An analysis of green energy technology policy implementation in the West Rand District Municipality

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DECLARATION

This dissertation*, "An analysis of green energy technology policy implementation in the West Rand District Municipality,"* is my original work, as I, Sifiso Vilakazi, certify. Every source of material utilised in this dissertation has been properly cited, and the owner of the information has been given due credit. All the research for this dissertation is entirely original with no prior research or publications that I am aware of. The information utilised for research is properly sourced and can be primary or secondary. Additionally, I affirm that none of the research's conclusions or results were lifted verbatim from another source. I may have borrowed parts of the design and style from other works to help with this dissertation. This dissertation's results and findings are entirely the author's own and do not represent the opinions of Northwest University or any other particular organisation.

DEDICATION

- This work is a testament to the guiding forces that transformed aspiration into achievement.
- With heartfelt dedication to my mother, brother and close friends, for their constant support and guidance.

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“Isaiah 60:22 when the time is right I, the lord will make it happen.”

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ABSTRACT

Globally, the imperative for green energy technologies is escalating as a crucial strategy to mitigate climate change, bolster energy security, and foster sustainable development. However, the effective translation of national policies to local contexts, particularly within the African landscape, presents considerable complexities. Although the significance of green energy in addressing sustainability and energy security issues is becoming more widely acknowledged in South Africa's national energy plan, local implementation, especially in certain municipalities like the West Rand District Municipality needs careful examination. The West Rand District Municipality in South Africa, a location with substantial potential for green energy but major adoption obstacles, is the focus of this study's investigation into the use of green energy technology policies. This study fills gaps in knowledge on the specifics of implementing green energy policies at the subnational level in developing regions. Guided by rational choice theory and incrementalism, this research aims to analyse how green energy technology policies are being implemented in the West Rand District Municipality. The analysis uses document review as its main technique of gathering data and employs a qualitative approach and case study research design. This investigation reveals a misalignment between the intended objectives of national policies and the realities encountered during their implementation within the West Rand. Initial findings indicate that the nature and pace of policy implementation are significantly influenced by factors such as the extent of stakeholder engagement, the existing institutional capability, and the prevailing socioeconomic context of the region. Further research is warranted to delineate the specific mechanisms of these influences and to inform potential adjustments for enhanced policy coherence and effectiveness. The study's implications underscore several critical considerations for advancing green energy adoption. Firstly, achieving national sustainability goals through green energy policies demands the development and application of sophisticated, context-aware implementation strategies that effectively harness localized renewable energy potentials. Secondly, the successful integration of green energy technologies is contingent upon policymakers acquiring a comprehensive understanding of the complex interplay between policy frameworks and specific regional characteristics. Finally, ensuring an equitable energy transition necessitates a deliberate focus on the socioeconomic ramifications associated with the deployment of green energy solutions. Consequently, future policy

endeavours must prioritise these multifaceted dimensions to optimize both the effectiveness and the fairness of green energy transitions.

Key words

Green energy, West Rand District Municipality, policy, implementation, technologies, South Africa

LIST OF ABBREVIATIONS

NWU	North-west University
AGoPA	Afrocentric Governance of Public Affairs
GET	Green Energy Technology
WRDM	West Rand District Municipality
GGT2030	Growing Gauteng Together 2030
EIPP	European Institute for Public Participation
REIPPP Programme	Renewable Energy Independent Power Producer Procurement
IRP	Integrated Resource Plan
NERSA	National Energy Regulator of South Africa
IDP	Integrated Development Plan
SEC	Sustainable Energy Council of South Africa
PAGE	Partnership for Action on Green Economy
CSIR	Council for Scientific and Industrial Research
LED	Local Economic Development
SLB	Street-Level Bureaucracy
JET	Just Energy Transition
UNFCCC	United Nations Framework Convention on Climate Change

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CHAPTER 1 ORIENTATION AND BACKGROUND.

1.1 Introduction

Green energy technology is becoming more widely accepted as vital for reducing climate change, improving energy security, and advancing environmental integrity (Kabeyi & Olanrewaju, 2022). The adoption of renewable energy sources is urgently needed to cut greenhouse gas emissions and meet carbon neutrality targets by the middle of the century, according to international organizations like the United Nations and the International Energy Agency (IEA) (IEA, 2022; Intergovernmental Panel on Climate Change (IPCC), 2021). Globally, countries are developing bold plans to switch from fossil fuels to renewable energy sources including hydropower, wind, and solar power, establishing guidelines for the adoption and integration of green energy technologies. But even with these global objectives, it has been difficult to successfully execute policies at the local level, and differences in sociopolitical circumstances, financial resources, and local governance capabilities have led to discrepancies (Swain *et al.,* 2021).

