might know that they need a solution to circumvent ESKOM's shortcomings, the knowledge of what a desired solution actually is and how it works is at times amiss. This, in her opinion, is a shortcoming which demands scrutiny as it poses conceptual and material implications for a C&I business. It is an opinion which was echoed by SSI 8 who indicated that

> 'C&I customers don't understand renewable energy and they don't understand, you know what it means for the energy mix' in instances where solar is the only choice they have and yet access to sunshine is very limited.

As an earlier section has already suggested through the insights of yet another participant, some C&I firms have since been observed as adopters of a mix of energy solutions. Compounding to this shortcoming is the limited skilled labour in the sector available to C&I businesses. SSI 1 indicated that "experienced artisans not readily available" and this meant that decisions around energy were at times rather poor. However, changes were underway as some firms particularly in mining other larger size C&I companies had begun to recruit project developers and engineers with expertise in

renewable energy. SSI 13 is an example of a professional that transitioned from an IPP to a C&I firm, recruited specifically to head adopted renewable energy solutions.

5.3.3 Government's role

If companies involved in C&I recognise the value of adopting renewable energy solutions for their corporate interests and government sets the tone for actors in the sector, what then does government do to facilitate ease of establishing and operating in renewable energy for C&I businesses? Alternatively, what interventions did the government have to allow for C&I businesses to pivot on available renewable energy technology which would then be vital for sustainable futures? Participants were neither hostile towards the government nor completely endorsing of it. The participants noted that the government had intervened via formulation of an IRP, developing regulations, granting developers access to Eskom's infrastructure via wheeling as well as setting rules of the game and controlling players.

In addition, there were operational forms of support as was the case when government endorsed market intervention via Eskom and NERSA to reserve grid capacity. A key intervention on the government's part pertained to who could produce excess energy for sale to either ESKOM or another client via wheeling. One participant noted that from government's "perspective, there've been a lot of changes in the policies and the procedures to help expedite, for example, the permitting" In addition, government "has also put together NECOM which is, you know, the one stop energy, one stop energy shop, right. So, you register your project on that platform", SSI 4. The government was therefore aware of the market inefficiencies and sought to devise ways to enable better interaction between players in the market.

Consistent with the positive light in which the government was perceived, numerous participants indicated that they appreciated the relaxation of "some of the rules or they're trying to make processes faster" – SSI 6. This positive sentiment was especially shared in reflecting on government's move to allow for more generators in the sector and then to allow them to produce energy without state interference up to a capacity of 100MW.

Often cited was the shift by the government from a very constrained set of regulations governing the generative capacity of IPPs to a policy which supports the formation of individual and collective generation and/or energy security. The intervention by the government of South Africa can also be understood as making leeway in terms of independent whether it is a REIPPPP project, or a C&I project; National Interest.

> Sometimes you need to be wary of just giving people free passes on assets that are seen as being of national importance, like the grid, so that could be one the reasons you don't wanna say C&I or private players control the grid then. You've lost one of your most important national assets, so I said one would be. National interests and the second one would be policy and political play whereby there are certain spheres of government are ruled by certain people, and they prefer things done a certain way - SSI 6

The words above which came from an individual working in the private sector for an IPP shows that some participants appreciate interventions which incorporated non-commercial interests. By and large, the factors which have been presented and the challenges associated with adoption have shown a strong awareness of economic concerns. Yet, in SSI 6's contribution above, a more elevated concern for national security is demonstrated, which makes for a much deeper meaning of energy security.

Among some participants, the government of South Africa was understood to intervene in the renewable energy industry for various reasons, some of which were referenced and are presented here. One such reason was to protect national strategic interest while the other was for efficiency and productivity reasons as the following shows. Speaking during an interview held 15 September 2024, and in response to the question ''How is government enabling the adoption of renewable energy solutions by C&I businesses in South Africa?' SSI 5 indicated that "…maybe the easiest example is how the CAP was basically removed in terms of you being able to generate up to let's say whatever megawatts you want to; the removal of a generation license" SSI 5

So far, the position of government has been presented through the lens of participants who were predominantly actors in private energy generation. As such, the actual voice of government has remained silent. On 30 September, the researcher attended a seminar hosted by the Department of Energy. The seminar was attended by both government officials and by invitation, private sector interested parties. Speaking at the seminar in a keynote speech, the minister of electricity indicated that the country faced an energy quadrilemma – a portmanteau highlighting a four layered dilemma. The quadrilemma was deemed peculiar to south Africa, as opposed to the more widely established trilemma. Importantly, the quadrilemma added “national interest” as a key concern for government in regulating and shepherding the renewable energy industry. This feature was an appendage to three concerns in the form of access (which translated to both availability and affordability); sovereignty; and sustainability (GovernmentZA, 2024).

Faced with these peculiarities, the government had adopted the role of facilitator, bringing various perspectives together and encouraging conversations about how to improve prevailing positions. All this was done to make energy more accessible to consumers, create employment and to hoist South Africa’s stature as a leader regionally and globally in renewables.

5.4 Anticipating sustainability

The study sought to explore whether the adoption of renewable energy solutions could enable and promote a sustainable energy transition. In adopting this tenor, the study was concerned with broader socio-political goals emanating from the adoption of renewable energy by C&I businesses. At the forefront of discussions with participants in this regard were the state’s roles in either supporting or complicating the interests and goals of C&Is. Participants largely spoke about these issues through forecasts of whether they envisaged a positive future for C&Is in renewable energy. Responding to such probing, one participant indicated that renewable energy and C&I was

> An exciting industry to be part of, I think there's still a lot that's going to happen to change. Think it's exciting in the sense that you know the laws

> are not as rigid as in in other industries. There's always room for flexibility which comes with and a lot of change, fast paced change and you know, lessons along the way. And I think you know the next few years are gonna be very exciting. The past few years, a lot of people would have laughed if you spoke about Wheeling, you know, or the private market. - SSI 3

For SSI 8 and SSI 9, the government was anticipated to continue playing its “traditional role” of policymaker and rule maker while allowing potential growth for private entities to develop new products or to “create benefits to the C&I space through the use of those final products that come out of it.” The anticipation was that various actors in the sector would stay in their lanes, only for new offerings to emerge and enhance product experience.

Adopting a different perspective SSI 5 opined that

> “I think in the next few years, if we were to overcome all the challenges that we do have, we will see a lot more of the C&I clients being within the renewable energy space.” This perspective foretells a structural shift in the make-up of the industry as current clients of ESKOM shift entirely from being consumers of renewable energy to producers or as some scholars might have it, “prosumers” (Dumitrescu et al., 2022; Inês et al., 2020; Milčiuvienė et al., 2019).

Whatever the structure and makeup of the industry, what remains clear is that the interlocutors all recognised the continued relevance of renewable energy together with C&I businesses. In this sense, the sustainability question was answered in the affirmative. The case for a sustainable future was especially solid given the contributions of participants considering prospects for REIPPPP. In short, where C&I was growing in South Africa as an area of development and energy generation, the prospects for REIPPPP were rather bleak.