Green energy adoption is further hampered in underdeveloped nations, especially in Africa. Although Sub-Saharan Africa has a wealth of green energy potential, particularly in the areas of solar and wind, for more than 500 million people's access is still limited. to dependable energy (World Bank, 2022). To bridge this gap and responsibly meet the continent's expanding energy needs, several African countries are promoting renewable energy projects. In an effort to lessen its reliance on coal, which now provides about 80% of its electricity output, South Africa, one of the continent's biggest economies, has established itself as a leader in the world of green energy (Department of Mineral Resources and Energy, 2019). However, despite these achievements at the national level, the policy's effectiveness at the local level remains uneven, reflecting substantial implementation challenges within municipal structures.

Local governments have a responsibility to make sure that green energy projects are in line with public expectations, budgetary realities, and regional developmental priorities in addition to carrying out national policies. West Rand District Municipality, a semi-urban area within Gauteng Province characterized by both residential and industrial zones, possesses substantial potential for renewable energy adoption. This potential is further

emphasized by the region's inclusion in the Growing Gauteng Together 2030 document, which highlights West Rand as a host of renewable energy amongst its identified high-growth sectors. This strategic positioning underscores the region's commitment to sustainable development and its readiness to capitalize on the benefits of renewable energy technologies. The municipality has faced some implementation obstacles in spite of this potential, such as insufficient funding, a lack of technical know-how, and conflicting policy priorities (Swain & Pillay, 2021). There are indications that the current local governance of green energy projects could be improved, and research into effective policy measures is advisable. Therefore, there is an urgent need for research that focuses on the unique difficulties municipalities experience while implementing green energy policies, as the gap between national policy and municipal implementation is still mostly ignored in the literature.

This chapter introduces the study by presenting its background, problem statement, research questions, and objectievs. Additionally, it delineates the core theoretical framework, methodological design, and the study's anticipated contributions. Finally, the chapter concludes with a clear layout of the subsequent chapters, providing a roadmap for the reader through this thesis.

1.2 Orientation and Background

The implementation of green energy policies has become a global priority due to the increasing demand for energy and the need to address environmental concerns (Zhan *et al.,* 2019). While the Paris Agreement has influenced policy decisions in the country, there is a need for further investigation into the challenges and opportunities of implementing renewable energy strategies (Janicke, 2018). For example, in South Africa and its impact on economic growth, social development, and environmental conservation, but there is a need for research on the effective implementation of green energy policies. Therefore, there is a research gap on the effective implementation of green energy policies in South Africa's local government.

Energy is a cornerstone for economic development and societal progress, wielding profound implications for global affairs, environmental sustainability, and human advancement (Jiang, 2008). Considering burgeoning concerns over energy security, environmental degradation, and climate change, the imperative to transition towards

renewable energy sources has emerged as a paramount objective for governments worldwide. This imperative is underscored by the over-exploitation of non-renewable energy resources and the escalating global energy crisis (Zhan *et al.,* 2019).

In response to these challenges, nations have increasingly focused on renewable energy strategies, driven by imperatives such as energy efficiency, reduction of greenhouse gas emissions, and the pursuit of clean production (Chen *et al.,* 2016). The landmark Paris Agreement, ratified in 2016, has served as a pivotal catalyst in shaping international discourse and policy frameworks aimed at mitigating climate change (United Nations Framework Convention on Climate Change (UNFCCC), 2015). Notably, the Paris Agreement has exerted noteworthy influence on the energy policies of nations, including South Africa, by setting ambitious targets in order to keep global warming well below two degrees Celsius (Janicke, 2018).

However, the translation of international commitments into effective energy policies and technologies at the local level, particularly within municipalities like the West Rand District Municipality in South Africa, has encountered formidable challenges (Sibaya *et al.,* 2023). Despite the proliferation of green energy initiatives and policies, the implementation landscape in developing regions, particularly Africa, remains fraught with obstacles such as insufficient investments, funding constraints, and difficulties in grid integration (Meissner, 2017; Levenda *et al.,* 2021).

In this context, the West Rand District Municipality stands as a microcosm of the broader challenges and complexities inherent in green energy policy implementation. While the municipality has demonstrated intentions and initiatives towards embracing renewable energy, a slew of factors including poor planning, technological constraints, and funding inadequacies have impeded the realization of these ambitions (West District Municipality, 2017; Engineering News, 2020).

Against this backdrop, there exists a conspicuous gap in scholarly inquiry pertaining to the implementation of green energy policies and technologies at the municipal level, particularly within the West Rand District Municipality. Scholarly reports from authors such as Musango and Brent (2017), Tsaurai (2020) and Muleugetta *et al.,* (2022) reflect on this conspicuous gap, these scholars underscores the need for focused studies that address the specific challenges and opportunities within this local context because there exists a

gap in scholarly inquiry concerning the effective implementation of green energy policies and technologies at the municipal level. While extant literature such as Bridge (2013) which provides a valuable geographical perspective on energy transitions and Sovacool (2017), which examined the intricacies of energy policy, has offered valuable insights into broader energy policy landscapes, there remains a paucity of research dedicated to dissecting the intricacies of local-level policy implementation failures (Tregenna, 2018; Sharife, 2016).