5.5 Renewable energy transition

The second part of the research question attended to how adoption could be enabled to allow for renewable energy transition. Although not extensively engaged, there were

some comments from participants which enabled for some key insights into the thinking about renewable energy transition. The renewable energy transition was understood as a transition from fossil energy “that emphasises moving towards a low carbon economy while addressing the social impacts on of phasing out coal” (SSI 01). As such, it was perceived as a shift from one energy mode to another while retaining sensitivity of social concerns. A key starting point in this area was commentary on what the prevailing energy crisis had meant for an energy transition. From one participant’s perspective,

> Probably the energy crisis has impacted positively on the transition to renewable energies because the country is funding itself in in the strong need of power, and because of that, the government speed it up or tried to speed up on programs that would deliver fast, new energy in the grid - SSI 10

Consistent with the notion that the transition had been accelerated by the energy crisis, SSI 07 an active role in being not only, you know, a stumbling block, but rather an enabler, to this transition that we are all going through as a country." As such, one key element in the transition process which by some accounts was well underway was the energy crisis which the country faced. The transition itself is led in part by various entities whose agenda goes beyond attaining profits. Among these are new shareholders with a social cause who work in collaboration with other external parties. The working arrangement in part was detailed by one participant in the following words, indicated that the

> "uptake of renewable energy has also motivated the public sector… a lot of NGOs and that are quite powerful lobby groups in South Africa, and you see them challenging a lot of the fossil fuel companies [and] Government to try to transition away and move away from fossil fuels, coal and gas and really try focus on renewables as the least cost solution, but they're very powerful in in the country - SSI 13

The complexities of transition were noted as particularly marked in regions such as Mpumalanga. In this part of the country, the tensions between old and new were

particularly marked. Having traced the geographic distribution of renewable energy solutions across the western and north-western parts of the country, one of the study's interlocutors then turned to Mpumalanga and noted that,

> For Mpumalanga region, there's this whole just energy transition discussion. And you know the impacts and sort of having to also educate stakeholders in that region about renewable energy projects. People are losing their jobs in the coal sector there - SSI 08

For the participant, the immediate real/perceived impact for many in Mpumalanga was loss of employment. The opportunities brought by alternative energy were not immediately visible. She went on to emphasise the urgency of the matter among the stakeholders by quizzing rhetorically how an entity could "move into an area where there was predominantly an industry that was the core job creator and you coming in with this new aspect". This tension played out even in the public media between government and labour as well as among ministers. A brief reflection of some of the notable public exchanges suffices.

Speaking at a seminar attended by the researcher, the Minister of Electricity and Energy indicated that the European Union was not backtracking on its move to ensure a carbon border adjustment mechanism. The mechanism is designed to restrict products whose carbon footprint is deemed undesirable and products from regions which have made little effort to ensure that a climate justice agenda is addressed. This is additional pressure on developing countries which is meant to steer economies away from fossil energy to renewables. However, there is a long-drawn debate over the morality of demanding that developing countries move away from energy sources which they have access to while moving to new forms of energy which may put them at a disadvantage. The dilemma plays out in international fora as suggested by the Minister of Electricity and Energy. However, they also animate relations within the country. There are few areas where this particularly manifest more than between labour and the renewable energy industry.

Within South Africa, coal is used to generate between 75% and 82.8% of electrical energy. As such, the economy continues to be heavily reliant on fossil energy despite the pressure suggested above and in spite of recent moves to embrace newer solutions to renewable energy. The mining industry itself employs more than 150 000 people who depend on it as a primary livelihood. Given such figures, it is almost obvious that the coal industry is a vital cog in the energy industry.

Organised labour and government had for some time before the study signalled concern and warnings that dispensing with coal would be problematic for them. A phased approach would be preferable although even then, it would have to take a long time while simultaneously creating jobs for workers in the renewable energy industry. The challenges were further explained by some scholars as including a mix of

1. minerals-energy-complex which exploits black labour and has been in play for over a century.
2. views from the department that the just energy transition is an extension of some neo-colonial agenda. Where an agenda is not imagined,
3. institutional incoherence
4. conflict of interest in the department

With respect to navigating challenges with making way for renewable energy, the coal mining sector faced a mix of challenges both within and from external pressures. A minerals-energy-complex existed which translated to deep-seated interests over what parts of the economy were privileged and protected. Related to this first complexity were perceptions by the current government that the pressure to transition was designed to disrupt the economy and transfer profits to non-South African interests. Within the department itself, there was incoherence in parts which meant that pressing matters sometimes did not get sufficient attention. Nonetheless, Mohlakoana makes clear that fears abound among miners since they imagine that the costs of upskilling are immense and with many having worked many years in the industry, they do not have much time to enter a new sector anyway. The fears have also been amplified by trade unions and the government who recognise the threats to social security posed by discontinuing coal

mining. In a province such as Mpumalanga, this would imply loss of jobs for many people who directly benefit from it and many others who are indirectly tied to the industry.

5.6 Conclusions

In conclusion, while load-shedding, rising electricity costs, and energy unreliability are driving C&I businesses to explore renewable energy solutions, time-consuming regulations and high initial costs remain key obstacles. Addressing these regulatory inefficiencies and providing more accessible financing options could significantly accelerate the adoption of renewable energy in South Africa's C&I sector, ultimately helping businesses achieve greater energy independence and cost savings.

The next chapter ties together the findings, literature and the analytical frames deployed by the study. In this sense, it presents a concise analysis of renewable energy adoption and challenges among South African C&I businesses as articulated by the research participants.

Chapter 6: Discussion of Results

Having presented the research findings in the preceding chapter, the research report now presents an analysis of the findings. The analysis is provided within a theoretical framework which incorporates the status-quo bias as well as the diffusion of innovation model. As analytical frames, the two enable an insightful look into the findings made and informs a theoretically guided response to the study's research questions. To recap, the study sought to explore the key factors influencing the adoption of renewable energy solutions by South Africa's C&I businesses, and how the adoption can be enabled to promote a sustainable energy transition?

Before engaging in a detailed analysis of the findings, it is useful to flag a key point concerning the theoretical tools. Among some of the criticisms of status quo bias is a moral tone which renders suggestions of bias less as objective criticisms and more as personal attacks (Gaede & Meadowcroft, 2016). With this in mind, the current chapter is presented neither as a moral critique nor as a moral analysis. Instead, it constitutes an examination of participant contributions as well as scrutiny of secondary data. Via the status quo bias, the chapter argues that although South Africa has been among the continent's countries at the forefront in adopting renewable energy both at policy level as well as in practice, it also continues to be confronted by inertia when adoption of new solutions is presented. This is particularly evident in the recent rapid adoption of renewable energy generation by C&I on the spur of an energy crisis. Barring this crisis, it is highly debatable that much movement would have transpired in adopting available solutions.

6.1 Adoption in C&I

The study explored factors which are considered as salient by participants in adoption of renewable energy solutions by C&I businesses. Three prominent dimensions emerge, and they were barriers, regulations particularly on the part of government as well as systemic factors. In general, the discussion below asserts that this study's findings are consistent with Akintande et al. (2020) who find a range of determinants for adoption of

renewable energy. They note that "credit provided by financial bank sectors, GDP growth, being an oil-exporting countries, land surface area, population increase, industry value-added, gross capital formation, school enrolment tertiary (% gross), urban population (% of total), the effectiveness of government, political stability, control of corruption, and rule of law as well as oil demand, electric power consumption, and agriculture, are the determinant of renewable energy adoption in the five selected African countries". While there is convergence around identifying the factors, there also prevails some gaps in the analysis as this study reveals. In the 2020 study cited above, little attempt is made to highlight how and why such factors are instrumental while in the study presented here, commitment to the status quo and sluggish movement in adopting dominate as overarching themes.

6.1.1 Barriers

The main barriers to adoption of renewable energy by South Africa's C&I businesses were cost, regulation, and grid capacity. As indicated in the findings chapter, the cost of setting up and maintaining operations in renewable energy were progressively declining but remained high. As such, few local producers could come on board in the market and even then, they often needed a partner because of the high cost of acquiring competent skills. The status quo bias would suggest that adoption of new solutions and technologies under such circumstances is slow. In similar fashion to diffusion of innovation theory, the adoption of technology was lethargic, reflecting a tendency to delay and then progressively enter the market. The renewable energy industry was generally characterised by frequent innovation on the technology used and this meant that capacity and performance improvements were made while costs also decreased over time.

Concerning regulation, the findings resonate with Nwaiwu (2021) whose focus on Nigeria and South Africa finds that there is a disconnect between policy and industry efforts in achieving of digital technologies into renewable energy. The key insight here is the gap between policy and practice. As already noted in the study, a gap prevailed which emanated from a slow-moving government whose opening of the policy space

was lethargic. When the policy environment was transformed to welcome more players, C&I were quick to occupy it, to the extent that some participants noted that the government flagship REIPPPP was facing imminent demise. Under these circumstances, the diffusion of innovation theory points at a two-paced process of technology adoption. On one hand is the government which although initially aggressive in adopting renewable energy in 2012, has since become very slow; on the other is C&I which has been quick to embrace renewable energy technologies. In this sense, regulation and policy constraints were indeed barriers but once attended to, opened immense opportunities for the participants.

6.1.2 Factors

Factors which were prominent in participant narratives of C&I adoption of renewable energy solutions were price and reliability of electricity supply from utilities. Researchers such as Chen et al. (2017) have for some time established that costs do not shape *attitudes* towards adoption of renewable energy solutions. This is not to suggest that price and costs are not considered both in setting up and in consuming renewable energy. Rather, attitudes are not easily moved by these factors alone. In the study, price was a factor often cited as prominent in adoption of renewable energy. While the focus was not on attitudes, it is important to deepen the analysis by considering how prices have shifted over time and what that has meant, considering the study's theoretical framing. Speaking at a seminar in Johannesburg, the Minister of Electricity and Energy indicated that since the inception of renewable energy policy in South Africa, the costs of setting up solar has declined by more than 60%. The downstream effect is also increasingly declining prices of energy generated via renewable solutions. The Centre for Renewable and Sustainable Energy Studies (2024) also notes that there has been a downward trend since 2010.

Understood via diffusion of innovation, the price factor appears to progressively enable greater adoption and inclusion in the renewable energy space. It is perhaps not surprising that this should be the case since many players in the C&I sector are new entrants who might have avoided renewables at previous prices. With the price of energy

generated via renewables fast converging with Eskom's price, the current adoption by C&I businesses finds consistency with some of the claims from diffusion of innovation theory.

A second factor mentioned in the study was reliability of energy supply. The comments around this matter were particularly salient given that South Africa was emerging from the struggle of an unprecedented phase of elevated load-shedding. Studies on the African continent have observed that energy generation is tied to broader socio-economic, socio-political and technological factors (Aboagye et al., 2021; Gboney, 2009; Mirzania et al., 2023; Osunmuyiwa & Kalfagianni, 2017); the enjoinment with such factors also plays out in renewable energy generation and distribution. Given the disruptive nature of erratic supply on businesses, the shift to adopt renewable energy solutions becomes somewhat easier if not relatively urgent. In such circumstances, delay due to biases as well as progressive diffusion of innovation is somewhat less prominent. Rather, as the findings suggest, the poor supply of electricity appears to have compelled firms particularly in C&I to invest in alternative energy sources of their own and in the process, wean themselves from dependency on ESKOM.

The theoretical lens that this study deploys advance arguments which the findings appear to contradict. Delays due to bias towards an established solution or delays due to slow or progressive adoption did not appear to occur when faced with unreliable energy supply. While this analysis is based on a snapshot of the renewable energy story in South Africa, it must also be stated that the energy crisis has simmered over many years starting around 2008 (Davies, 2021) and C&I businesses have had a reasonably long time to assess conditions then decide on a course of action to take. In this sense, C&I entities have taken time to transition to renewable energy, a position which, could be argued, to be consistent with diffusion of innovation. In this sense, the study finds consistency with Eder et al. (2015) who observe that households persist with familiar technologies unless there are exceptional instances where technical, economic and social factors converge. Moving away from familiar technologies, which economists

discuss via the concept of path dependency, is not easily done at household level and the study has found similar positions by C&I businesses.

Although Tigabu (2017) uses a different conceptual framework for his paper, the current study finds consistency with the observation that technology innovation systems require strengthening and support particularly at policy level. The factors attended to in this study which incorporate grid allocation as well as government's roles collectively hint at policy interventions which affect adoption. These were presented in Chapter 5 in separate sections.

6.1.3 Government role in adoption of renewable energy by C&I

In a later section of this chapter, a discussion is presented on the politics of adoption in South Africa. The section will attend to the complexities of adoption which put government, labour and producers together. In the current section, attention if placed firmly on the role of the government in influencing renewable energy adoption in South Africa. Government's roles were understood as comprising of devising an IRP, developing regulations, granting developers access to Eskom's infrastructure via wheeling as well as setting rules of the game and controlling players. These roles can alternatively be presented as regulating, monitoring and facilitating renewable energy adoption. Although not a developer, the government may also be understood as active and pivotal in the renewable energy sector particularly for C&I business.

As the main facilitator of conditions in the industry, the government has been progressive to enable C&I involvement in the renewable energy sector. The change in regulations allowing for private generation up to a specified capacity enabled quick adoption of renewable solutions. In making a swift move to enable independent producers room for production, the government demonstrated that they could promptly insert policy (Lu et al., 2020) to adopt renewable solutions. However, as noted in the preceding subsection, much movement in recent times has been prompted largely by the energy crisis and less because of the need to innovate or the urgency to introduce other players into the sector. This observation is not to belittle government's proactive role in formally embracing renewable energy solutions when it was still unfashionable particularly in the

sub-Saharan region (Ouedraogo, 2019). Moreover, the government as facilitator has been at the helm of providing institutional and infrastructure which the C&I businesses keep an eye on from time to time. While such contributions are vital, they have nonetheless struggled to avail sufficient resources in the ministry.

Despite the foregoing, it is useful to deepen the analysis in a theoretical sense. Given the state's stop-start treatment of renewable energy adoption and its implications for adoption among C&I, what does this imply considering the diffusion of innovation theory? Alternatively, what does the adoption process reveal seeing as in 2012 South Africa's government was quick to move in policy terms yet became stuck and is only now moving fast to enable the adoption of renewable energy solutions by C&I businesses. The research suggests that the stop-start nature of South Africa's adoption amounts to a "lurching diffusion" which reveals a move from one level of adoption to another. By Rogers' (2003) account, the adopter categories in his theory are (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards. This would suggest that with the introduction of technology, entities identify with one stage at a time. Yet, because C&I rely on government for their adoption of technology, the government's responsiveness to adoption is a determining factor in how C&I also adopt renewable energy technologies. The result is that both government and C&I have been involved in a process of moving and stopping in their adoption. Over time, the early adopters have become laggards and then moved swifty again to represent yet another phase of the diffusion process. This observation directly engages findings such as Tigabu (2017) who argues for the adoption of Technological Innovation Systems to systematically understand the enabling institutional context of renewable energy technologies. He also argues that strengthening the functional build-up of the systems is crucial to increase the diffusion of renewable energy technologies in Africa. Notably, the focus of his lens is on systemic change which this paper recognises but augments as there are structural determinants of adoption such as the sustainability and political issues in the following subsections.

6.2 Anticipating sustainability

For many years, sustainability has been a desirable outcome for renewable energy industries across Africa. The study findings were consistent with Aliyu et al. (2018) who observe that prospects for various renewable energy “sources” have high prospects in three of Africa’s leading economies: South Africa, Nigeria and Egypt. Participants were optimistic that renewable energy was possibly a technology which would yield sustainable benefits. Focusing precisely on South Africa, Naicker & Thopil (2019) add a framework around which to consider sustainable utility scale selection. Based on the study findings and the diffusion of innovation theorisation, the anticipation is that over time, the wide adoption of renewable energy as a technology will culminate in sustainable solutions to the energy crises as well as more conservation-oriented interventions on the environment. Rogers (2003) posits that diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system. The progressive adoption of renewable energy solutions follows a diffusion model in the sense that as renewable energy technologies have changed, adoption of improvements have followed a time lag. Importantly for sustainability, the global uptake of renewable energy coupled by the global agenda to address climate change, and its effects have meant that sustainable solutions are increasingly in demand.