This study seeks to analyse this gap by conducting a comprehensive analysis of green energy technology policy implementation failures within the West Rand District Municipality. Through analysing the specific challenges, constraints, and contextual factors shaping the efficacy of green energy policies and technologies at the local level, this research aims to offer nuanced insights that can inform more effective policy. Moreover, by shedding light on the experiences of municipalities like the West Rand District, this study endeavours to contribute to a broader analysis of the challenges confronting energy transitions at the local government level

1.3 Problem statement

Notwithstanding the articulated global, national, and provincial imperatives towards the adoption of green energy technologies, scholarly inquiry into the nuanced role of policy implementation at the local government level remains conspicuously limited. For instance, Hamann (2020) investigated the West Rand District Municipality's challenges in enacting energy-saving measures, identifying key impediments such as an ambiguous policy framework, inadequate financial resources, and a deficit in local and enterprise-level understanding and awareness. Similarly, Dhliwayo and Peters (2020) posit collaborative governance as a potential mechanism to mitigate issues of insufficient inter-departmental coordination and weak institutional capacity, both of which impede effective policy implementation. Moreover, Gibson (2016) contends that the frequently observed policy implementation deficit in South Africa is attributable, in part, to a lack of synergistic coordination between national and local governmental tiers, a phenomenon particularly evident in the execution of local economic development (LED) policies. Drawing from these observations within the extant literature, there is a demonstrable exigency for further empirical investigation into the specific ways in which policy implementation

dynamics influence the success or failure of policies at the sub-national level. Against this backdrop and focusing on the West Rand District Municipality's efforts in adopting green energy technology, this study aims to critically analyse the processes underpinning green energy technology policy implementation.

1.4 Research questions

The main research question guiding this study is:

How are green energy technology policies being implemented in the West Rand District Municipality?

The secondary research questions that the study answers include:

a What drives the implementation of green energy technology policies in the West Rand region?

b What are the key frameworks (institutional, policy and legal) that are guiding the implementation of green energy technologies in the West Rand District Municipality?

c What barriers are faced in implementing green energy technology policies in the West Rand District Municipality?

d What strategies can the West Rand District Municipality adopt to improve green energy technologies policy implementation?

1.5 Research objectives

The main research objective of this study is:

To analyse how green energy technology policies are being implemented in the West Rand District Municipality.

The secondary research objectives of this study are:

a To assess the drivers that led to the implementation of green energy policies in the West Rand region,

b To investigate the key institutional policies and legal frameworks guiding the implementation of green energy technologies in the West Rand District Municipality,

c To examine the barriers faced by the West Rand District Municipality in implementing green energy technology policies and

d To analyse the strategies adopted by the West Rand District Municipality to improve green energy technologies.

1.6 Central theoretical statements

Acknowledging the imperative for effective green energy technology policy implementation, as highlighted by Kumar et al. (2018) in the context of global frameworks for multi-tier energy access, and the emphasis on successful enactment by Hamann (2020), a tentative assertion can be formulated regarding the West Rand District Municipality. It appears that the municipality's progress in implementing green energy technology policies is characterized by a pattern of measured and adaptive adjustments. This incrementally evolving process, potentially shaped by considerations of rational resource allocation and a series of pragmatic, localized actions, suggests a trajectory towards contributing to international mitigation efforts for climate change and the advancement of sustainable development objectives. The capacity to leverage multi-stakeholder support likely plays a facilitative role in navigating inherent challenges and realizing the potential of green energy initiatives within the local context.

1.7 Significance of the study

This research addresses critical gaps in understanding the challenges surrounding green energy technology policy implementation within the West Rand District Municipality. Through an examination of policy implementation, this study adds to the minimal amount of research on the use of green energy technologies in South Africa, particularly in the context of local government.

Prior investigations, such as those by Swain et al. (2021) and Kenk et al. (2019), have looked at ways to make green energy more affordable and environmentally viable in the public sector of South Africa. The social and economic potential of green energy transitions to reduce inequality is further emphasized (Muvihil *et al.,* 2021). However, they also point out obstacles that stand in the way of these changes. Nevertheless, a focused examination of policy barriers at the municipal level, especially in semi-urban areas like the West Rand, is lacking in the literature. This study is noteworthy because it focuses on

these policy-specific obstacles, which have not received much attention in the context of South Africa's municipal green energy deployment.

1.8 Chapter layout and conclusion

Chapter 1: Orientation and Background: This chapter introduces the study's background and orientation, highlighting its problem statement and contribution. It presents the research questions and objectives.

Chapter 2: Literature Review and Theoretical Framework: This chapter focuses on reviewing the literature around green energy policies and possible technological advancements. The chapter provides fundamental characteristics to create a theoretical framework for the study. This chapter discusses the theories involved in this research as well as the empirical framework.