The study finds consistency with Usha Rao & Kishore (2010) whose review focuses on renewable energy and sustainability. Sustainability is at the centre of renewable energy interventions by states, private sector entities and in the programming of non-state entities. The inclination towards adopting renewable energy as a sustainable solution was however tempered by contextual factors which complicated pace and scale of adoption. As some participants indicated, among C&I firms the intervention was no longer on how to consume clean energy alone but how to also produce cleaner energy which meant a reduced carbon footprint. In part, this was due to better technology and the pressures of an energy crisis. Nwaiwu (2021) addresses the adoption of renewable technology as a policy and regulatory matter which nonetheless responds to the urgency of sustainability concerns. In sum, adoption of renewable technology among C&I

businesses in South Africa was approached not just as a commercial or technology advancement initiative but, served as a sustainability and climate change issue. However, sustainability matters and adoption of renewable energy in general are not simple matters detached from a complex political terrain. The analysis now addresses this complexity as a politics of adoption.

Of note when considering the contributions on sustainability is that while anticipations were positive, the actual attitude towards climate change has been found by Rabaa et al. (2022) to be caught in status quo bias which in some instances work both ways. That is, people or organisations can either retain the familiar to persist with harmful practices, as the retention of coal appears to suggest in South Africa or flipped for positive purposes into a new climate-friendly status quo. The adoption process which is underway in South Africa finds elements of both because of the government's preference for prolonged use of coal and simultaneous opening of the policy space to enable new entrants such as C&I businesses to entrench renewable energy as an emerging or even new status quo.

6.3 Politics of adoption

The last section presented in the findings alluded to the politics of renewable energy adoption in a broad structural sense as well as considering C&I. In a nutshell, the environment in which renewable energy technologies are introduced is one characterised by persistent contests between unions and producers as well as tensions between the state's development agenda and multilateral demands for reform. This section attends to these two aspects individually.

To start off, adoption of renewable energy is persistently challenged by tensions between organised labour which has a strong representation in mining (where coal remains a vital part of the industry) and new technology whose proposition is deemed a threat to security of employment. In other words, if alternative energy is adopted, what becomes of the miners who are currently employed? If statements by the responsible ministers are to be taken as indicative of the future of energy in the short-to-medium

term, then adoption of renewable energy is certainly not universal. The government continues to retain an interest to keep sections of the carbon-emitting economy open and active. This finding is consistent with observations by Mohn (2020) whose focus was on the international energy agency's report. However, focusing on the same institution, Gaede & Meadowcroft (2016) disputes claims of bias, preferring to recognise more complex political shifts and interests. These debates notwithstanding, the current study observes that in the South African context, labour and the state occupied positions which to some extent reflect a bias to the status quo. The state was however less committed to retaining the status than labour sue to increased pressure to diversify the energy crisis as well as stated commitments to diversify the energy mix. Labour on the other hand maintained an aggressive stance, opting to persist with coal-fired energy, which would ensure preservation of jobs, instead of switching to renewable options. Mirzania et al. (2023) have already alluded to the prevalence of socio-political constraints in the development of South Africa's renewable energy sector. This paper finds consistency with their findings in noting socio-political complexities in adoption of renewable energy technologies/solutions. However, the current study has given nuance to these complexities by flagging the textured position of government (sometimes resistant and sometimes receptive). It has also indicated the role of labour in complicating the environment.

The second area wherein adoption of solutions has been complicated relates to the ties between state development and multilateral demands for a just energy transition (GovernmentZA, 2024). Findings noted the current and impending pressures which highlight these tensions. Again, the status quo bias offers useful theoretical lens through which to understand the prevailing tensions. With the state cognisant of large coal reserves and aware of the developmental potential to be extracted thereof, discarding coal and switching to renewable presents both an appealing prospect as well as a lost opportunity. The result so far has been lethargic pace towards renewables and obstinacy to discard from coal. Again, status quo bias does not suggest a zero-sum game where actors remain committed to a known technology or solution. Rather, as a number of scholars (Aboagye et al., 2021; Lee & Joshi, 2017; Shirish & Batuekueno, 2021) have

noted, progressive change to a new technology may transpire as the status quo slowly evolves. As such, it is hardly surprising that despite government's inflexibility, there is a progressive albeit slow shift towards renewable energy adoption at policy level and now in practice among households and more importantly, for the C&I sector.

The politics of adoption reveal a deference towards maintaining the status quo unless exceptional circumstances come to the fore. The study has suggested that much of the recent adoption by C&I has been motivated by demand and supply incongruencies which the government, via Eskom, has failed to resolve. The decision to shift from state-dominance over generation and transmission appears to have been determined by pressure on the market. Such an outcome indicates that *ceteris paribus*, the status quo would have been retained. In this sense, the study recognises the work by Naicker & Tholip (2019) which advances a decision-making matrix for renewable energy adoption. It further finds resonance with the suggestion that persisting with the status quo is largely a process of decision-making which in the study's case was principally government's responsibility. When pressure had come to bear and C&I could now decide on whether to enter or not, they moved swiftly.

6.4 Conclusions

Considering the discussion presented and developed in this chapter, the two theoretical frames shed light on how the adoption process of renewable energy has transpired in South Africa. Besides mere adoption, the discussion has particularly attended to adoption by C&I businesses whose role in extending and utilising renewable energy has grown in recent times. A key observation is that adoption has not always been swift. In fact, the latest uptake of renewable energy solutions has primarily been ushered by shortcomings in the supply of energy in South Africa. The literature makes clear how there are numerous systemic, structural and ad hoc factors which come to play in shaping renewable energy adoption in South Africa (Longe, 2021; Mkhize & Nel-Sanders, 2023; Nwaiwu, 2021; Oguntona et al., 2021).

One of the main catalysts for renewable energy adoption by both C&I businesses and the government was the energy crisis. Having initially opened the renewable energy policy space through the IRP and REIPPPP, the pace of adoption post 2012 proved remarkably slow. The chapter has highlighted that this transpired amidst Eskom's failures to meet demand. The situation was then compounded by political choices which came to the fore both locally and in global contexts. Locally, the government has been reluctant to hurriedly adopt renewable energy technologies for fear of stirring social strife due to frustrations with organised labour. The coal mining industry is a formidable force in this regard. With respect to international actors, the concern is with shifting away from coal to renewables. Various forms of pressure are exerted on developing countries despite some developed countries retaining the use of fossil fuel. This contested space has been attended to as a politics of adoption which manifests in sluggish adoption by the government as well as strong bias for persisting with technologies of the past.

The chapter recognised barriers to adoption which also affect adoption of renewable energy technologies by C&I businesses. The barriers were largely responsible for slow uptake of technologies, a position which is consistent with diffusion of technologies theory.

In the following chapter, conclusions and recommendations are presented considering the findings and discussion engaged. The recommendations will particularly focus on theoretical, methodological and empirical directions which research in future can attend to.

Chapter 7: Conclusions and Recommendations

The study sought to explore the processes in adoption of renewable energy solutions by South Africa's C&I companies. It addressed a gap in the scholarship regarding adoption of renewable energy solutions in developing country contexts. In the case of this research, a focus on South Africa. To do this, the research questioned what the key factors were in influencing the adoption of renewable energy solutions by South Africa's C&I businesses, and how the adoption could be enabled to promote a sustainable energy transition? As such, a qualitative research design was employed, relying on semi-structured interviews as well as secondary data sources. The data were thematically analysed resulting in the findings which are sketched in the subsection below.

7.1. Summary of Key Findings

The study found that load-shedding, rising electricity costs, and energy unreliability were driving firms to explore renewable energy solutions. However, time-consuming regulations and high initial costs remained key obstacles. These issues constituted some of the factors and barriers influencing adoption of renewable energy solutions particularly by C&I businesses.

Politics of adoption

Equally prominent in the accounting for the different pace and processes of renewable energy adoption by C&I businesses in South Africa was the politics of renewable energy adoption. This politics which was attended to in the formal sense and in both local and international contexts has meant delays in instances. Labour has imposed pressure on the government to protect jobs in coal, a position which has meant retaining the status quo; international parties have demanded transition to renewable energy but the move to adopt such demands has been slow as diffusion has in some instances been treated with little urgency. It is largely a result of the energy crisis that pace has gathered in adoption by C&I businesses.

Sustainability

The study also found that C&I businesses were upbeat about the prospects for sustainability through adoption of renewable energy. Of particular note was the anticipation that C&I businesses would continue to be involved in renewable energy adoption, increasing their footprint in the process. Key drivers for this were government's recent opening of more space for independent generation and transmission via wheeling. Equally important were the carbon-related incentives for the businesses themselves. With less carbon emissions, the businesses stood to benefit from accumulating carbon credits which bode well for firms in a climate conscious world.

Addressing regulatory inefficiencies, adopting more aggressive policies and providing more accessible financing options could significantly accelerate the adoption of renewable energy in South Africa's C&I sector, ultimately helping businesses achieve greater energy independence and cost savings.

7.2. Contribution to Knowledge

The study offers contributions to the current state of knowledge on renewable energy adoption by C&I firms in South Africa in at least three key directions. There are methodological contributions which recognise the value offered by qualitative insights when attending to adoption processes of technology. Some studies have attended to adoption in Africa in general (Eder et al., 2015; Gholami et al., 2013; Longe, 2021; Tigabu, 2017) and in South Africa in particular (Kumba et al., 2023; Oguntona et al., 2021). While these studies deploy qualitative approaches, they however employ theoretical perspectives which are narrow and therefore partially account for the complex processes of adoption. The current study has opted to complicate the scholarship by adopting dual lens which are complimentary while retaining incisiveness. There are contributions which are of an empirical nature, attending to the state of knowledge on renewable energy in South Africa. Here, the study has contributed to what is known about South Africa's renewable energy industry as well as what is broadly appreciated about C&I businesses which have adopted renewable energy. A rich body of work already existed on renewable energy in South Africa (Akintande et al., 2020; Ayamolowo et al., 2022; Montmasson-Clair & Ryan, 2014; Naicker & Thopil, 2019;

Oguntona et al., 2021) as well as a growing body on C&I businesses (Dumitrescu et al., 2022; Inês et al., 2020; Milčiuvienė et al., 2019; Mirzania et al., 2023; Su & Fan, 2022). The current study has contributed to both strands by highlighting how South Africa's C&I businesses have treated adoption given the prevailing energy crisis and in light of potential for sustainability. Importantly, it adopted analytical lens which differed from prior studies which may have flirted with the intersection of C&I business and renewable energy in South Africa. In adopting status quo bias as well as diffusion of technologies, the study has explored the processes which, over time, entailed gridlock, sluggish movement and fast movement.

The third broad direction which the study has contributed to concerns the theoretical appreciation of technology adoption in the renewable energy industry in South Africa and in light of C&I businesses. Since the adoption process has developed in phases, partly influenced by government policy and decisions and partly influenced by the responsiveness of businesses themselves, the study has identified a "lurching diffusion". This concept signifies the stop-start nature of diffusion in the renewable energy industry. Whereas diffusion of technology marks out different stages of adoption (Dearing & Cox, 2018; Rogers, 2003), the study finds movement across and between stages over time.

7.3. Recommendations for Future Research

The recommendations made follow in the direction of the contributions made in the subsection above. Here, the point is that a logical flow is maintained where findings set a base for analysis which in turn sets a base for the conclusions and recommendations.

The first recommendation made concerns methodological matters. Although researchers in South Africa (for example: Akinbami et al., 2021; Naicker & Thopil, 2019) have deployed quantitative approaches in their focus on renewable energy, the current study finds a basis to recommend further attention using quantitative means in order to complement aspects of what has been discussed here. Given that the key focus was on adoption of renewable energy by C&I businesses, the study recommends further enquiry which focuses on the scalar dimensions of adoption as part of the quantitative element.

We may know how adoption has transpired from the current study, but little is known about levels of investment, how extensive, with what economic and environmental impacts and with how much variation across technologies. These are possible areas for exploration in future for C&I businesses.

The study has contributed to what is known about South Africa's renewable energy industry as well as what is broadly appreciated about C&I businesses which have adopted renewable energy. The insights offered are relevant for both researchers and practitioners in renewable energy and more specifically among players in the C&I sector. With regards to the latter group, it is clear that adoption is principally driven by the government's attitude towards renewable energy policy as well as prevailing conditions in energy generation. Given the struggles that Eskom has endured and the increasing space for private generation and transmission, the study suggests that there is scope to increase C&I's future presence in renewable energy. To do this however, the study recommends increased engagement with government as a first key step towards broad energy transition. The process of engagement will however require leadership from more than a few main players in C&I. This is because engagement entails pushing back against fears held by interests which wish to retain the status quo, and these are interests which government has a sympathetic ear towards. Moreover, engagement also poses the real possibility of C&I businesses deploying language which mirrors the language of international entities whose demands for a transition have been pronounced.

The study lastly recommends adoption of diverse theoretical lens in making sense of the complexities of renewable energy adoption. Status quo and diffusion have gone some way to shedding light, but more can be learnt from utilising other theoretical lens. As Chapter 3 has shown, there are many more perspectives through which the question of adoption can be engaged.

7.4. Limitations

The study's broad limitations were in scale and resources. The study's focus was on C&I businesses in South Africa but because of methodological choices, is restricted to the perspectives of mostly senior officers working for IPPs involved in assisting C&I businesses adopt renewable energy solutions. As such, the perspectives of other players involved in the ecosystem have been unattended. Moreover, although the scale appears to be national, many entities have remained unrepresented by the interviews.

Resources are the major constraint that the study encountered. By resources is meant time and financial resources. Time was limited and therefore a study which could have benefited from a longitudinal exploration was conducted and completed in much less time. This outcome is indicative of the researcher's industry but also points to the need for future research which takes a much more detailed exploration across a longer period of time. Financial resources also determine the extent to which a study can incorporate certain tools and methods. In this regard, the study was not funded and therefore attended to instrumentation techniques which cost as little as possible; a similar approach applied in the analysis phase. Better financing could possibly enable more detailed exploration of the same issues which can then be analysed using more efficient analysis tools in the form of data analysis software.

7.5. Reflections

As a final section in the research paper, the researcher addresses reflections in two dimensions. The first is an act of researcher reflexivity which Dowling (2008) identifies as essential in considering one's place and role in the production of knowledge particularly in qualitative studies. As already indicated in Chapter 4, at the time of the study, the researcher was actively engaged in the renewable energy industry where substantial experience and cultural capital had been accumulated. While this presented the researcher with relative ease in accessing some participants and engaging the key concepts around renewable energy with ease, the researcher also acknowledges that there were areas where negotiations with participants demonstrated different and often

shifting power balances. For example, with one participant, securing an interview took a long time and even then, the time allocated for the interview was relatively narrow. However, during the interview, the participant relied on the researcher to guide the interview process even requesting post-interview feedback on how they had performed. Such instances revealed the shifting power ties between researcher and researched.

A second area for reflection concerns the research process itself. Ideally, one might want a flawless process which follows the preset procedures and timelines. However, on many occasions interviews had to be postponed and adjustments made to ensure that participants were engaged at times when they were least likely to encounter distractions.

8. References

Aboagye, B., Gyamfi, S., Ofosu, E. A., & Djordjevic, S. (2021). Status of renewable energy resources for electricity supply in Ghana. *Scientific African*, *11*, e00660. https://doi.org/10.1016/j.sciaf.2020.e00660

Adams, A., & Acheampong, A. O. (2019). Reducing carbon emissions: The role of renewable energy and democracy. *Journal of Cleaner Production*, *240*, 118245.