Chapter 3: Methodology: This chapter outlines the research methodology and presents the research design. It indicates which data collection method is employed and highlights ethical considerations.

Chapter 4: Presentation of Findings: Data will be presented and discussed in chapter 4. The research findings are reviewed thoroughly. Chapter four also recaps and responds to the research questions. It tackles the problem statement with relevant sources.

Chapter 5: Recommendations and Conclusions: Chapter 5 serves as the conclusion. It summarises the main findings and presents various recommendations.

Essentially, this introduction chapter has placed the global demand for green energy technology policy implementation in perspective, emphasized the difficulties in implementing it locally, and identified a crucial research gap regarding the implementation of municipal policies in South Africa, particularly in the West Rand District Municipality. It provides the foundation for a thorough examination of the challenges and potential solutions for improving the implementation of green energy technology policies at the local government level by clearly defining the problem, the primary questions and objectives of the research, and the theoretical framework. Chapter Two will focus on an in-depth review of the literature and will introduce the theoretical framework underpinning this study.

CHAPTER 2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

Chapter Two establishes the theoretical and empirical foundation by defining green energy technology, outlining the public administration of green energy policy, and conceptualizing policy implementation through various models. It reviews literature on implementation challenges, the technology-policy nexus, and drivers of local green energy adoption, referencing key South African policies. This groundwork sets the stage for analysing the specific challenges faced by local municipalities in implementing green energy technology policy.

2.2 Green energy policy implementation within public administration

Historically, Public Administration served as a pivotal facilitator, actively driving and structuring the engagement of private sector expertise to enhance citizen well-being through comprehensive service provision (Papiloud, 2023). However, contemporary societal imperatives emphasizing efficiency and sustainability are now compelling a fundamental reorientation of administrative priorities and the adoption of innovative policy measures (Papiloud, 2023). According to McQueen (2022), governments must take the lead, but a lack of national and international leadership, along with political, economic, and regulatory barriers, are impeding development. Reaching challenging sustainability goals calls for a daring, community-wide strategy supported by continuous government support.

Energy policies seek to back political commitment and advance national goals. Michoud and Hafner (2021) indicate that their overarching goal is to establish a stable and advantageous legal and regulatory environment while also offering sufficient incentives to promote the sector's growth, including the availability of clean energy. Furthermore, the Renewable Energy Independent Power Producer Procurement program (REIPP) in South Africa was created to strengthen the nation's green energy sector by standardizing and simplifying bidder requirements (IPP Projects, 2020). Moreover, Aydin et al. (2024) posit that the green energy transition and the strictness of policies have a complicated

and diverse relationship. Hence, Partnership for Action on Green Economy (PAGE) (2017) explained that public administration's green energy policies in South Africa are primarily concerned with advancing energy efficiency and green energy sources in order to combat climate change and guarantee sustainable energy development.

2.3 Defining Green Energy Technology

Green energy technologies are critical for reducing greenhouse gas emissions and mitigating climate change. Carrero-Díaz (2021) defines green energy technologies as technologies that produce energy from renewable and environmentally friendly sources, aiming to reduce greenhouse gas emissions and minimize environmental impact, while Nemet (2022) defines green energy technologies as energy technologies that use renewable energy resources and are low-carbon or carbon-free. The pursuit of clean, sustainable energy solutions, leveraging renewable resources such as solar, wind, hydro, geothermal, and biomass, necessitates the strategic implementation of green energy technologies, a critical endeavour in addressing the interconnected challenges of energy security, ecological preservation, and climate change mitigation, thereby demanding rigorous interdisciplinary analysis and policy development (Pawar & Safia, 2023). According to Crossely (2022), "green energy" is a concept with varying legal interpretations across jurisdictions, rather than a universally fixed definition. Green energy technologies minimize waste and maximize the use of recycled materials, which greatly reduces carbon footprints and the depletion of precious natural resources.

The combined issues of climate change and sustainable development must be addressed with the help of green energy solutions. These systems provide a workable route to a cleaner, more robust, and sustainable energy future by utilizing renewable resources and improving technical advancements. The scholarly works of prominent figures such as Carrero-Díaz, Nemet, and Crossely offer invaluable frameworks and insights that highlight the importance and promise of renewable energy technology in the global energy arena.

2.4 Conceptualizing policy implementation

Policy implementation is essentially the process of turning government policies into action. According to Demier (2021) policy implementation is multifaceted, considering

both theoretical considerations and the practical realities of implementing policies. Geva-May and Fontaine (2024) contribute significant insights to understanding the methodological complexities of comparative policy analysis, particularly concerning the obstacles to effective policy implementation.