Adedoyin, F. F., Ozturk, I., Agboola, M. O., Agboola, P. O., & Bekun, F. V. (2021). The implications of renewable and non-renewable energy generating in Sub-Saharan Africa: The role of economic policy uncertainties. *Energy Policy*, *150*, 112115. https://doi.org/10.1016/j.enpol.2020.112115

Agrawal, R., Agrawal, S., Samadhiya, A., Kumar, A., Luthra, S., & Jain, V. (2024). Adoption of green finance and green innovation for achieving circularity: An exploratory review and future directions. *Geoscience Frontiers*, *15*, 101669. https://doi.org/10.1016/j.gsf.2023.101669

Agyekum, E. B., Amjad, F., Mohsin, M., & Ansah, M. N. S. (2021). A bird's eye view of Ghana's renewable energy sector environment: A Multi-Criteria Decision-Making approach. *Utilities Policy*, *70*, 101219. https://doi.org/10.1016/j.jup.2021.101219

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, *2*(4), 314–324. https://doi.org/10.1002/hbe2.195

Akinbami, O. M., Oke, S. R., & Bodunrin, M. O. (2021). The state of renewable energy development in South Africa: An overview. *Alexandria Engineering Journal*, *60*(6), 5077–5093. https://doi.org/10.1016/j.aej.2021.03.065

Akintande, O. J., Olubusoye, O. E., Adenikinju, A. F., & Olanrewaju, B. T. (2020). Modeling the determinants of renewable energy consumption: Evidence from the five most populous nations in Africa. *Energy*, *206*, 117992. https://doi.org/10.1016/j.energy.2020.117992

Aliyu, A. K., Modu, B., & Tan, C. W. (2018). A review of renewable energy development in Africa: A focus in South Africa, Egypt and Nigeria. *Renewable and Sustainable Energy Reviews*, *81*, 2502–2518. https://doi.org/10.1016/j.rser.2017.06.055

Amir, M., & Khan, S. Z. (2022). Assessment of renewable energy: Status, challenges, COVID-19 impacts, opportunities, and sustainable energy solutions in Africa. *Energy and Built Environment*, *3*(3), 348–362. https://doi.org/10.1016/j.enbenv.2021.03.002

Asebedo, S. D., Wilmarth, M. J., Seay, M. C., Archuleta, K., Brase, G. L., & MacDonald, M. (2019). Personality and Saving Behavior Among Older Adults. *Journal of Consumer Affairs*, *53*(2), 488–519. https://doi.org/10.1111/joca.12199

Ayamolowo, O. J., Manditereza, P. T., & Kusakana, K. (2022). South Africa power reforms: The Path to a dominant renewable energy-sourced grid. *Energy Reports*, *8*, 1208–1215. https://doi.org/10.1016/j.egyr.2021.11.100

Ayaz, A., & Yanartas, M. (2020). An analysis on the unified theory of acceptance and use of technology theory (UTAUT): Acceptance of electronic document management system (EDMS). *Computers in Human Behavior Reports*, *2*, 100032. https://doi.org/10.1016/j.chbr.2020.100032

Bashir, M. F., Ma, B., Bashir, M. A., Radulescu, M., & Shahzad, U. (2022). Investigating the role of environmental taxes and regulations for renewable energy consumption: Evidence from developed economies. *Economic Research-Ekonomska Istraživanja*, *35*(1), 1262–1284. https://doi.org/10.1080/1331677X.2021.1962383

Bell, E., Harley, B., & Bryman, A. (2022). *Business research methods* (Sixth edition). Oxford University Press.

Bjørner, T. B., & Mackenhauer, J. (2013). Spillover from private energy research. *Resource and Energy Economics*, *35*(2), 171–190. https://doi.org/10.1016/j.reseneeco.2013.01.001

Börsch--Supan, A., & Stahl, K. (1991). Life cycle savings and consumption constraints: Theory, empirical evidence, and fiscal implications. *Journal of Population Economics*, *4*(3), 233–255. https://doi.org/10.1007/BF00602431

Bowman, A. (2020). Parastatals and economic transformation in South Africa: The political economy of the Eskom crisis. *African Affairs*, *119*(476), 395–431. https://doi.org/10.1093/afraf/adaa013

Centre for Renewable and Sustainable Energy Studies. (2024, October). SA energy made visual: Visualisation of South African energy data. *Centre for Renewable and Sustainable Energy Studies*. https://crses.sun.ac.za/sa-energy-stats/

Chan, M. C. E., & Clarke, D. (2021). Multi-theoretic research involving classroom video analysis: A focus on the unit of analysis. *Learning, Culture and Social Interaction*, *31*.

Chen, C., Xu, X., & Arpan, L. (2017). Between the technology acceptance technology model and sustainable energy acceptance model: Investigating in smart meter acceptance the United State. *Energy Research & Social Science*, *25*, 93–104. http://dx.doi.org/10.1016/j.erss.2016.12.011

Chi, Y., Hu, N., Lu, D., & Yang, Y. (2023). Green investment funds and corporate green innovation: From the logic of social value. *Energy Economics*, *119*, 106532. https://doi.org/10.1016/j.eneco.2023.106532

Conner, M. (2015). Extending not retiring the theory of planned behaviour: A commentary on Sniehotta, Presseau and Araújo-Soares. *Health Psychology Review*, *9*(2), 141–145. https://doi.org/10.1080/17437199.2014.899060

Dato, P. (2018). Investment in Energy Efficiency, Adoption of Renewable Energy and Household Behavior: Evidence from OECD Countries. *The Energy Journal*, *39*(3), 213–244. https://doi.org/10.5547/01956574.39.3.pdat

Davies, M. L. (2021). *South Africa's contested transition to energy democracy: Lessons and struggles from the Renewable Energy Independent Power Producer Procurement Programme* [PhD Thesis]. Stellenbosch University.

Dearing, J. W., & Cox, J. G. (2018). Diffusion Of Innovations Theory, Principles, And Practice. *Health Affairs*, *37*(2), 183–190. https://doi.org/10.1377/hlthaff.2017.1104

Department of Environment, Forestry and Fisheries. (2019). *National Climate Adaptation Strategy:* https://www.dffe.gov.za/south-africas-national-climate-change-adaptation-strategy-approved

Department of Environmental Affairs [Republic of South Africa]. (2013, September). *Draft National Renewable Energy Guideline*. Department of Environmental Affairs, Pretoria, South Africa. https://wwwgov.za/DEA/default/files/eiaguidelinerenewableenergyprojects.pdf

Department of Mineral Resources & Energy. (2019). *Integrated Resource Plan 2019*. https://www.energy.gov.za/irp/2019/IRP-2019.pdf

Department of Mineral Resources & Energy. (2024). *IPP Projects.* https://www.ipp-projects.co.za/ProjectDatabase/Map

Diamantidis, A. D., & Chatzoglou, P. (2018). Factors affecting employee performance: An empirical approach. International. *Journal of Productivity and Performance Management*, *68*(1), 171–193.

Dowling, M. (2008). Reflexivity. In L. M. Given (Ed.), *The Sage encyclopedia of qualitative research methods* (Vols 1 & 2, pp. 747–748). Sage Publications.

Duarte, J. L. R., Fan, N., & Jin, T. (2020). Multi-process production scheduling with variable renewable integration and demand response. *European Journal of Operational Research*, *281*(1), 186–200.

Dumitrescu, R., Lüth, A., Weibezahn, J., & Groh, S. (2022). Prosumer Empowerment through Community Power Purchase Agreements: A Market Design for Swarm Grids. *Economics of Energy & Environmental Policy*, *11*(1). https://doi.org/10.5547/2160-5890.11.1.rdum

Dzwigol, H., Kwilinski, A., Lyulyov, O., & Pimonenko, T. (2023). The Role of Environmental Regulations, Renewable Energy, and Energy Efficiency in Finding the Path to Green Economic Growth. *Energies*, *16*(7), 3090. https://doi.org/10.3390/en16073090

Eberhard, A., & Naude, R. (2016). The South African Renewable Energy Independent Power Producer Procurement Programme: A review and lessons learned. *Journal of Energy in Southern Africa*, *27*(43), 1–14. http://dx.doi.org/10.17159/2413-3051/2016/v27i4a1483

Eder, J. M., Mutsaerts, C. F., & Sriwannawit, P. (2015). Mini-grids and renewable energy in rural Africa: How diffusion theory explains adoption of electricity in Uganda. *Energy Research & Social Science*, *5*(Special Issue on Renewable Energy in Sub-Saharan Africa: Contributions from the Social Sciences), 45–54. http://dx.doi.org/10.1016/j.erss.2014.12.014

Eskom. (2023). *Integrated Report*. https://www.eskom.co.za/investors/integrated-results/

Fineberg, Z. (2023). *Investing in Decentralised Power Generation – Financial Success Factors in South Africa's C&I Sector* [Master of Commerce, University of Cape Town]. https://open.uct.ac.za/server/api/core/bitstreams/a3a34c65-97b5-4bfd-bbec-9e0c461aa63e/content

Fleta-Asín, J., & Muñoz, F. (2021). Renewable energy public–private partnerships in developing countries: Determinants of private investment. *Sustainable Development*, *29*(4), 653–670. https://doi.org/10.1002/sd.2165

Gaede, J., & Meadowcroft, J. (2016). A Question of Authenticity: Status Quo Bias and the International Energy Agency's World Energy Outlook. *Journal of Environmental Policy & Planning*, *18*(5), 608–627. https://doi.org/10.1080/1523908X.2015.1116380

Gboney, W. (2009). Policy and regulatory framework for renewable energy and energy efficiency development in Ghana. *Climate Policy*, *9*(5), 508–516. https://doi.org/10.3763/cpol.2009.0636

Gholami, R., Sulaiman, A. B., Ramayah, T., & Molla, A. (2013). Senior managers' perception on green information systems (IS) adoption and environmental performance: Results from a field survey. *Information & Management*, *50*(7), 431–438. https://doi.org/10.1016/j.im.2013.01.004

Golmohamadi, H. (2022). Demand-side flexibility in power systems: A Survey of residential, industrial, commercial, and agricultural sectors. *Sustainability*, *14*, 7916. https://doi.org/10.3390/su14137916

GovernmentZA (Director). (2024). *Renewable energy seminar 2024* [Video recording]. https://youtube.com/live/Dh-y26bxTKA?feature=shared

GWEC. (2023). *Global Wind Energy Council*. https://gwec.net/globalwindreport2023/

Hain, M., Schermeyer, H., Uhrig-Homburg, M., & Fichtner, W. (2018). Managing renewable energy production risk. *Journal of Banking & Finance*, *97*, 1–19.

Higueras-Castillo, E., Liébana-Cabanillas, F. J., Muñoz-Leiva, F., & Molinillo, S. (2019). The role of collectivism in modeling the adoption of renewable energies: A cross-cultural approach. *International Journal of Environmental Science and Technology*. https://doi.org/10.1007/s13762-019-02235-4

Hsu, M.-H., & Chiu, C.-M. (2004). Predicting electronic service continuance with a decomposed theory of planned behaviour. *Behaviour & Information Technology*, *23*(5), 359–373. https://doi.org/10.1080/01449290410001669969

Inês, C., Guilherme, P. L., Esther, M.-G., Swantje, G., Stephen, H., & Lars, H. (2020). Regulatory challenges and opportunities for collective renewable energy prosumers in the EU. *Energy Policy*, *138*, 111212. https://doi.org/10.1016/j.enpol.2019.111212

International Energy Agency. (2023). *World Energy Outlook 2023*. https://www.iea.org/

IRENA. (2024). *Technology—Renewable Energy Generation*. https://www.irena.org/Energy-Transition/Technology

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). The Endowment Effect, Loss Aversion, and Status Quo Bias. *Journal of Economic Perspectives*, *5*(1), 193–206.

Kanimozhi, S., & Selvarani, A. (2019). Application of the decomposed theory of planned behaviour in technology adoption: A review. *International Journal of Research and Analytical Reviews*, *6*(2), 735–739.

Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, *42*(8), 846–854.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management*, *43*(6), 740–755. https://doi.org/10.1016/j.im.2006.05.003

Kitsis, A. M., & Chen, I. J. (2021). Do stakeholder pressures influence green supply chain Practices? Exploring the mediating role of top management commitment. *Journal of Cleaner Production*, *316*, 128258.

Kumba, H., Akpan, J., Twite, B., & Olanrewaju, O. (2023). Renewable energy adoption and integration in South Africa: An overview. *12th International Conference on Clean and Green Energy (ICCGE 2023)*, 74–87. https://doi.org/10.1049/icp.2023.1607

Langdridge, D., Sheeran, P., & Connolly, K. J. (2007). Analyzing Additional Variables in the Theory of Reasoned Action. *Journal of Applied Social Psychology*, *37*(8), 1884–1913.

Lee, K., & Joshi, K. (2017). Examining the use of status quo bias perspective in IS research: Need for re-conceptualizing and incorporating biases. *Information Systems Journal*, *27*(6), 733–752.

Longe, O. M. (2021). An Assessment of the Energy Poverty and Gender Nexus towards Clean Energy Adoption in Rural South Africa. *Energies*, *14*(12), 3708. https://doi.org/10.3390/en14123708

Lu, Y., Khan, Z. A., Alvarez-Alvarado, M. S., Zhang, Y., Huang, Z., & Imran, M. (2020). A Critical Review of Sustainable Energy Policies for the Promotion of Renewable Energy Sources. *Sustainability*, *12*(12), 5078. https://doi.org/10.3390/su12125078

Marangunić, N., & Granić, A. (2015). Technology acceptance model: A literature review from 1986 to 2013. *Universal Access in the Information Society*, *14*(1), 81–95. https://doi.org/10.1007/s10209-014-0348-1

Marikyan, D., & Papagiannidis, S. (2023). Unified Theory of Acceptance and Use of Technology: A review. In S. Papagiannidis (Ed.), *TheoryHub Book*. https://open.ncl.ac.uk /

Marikyan, D., Papagiannidis, S., & Stewart, G. (2023). Technology acceptance research: Meta-analysis. *Journal of Information Science*, 1–22. https://doi.org/10.1177/01655515231191177

Milčiuvienė, Kiršienė, Doheijo, Urbonas, & Milčius. (2019). The Role of Renewable Energy Prosumers in Implementing Energy Justice Theory. *Sustainability*, *11*(19), 5286. https://doi.org/10.3390/su11195286

Mirzania, P., Gordon, J. A., Balta-Ozkan, N., Sayan, R. C., & Marais, L. (2023). Barriers to powering past coal: Implications for a just energy transition in South Africa. *Energy Research & Social Science*, *101*, 103122. https://doi.org/10.1016/j.erss.2023.103122

Mishra, R., Naik, B. K. R., Raut, R. D., & Kumar, M. (2022). Internet of Things (IoT) adoption challenges in renewable energy: A case study from a developing economy. *Journal of Cleaner Production*, *371*, 133595.

Mkhize, N., & Nel-Sanders, D. (2023). An analysis of Energy Policy Implementation in South Africa: A Case Study of the Gas-to-Power Programme. *African Journal of Business and Economic Research*, *18*(1), 273–290.

Mohn, K. (2020). The Gravity of Status Quo: A Review of IEA's World Energy Outlook. *Economics of Energy & Environmental Policy*, *9*(1), 63–82. https://doi.org/10.5547/2160-5890.9.1.kmoh

Momani, A. M. (2020). The Unified Theory of Acceptance and Use of Technology: A New Approach in Technology Acceptance. *International Journal of Sociotechnology and Knowledge Development*, *12*(3), 79–97. https://doi.org/10.4018/IJSKD.2020070105

Montmasson-Clair, G., & Ryan, G. (2014). Commissioning renewable energy: A review of South Africa's regulatory and procurement experience. *Journal of Economics and Financial Sciences*, *7*.

Naicker, P., & Thopil, G. A. (2019). A framework for sustainable utility scale renewable energy selection in South Africa. *Journal of Cleaner Production*, *224*, 637–650. https://doi.org/10.1016/j.jclepro.2019.03.257

Nebel, J. M. (2015). Status Quo Bias, Rationality, and Conservatism about Value. *Ethics*, *125*(2), 449–476.

Nwachukwu, M. U., Ezedinma, N. F., & Jiburum, U. (2014). Comparative Analysis of Electricity Consumption among Residential, Commercial and Industrial Sectors of the Nigeria's Economy. *Journal of Energy Technologies and Policy*, *4*(3), 7–13.