Effective planning, strong institutional backing, resource mobilization, and active stakeholder involvement are necessary for the dynamic and diverse process of implementing policies. Bekkers, Fenger, and Scholten (2020) believe that implementing policies entails a complex web of political, organizational, and societal processes that can affect policy decisions and their efficacy. It goes beyond simple bureaucratic compliance and stresses how important it is for governmental organizations and other players to continuously monitor, assess, and modify policies in response to input and evolving conditions (Lipsky 2010, Williams 2018). In addition, policy implementation is a dynamic and intricate process that involves interacting with a few different players, institutions, and procedures and procedures, as noted by Hill and Hupe (2022). Cairney (2019) adds that a number of factors affect how well policies are implemented which include the nature of the policy environment, which refers to the political, economic, and social contexts in which policies are implemented, the degree of support or opposition from various stakeholders, and policy design, which discusses the specificity and clarity of the policy goals and the strategies for achieving them.

This dissertation study has explored the multifaceted and evolving nature of policy implementation, highlighting the crucial factors that influence its success. Studied literature such as Bekker et al. (2020), Lipsky (2010), Hupe (2022), and Cairney (2019) indicates that the process of implementing policies is intricate and dynamic, impacted by various critical elements such as policy design, actor ability, and policy environment.

2.5 The Policy Implementation Process

It is imperative to investigate and assess the implementation process given the significance of comprehending the entire policy-making process (Smith, 1973:209). The significance of the implementation process as a crucial stage in the policymaking process was further emphasized by Peter May's (1975) idea of "program implementation". Hood (1983) states that the discretion used by street-level bureaucrats in carrying out policies and programs can have significant effects on the process of implementing policies. In one

instance, some bureaucrats might put efficiency ahead of equality, leading to a more uniform application of policies that might not consider certain requirements of certain people or groups. According to Dye (1987: 156), a policy's ability to succeed or fail is mostly determined by the resources allocated to it, how well it is organized, and how much evaluation and monitoring is done. This highlights how crucial a financially sound and managed policy implementation process is to accomplish the aims and objectives of the policy. Nevertheless, Anderson (2003: 270 indicates that the implementation of policies must be legitimate, flexible, and coordinated which demonstrates the significance of establishing and maintaining legitimacy, being flexible in response to changing conditions, and encouraging cooperation between various agencies and actors involved in the policy-making process. Recent scholars, such as Stone and Altbeker (2010:203), suggest that political will and bureaucratic ability are needed for successful policy implementation which illustrates the need for qualified government officials' leadership in guaranteeing policy implementation, in addition to the necessity of properly running government departments and processes.

2.6 Policy Implementation Models

Models of policy implementation, according to Pal (2005), are helpful resources for comprehending the dynamics of policymaking and execution. Pal (2005) does, however, also point out that these models have certain drawbacks, including the tendency to oversimplify the intricate and dynamic process of policymaking. Pal thus believes that policy analysis and execution should be flexible and context-specific, taking into consideration the unique conditions and stakeholders involved. According to Smith (1998: 274) policy implementation models aid in our understanding of how and why policies are put into practice, as well as the reasons why implementation procedures don't always work as planned. He continues by making the case that various models for implementing policies aid in our comprehension of multiple aspects of the process (1998). Various models of policy implementation, including the "Street-Level Bureaucracy" model, the "Policy Cycle" model, and the "Capacity-Building" model, have been discussed in various literature sources.

2.6.1 Street-level Bureaucracy Model

The sociological theory known as "street-level bureaucracy" (SLB), which Michael Lipsky created, aims to explain the behaviour and attitudes of front-line employees in public services as well as how they implement public policy in their day-to-day job (Cooper *et al.,* 2015). Chang (2021) adds that it draws attention to the ways in which personal prejudices, workload demands, and resource limitations might affect their choices. It transcends the standard top-down perspective on the application of policies. Lipsky(2010) writes in Street-Level Bureaucracy that these comparatively low-level public servants endure excessive caseloads, unclear agency objectives, and insufficient funding.

2.6.2 Policy Cycle Model

According to Warner (2022), this model views policy implementation as one stage in a cyclical process that includes agenda-setting, policy formulation, decision-making, implementation, and evaluation. It underlines how each of these stages are interrelated and how crucial feedback chains are to the learning and modification of policies. Capano and Pritoni (2020) emphasized that it provides a structured framework for analysing the policy process. Problem definition, policy creation, implementation, enforcement, and evaluation are the steps of a policy cycle (Janssen and Helbig, 2018).

2.6.3 Capacity-Building Model

This model focuses on the importance of building the capacity of organizations and individuals involved in policy implementation. According to World Health Organization (WHO) (n.d), capacity building is the ability of individuals, organizations, or systems to perform appropriate functions effectively, efficiently, and sustainably. Capacity building is building networks, offering top-notch training, and carefully choosing employees all of which are essential to enhancing both individual and group capacity inside a company. Chauveron *et al,* (2021) support this by stating that Capacity Building (CB) addresses the processes and practices at the individual and organizational levels necessary for sustained high-quality evaluation.

Lipsky (1980) developed the "Street-Level Bureaucracy" model, which emphasizes how bureaucrats and frontline employees influence how policies are implemented. According

to Lipsky (1980: 22), street-level bureaucrats are "middle-level and low-level officials whose tasks involve the direct delivery of goods and services, either directly to citizens or to other organizations." He continues by saying that because these bureau crats "work in an environment of limited resources, ill-defined goals, and little guidance from above," they have a special opportunity to influence how policies are implemented by their choices and actions (1980). The policy cycle model, according to Dahl and Lindblom (1953: 17), is a series of steps that public problems go through before being addressed by public policies. They further state that this cycle includes the evaluation of various proposals for solving a problem, the choice of one of these proposals, and the implementation of that preferred solution. Several academics, including Moore (1995), developed the "Capacity-Building" model, which emphasizes the significance of developing institutional infrastructure and capacity to enable efficient policy implementation. The act of creating and enhancing the abilities, instincts, assets, and frameworks required for a government agency or other institution to carry out its purpose is known as capacity-building (Moore, 1995: 16).

Using the well-known policy cycle model (Warner, 2022; Capano & Pritoni, 2020), the current research suggests that it can be used as a strong analytical tool to analyse the complexities of implementing green energy technology policies in local municipalities. The model offers a structured method for methodically analysing the various aspects affecting the results of green energy projects by conceptualizing policymaking as an iterative and phased process that includes agenda-setting, formulation, decision-making, implementation, and evaluation. This framework makes it easier to conduct a detailed analysis of the ways in which every step of the policy cycle influences and interacts with the later implementation phase, clarifying the factors that determine success and failure. Furthermore, the inherent emphasis on feedback loops within the policy cycle model allows for a rigorous analysis of the mechanisms through which municipalities adapt their strategies and learn from the experiences of implementation, technological advancements, and the dynamic evolution of policy objectives in the green energy sector.

2.7 Public policy implementation problems

Most scholars would concur that it is troublesome if there is a gap between the law and practice when it comes to policy implementation (Keiser & Soss, 1998). In his seminal

work, Howlett (1998 :45) discusses how unforeseen effects, political meddling, and lax enforcement can undercut policy intentions. The mentioned problems emphasize the need to predict and address potential issues during the policy implementation process, which includes monitoring and assessing regulations to detect and remedy unintended consequences or enforcement gaps (Warner, 2022). An implementation problem occurs when a political decision is not carried out in accordance with what the decision maker wants. In his analysis, Munger (1996: 141) examined the process of implementing policies and noted a variety of potential problems, such as a lack of public support and a dispersion of responsibility. Dunn (2015: 76) draws attention to the idea of the "implementation gap," which describes the difference between the intended and actual results of policy. Various problems might cause this gap, such as insufficient funding, a breakdown in communication, and opposition from stakeholders or implementers. Smith (1973: 199) further explains that the nature of the policies that political systems must establish is one reason why nations find it challenging to implement governmental policies. Even when numerous modifications have been made, developing a suitable policy solution can be challenging, as noted by Lindblom and Cohen (1979: 124). The fact that even seemingly little or incremental changes can have unexpected repercussions or make implementation more difficult is highlighted by this, which is one of the main obstacles to implementing public policy. In their writings, Lindblom and Cohen (1979) stress the significance of adopting an achievable and evidence-based approach when evaluating the long-term effects of policies, in addition to the value of flexibility and adaptability in policymaking.

2.8 The nexus between green energy technologies and policy implementation

The nexus between green energy technologies and policy implementation is critical for achieving sustainable energy transitions. According to Lewis (2013), a close relationship between green energy technology and policy implementation has played a significant role in the development of China's renewable energy sector. Sivaram (2018) argues that a swift switch to renewable energy requires a close relationship between the application of green energy policies and technology and also points out that new policies are required to encourage investment and lower adoption barriers because the present laws and regulations frequently fail to promote the implementation of cutting-edge solar technologies. Furthermore, von Blottnitz (2020) highlights the importance of public

participation and community engagement in implementing renewable energy and air quality policies.

Martin and Baker (2016) believe that attaining social justice goals in South Africa requires a close relationship between green energy technologies and policy implementation. Similarly, Eberhard *et al.,* (2014) state that the positive relationship between green energy technology adoption and policy implementation in South Africa has been driven by critical factors, including efficient policy design, robust institutional capacity, and strategic pricing and risk allocation. As examined by Burton and Trollip (2019), a number of obstacles have prevented the integration of green energy technology with the execution of policies in South Africa, including the coal lobby's influence, political favouritism, and the lack of sufficient policy support. Likewise, Humby (2020) also highlights the issue of slow and bureaucratic processes for regulatory approvals and licensing as a factor that hinders the nexus between green energy technologies and policy implementation in South Africa. Conversely, policy coordination between the national and local governments will be crucial to promote the adoption and application of green energy technologies (Winkler & Marquard, 2009: 26).