Nwaiwu, F. (2021). Digitalisation and sustainable energy transitions in Africa: Assessing the impact of policy and regulatory environments on the energy sector in Nigeria and South Africa. *Energy, Sustainability and Society*, *11*(1), 48. https://doi.org/10.1186/s13705-021-00325-1

Oguntona, O. A., Aigbavboa, C. O., Monnanyana, T., & Thwala, W. D. (2021). Drivers of Renewable Energy Adoption in the Built Environment: A Case of South Africa. *IOP Conference Series: Materials Science and Engineering*, *1107*(1), 012217. https://doi.org/10.1088/1757-899X/1107/1/012217

Omole, F., Olajiga, O. K., & Olatunde, T. M. (2024). Hybrid power systems in mining: Review of implementations in Canada, USA, and Africa. *Engineering Science & Technology Journal*, *5*(3), 1008–1019.

Osunmuyiwa, O., & Kalfagianni, A. (2017). Transitions in unlikely places: Exploring renewable the conditions for energy adoption in Nigeria. *Environmental Innovation Societal and Transitions*, *22*, 26–40. http://dx.doi.org/10.1016/j.eist.2016.07.002

Ouedraogo, N. S. (2019). Opportunities, Barriers and Issues with Renewable Energy Development in Africa: A Comprehensible Review. *Current Sustainable/Renewable Energy Reports*, *6*(2), 52–60. https://doi.org/10.1007/s40518-019-00130-7

Pakravan, M. H., & MacCarty, N. (2021). An Agent-Based Model for Adoption of Clean Technology Using the Theory of Planned Behavior. *Journal of Mechanical Design*, *143*(2), 021402. https://doi.org/10.1115/1.4047901

Pielow, A., Sioshansi, R., & Roberts, M. C. (2012). Modeling short-run electricity demand with long-term growth rates and consumer price elasticity in commercial and industrial sectors. *Energy*, *40*, 533–540. http://dx.doi.org/10.1016/j.energy.2012.07.059

Rabaa, S., Geisendorf, S., & Wilken, R. (2022). Why change does (not) happen: Understanding and overcoming status quo biases in climate change mitigation. *Abhandlungen*, 100–134.

Rhodes, R., & Courneya, K. (2003). Modelling the theory of planned behaviour and past behaviour. *Psychology, Health & Medicine*, *8*(1), 57–69. https://doi.org/10.1080/1354850021000059269

Rogers, E. M. (2003). *Diffusions of innovations* (5th ed.). Free Press.

Salari, M., Kelly, I., Doytch, N., & Javid, R. J. (2021). Economic growth and renewable and non-renewable energy consumption: Evidence from the U.S. states. *Renewable Energy*, *178*, 50–65. https://doi.org/10.1016/j.renene.2021.06.016

Salim, R. A., & Rafiq, S. (2012). Why do some emerging economies proactively accelerate the adoption of renewable energy? *Energy Economics*, *34*, 1051–1057. https://doi.org/10.1016/j.eneco.2011.08.015

Sarker, M., & Al-Muaalemi, M. A. (2022). Sampling techniques for quantitative research. In *Principles of Social Research Methodology* (pp. 221–234). Springer Nature Singapore.

Sasol. (2024). *Media Centre*. https://www.sasol.com/media-centre

Saunders, M., & Lewis, P. (2018). *Doing Research in Business and Management: An essential guide to planning your project* (Second). Pearson.

Scharnhorst, I., Sloot, D., Lehmann, N., Ardone, A., & Fichtner, W. (2024). Barriers to demand response in the commercial and industrial sectors – An empirical investigation. *Renewable and Sustainable Energy Reviews*, *190*, 114067. https://doi.org/10.1016/j.rser.2023.114067

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill-building approach* (Seventh edition). John Wiley & Sons.

Shahzad, M., Qu, Y., Rehman, S. U., & Zafar, A. U. (2022). Adoption of green innovation technology to accelerate sustainable development among manufacturing industry. *Journal of Innovation & Knowledge*, *7*(4), 100231. https://doi.org/10.1016/j.jik.2022.100231

Shirish, A., & Batuekueno, L. (2021). Technology renewal, user resistance, user adoption: Status quo bias theory revisited. *Journal of Organizational Change Management*, *34*(5), 874–893. https://doi.org/10.1108/JOCM-10-2020-0332

Solarino, A. M., & Aguinis, H. (2021). Challenges and best-practice recommendations for designing and conducting interviews with elite informants. *Journal of Management Studies*, *58*(3), 649–672.

Steffen, B. (2020). Estimating the cost of capital for renewable energy projects. *Energy Economics*, *88*, 104783.

Straub, E. T. (2009). Understanding Technology Adoption: Theory and Future Directions for Informal Learning. *Review of Educational Research*, *79*(2), 625–649. https://doi.org/10.3102/0034654308325896

Su, Y., & Fan, Q. M. (2022). Renewable energy technology innovation, industrial structure upgrading and green development from the perspective of China's provinces. *Technological Forecasting and Social Change*, *180*, 121727.

Taherdoost, H. (2018). A review of technology acceptance and adoption models and theories. *Procedia Manufacturing*, *22*, 960–967. https://doi.org/10.1016/j.promfg.2018.03.137

Terrell, S. R. (2016). *Writing a Proposal for your Dissertation: Guidelines and Examples*. The Guilford Press.

Thompson, J. K., Ata, R., Roehrig, M., & Chait, S. (2012). Tanning: Natural and Artificial. *Encyclopedia of Body Image and Human Appearance*, *2*, 775–782. https://doi.org/10.1016/B978-0-12-384925-0.00122-X

Tigabu, A. D. (2017). Analysing the diffusion and adoption of renewable energy technologies in Africa: The functions of innovation systems perspective. *African Journal of Science, Technology, Innovation and Development*. https://doi.org/10.1080/20421338.2017.1366130

Tonglet, M., Phillips, P. S., & Read, A. D. (2004). Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. *Resources, Conservation and Recycling*, *41*(3), 191–214. https://doi.org/10.1016/j.resconrec.2003.11.001

Tracy, S. J. (2019). *Qualitative Research Methods: Collecting Evidence, Crafting Analysis, Communicating Impact*. Wiley-Blackwell.

Train, K. E. (1988). Incentives for energy conservation in the commercial and industrial sectors. *The Energy Journal*, *9*(3), 113–128.

Usha Rao, K., & Kishore, V. V. N. (2010). A review of technology diffusion models with special reference to renewable energy technologies. *Renewable and Sustainable Energy Reviews*, *14*, 1070–1078. https://doi.org/10.1016/j.rser.2009.11.007

Usman, F. O., Ani, E. C., Ebirim, W., Montero, D. J. P., Olu-lawal, K. A., & Ninduwezuor-Ehiobu, N. (2024). Integrating renewable energy solutions in the manufacturing industry: Challenges and opportunities: A review. *Engineering Science & Technology Journal*, *5*(3), 674–703.

Weeks, K. P., & Schaffert, C. (2019). Generational differences in definitions of meaningful work: A mixed methods study. *Journal of Business Ethics*, *156*, 1045–1061.

Williams, M. D., Rana, N. P., & Dwivedi, Y. K. (2015). The unified theory of acceptance and use of technology (UTAUT): A literature review. *Journal of Enterprise Information Management*, *28*(3), 443–488. https://doi.org/10.1108/JEIM-09-2014-0088

Wu, C.-C. (2016). Status quo bias in information system adoption: A meta-analytic review. *Online Information Review*, *40*(7), 998–1017. https://doi.org/10.1108/OIR-09-2015-0311

Yuen, K. F., Cai, L., Qi, G., & Wang, X. (2021). Factors influencing autonomous vehicle adoption: An application of the technology acceptance model and innovation diffusion theory. *Technology Analysis & Strategic Management*, *33*(5), 505–519.

Zerrahn, A., Schill, W. P., & Kemfert, C. (2018). On the economics of electrical storage for variable renewable energy sources. *European Economic Review*, *108*, 259–279.