The literature review underscores the importance of aligning green energy technologies with robust policy frameworks to achieve sustainable energy transitions. As exemplified by Lewis (2013) and Sivaram (2018), scholarly discourse emphasises the foundational role of a strong coupling between technological advancement and policy implementation. Within the South African context, the reviewed literature reveals a complex landscape. While authors such as Eberhard *et al.,* (2014) identify key enabling factors, including efficient policy design, institutional capacity, and strategic pricing, the review also highlights significant impediments, notably vested interests, bureaucratic bottlenecks, and policy lacunae, as documented by Burton and Trollip (2019) and Humby (2020). Moreover, the literature emphasizes the crucial role of public participation, community engagement, and multi-level governmental coordination, as demonstrated by von Blottnitz (2020) and Winkler and Marquard (2009), in successful implementation. This review concludes that navigating these complexities necessitates a comprehensive and context-specific policy approach. Through synthesizing these diverse perspectives, this literature review lays the groundwork for a deeper understanding of the interplay between

green energy technologies and policy implementation in South Africa, informing the subsequent analysis and discussion within this dissertation.

2.9 Factors leading to the implementation of green energy technologies in the local government

This section investigates the complex drivers facilitating the implementation of green energy technologies within local government. It examines the socio-political, economic, and technological factors that shape municipal adoption, providing a critical analysis of the dynamics impacting local sustainable energy transitions. According to Van der Westhuizen (2021), local government has the ability to be extremely important to the growth of green energy in South Africa.

2.9.1 Energy Security

Energy security emerges as a critical driver for the implementation of green energy technologies (GETs) at the municipal level. Scholars, including Sovacool (2014) and others (Bridge, 2018; Cherp & Vinichenko, 2009), have highlighted the role of decentralized renewable energy solutions in mitigating vulnerabilities associated with centralized energy systems and volatile fossil fuel markets. Similarly, Van der Westhuizen (2021) observed that South African municipal governments prioritise on energy security, especially considering the nation's reliance on imported energy and susceptibility to disturbances in international energy markets. According to Montmasson-Clair (2019), energy security is the primary concern for South African municipalities. Eberhard (2017) stresses that the energy sector in South Africa must take municipal-level energy security into account.

2.9.2 Economic development

While von Blottnitz (2019) suggested that the development of green energy sources can have a major positive economic impact on nearby communities. The scholar indicates that these projects (Just Energy Transition (JET), Green Hydrogen and Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)) can support local economic growth, generate jobs, and foster regional development, especially in the West Rand Region's rural and underdeveloped areas. Ngwenya (2020) investigates

further the potential of renewable energy to drive local economic development in South Africa. Ngwenya (2020) posits that green energy initiatives can create significant economic benefits for local communities, particularly in areas that are historically marginalized and under-resourced. In their findings, Burton, Caetano, and Shingange (2018) address the significance of involving local communities in green energy projects and making sure they profit from the jobs and economic opportunities these projects create. They contend that strong local content requirements, community ownership models, and local procurement policies are necessary to achieve this (Burton *et al,* 2018). Furthermore, Wallace, (2017) explains that community-focused renewable energy initiatives can support regional economic growth and energy availability.

2.9.3 Government policies

The adoption of green energy technologies (GETs) is greatly aided by government policies, which also influence the market environment and attract investment. The South African Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), for example, is an example of how specific laws can greatly speed up the development of renewable energy infrastructure. Its goal is to draw private investment through competitive bidding (Eberhard *et al.,* 2014). Moreover, Martin (2018), highlights that social justice and equity concerns have influenced South Africa's energy policy historically, emphasizing on how these issues have affected environmental degradation, poverty, and inequality. Thus, when local energy policies are implemented to incorporate fair access to energy, community participation, and local benefit sharing, they can be particularly effective in advancing social justice. Further examining the role of policy in fostering green energy transitions in South Africa, Harro von Blottnitz (2020) points out that the country faces significant in the areas of social justice, environmental sustainability, and energy security, all of which call for a fundamental overhaul of the country's energy infrastructure. Eberhard (2014) highlights the need for strong legislative frameworks and strategies to execute renewable energy projects successfully. The literature reviewed indicates that it is necessary for the local governments must modify and connect national green energy plans with local situations. Clear objectives, incentives for renewable energy uptake, and efficient regulatory processes are all essential to effective local policy.

2.9.4 Technological advancement

According to Brent (2020), technological advances are crucial for fostering the integration of green energy sources and tackling issues of equity and energy access. They can also aid in resolving some of the technical obstacles related to renewable energy, such as intermittency and grid integration. Schilling *et al.,* (2008) explain that in the early stages of technology development, significant work is necessary to accomplish minor gains because the fundamentals of the technology are still being learned. Efficiency improves quickly when developers gain more knowledge and focus on the areas that produce the most significant advancements (Schilling & Esmundo, 2008). Technology will eventually hit an intrinsic limit, requiring ever-larger investments to achieve even minor performance gains. Furthermore, according to Godfrey's (2019) research, waste-to-energy technology may offer a viable way to manage municipal solid trash and encourage the use of renewable energy sources in the community. West Rand District Municipality created a comprehensive plan to employ technology developments in green energy by utilizing the insights from these researchers.

2.10 Policies and frameworks underpinning the implementation of green energy technologies in South Africa

A robust framework of national, provincial, and local policies underpins the implementation of green energy technologies in South Africa. Municipalities and other rural South African communities can benefit from local energy projects that aim to address poverty reduction and energy access (Ampiah & Mebile, 2018). In their inventory, Montmasson-Clair and Ryan (2020) note that many of the green policies, programs, and strategies in South Africa have been implemented with a focus on local communities and municipalities. Furthermore, international agreements on combating climate change, like the Paris Accords agreed in 2015, inform these energy policies and fuel efficiency regulations (Anderson, 2020:1). The study discusses some of the policies and frameworks below:

2.10.1 The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)

The REIPPPP helps address challenges of energy access and security within municipalities and offers chances for local economic growth and employment creation. According to Jacobs and Perez (2016), South Africa has benefited economically from the REIPPPP, especially in rural areas like the West Rand Region. They argue that "the REIPPPP has created a platform for local municipalities, and indeed across the country, to generate and deliver electricity using renewable resources, contributing to a cleaner environment and a more resilient energy system" (Jacobs & Perez, 2016 :613). The Renewable Energy Independent Power Producer Procurement Programme is one of the biggest renewable energy initiatives in South Africa (REIPPPP). According to Walwyn & Brent, (2015), a sizable infrastructure plan was created to address concerns about South Africa's reliance on coal as its main energy source and lower carbon emissions. Moreover, Baker & Wlokas (2015), Eberhard et al., (2014), and Wlokas (2015) concur that the South African government introduced the REIPPPP in 2011 with the goal of promoting investment and fostering socioeconomic and environmental growth. The scholars underscore that corporate participants in this program are required to make investments in their host communities to promote socioeconomic development, including the creation of jobs in those places.

2.10.2 The Integrated Resource Plan (IRP)

The Integrated Resource Plan (IRP) is a pivotal framework guiding South Africa’s transition towards a more sustainable, reliable, and cost-effective energy future. Municipalities regularly investigate the local implementation of national energy policies. Scholars have explored this. According to Burton and Lott (2018), the IRP is a crucial policy document that directs South Africa's energy planning. They suggest that the IRP ought to be created in a way that encourages the growth of renewable energy projects in local municipalities. Furthermore, Montmasson-Clair and Ryan (2020) suggest that the IRP, through detailed resource assessments and mapping, has the potential to reveal significant untapped renewable energy resources within South African local municipalities. Specifically, this potential would be identified during the IRP's analysis of distributed generation options and localized energy needs, demonstrating that

municipalities can play a critical role in the country's broader energy transition (Montmasson *et al.,* 2020). This could result in the creation of renewable energy projects in the area.

The IRP aligns with the Growing Gauteng Together 2030(GGT 2030) vision, a strategic framework that sets out a vision for the province of Gauteng, including economic, social, and environmental objectives. One of the main goals of the GGT2030 is to raise the proportion of renewable energy in Gauteng's energy mix (GGT2030, p. 21). Another target of the GGT2030 is to increase the proportion of public transportation in Gauteng's transportation system, emphasizing low-carbon transportation options (GGT2030, p. 20). According to Fahed et al. (2020), a successful transition to a low-carbon economy in Gauteng will necessitate a range of interventions, including the promotion of renewable energy, energy efficiency, and sustainable transport. They also analysed the significance of aligning local and provincial policies with national policies, such as the GGT2030 and the IRP. Mncwabe (2019, p. 19) further recognizes the significance of involving local communities and municipalities, particularly those in the West Rand Region, in the formulation and execution of Gauteng's green economy plan, which is in line with the objectives of the IRP for local communities.

2.10.3 The National Energy Regulator of South Africa (NERSA)

The National Energy Regulator of South Africa (NERSA) is a key organisation in the nation's energy sector, playing a vital role in the implementation of the IRP. It is essential for the country's transition to a more secure and sustainable energy future. It also ensures fair regulation, protects consumers, and promotes economic efficiency and sustainability. Paarlberg (2020) emphasizes that NERSA's regulatory actions have substantially impacted the supply of electricity and energy infrastructure, particularly in the West Rand Region. Furthermore, he asserts that NERSA's policies have had varying effects on South Africa, with the West Rand Region and other areas and communities facing more difficulties obtaining inexpensive and dependable power (Paarlberg, 2020: 55). Montmasson-Clair & Ryan, 2020: 43) explain that there has been a notable impact of the REIPPPP and other green policies on South African local communities and municipalities, including those in the West Rand Region. They emphasize the significance of community ownership and participation in renewable energy projects, stating that "communities with

a stake in renewable energy projects are more likely to support and promote their development, and to ensure that the benefits are shared equitably. Gottschalk (2019) concludes that because NERSA's regulatory decisions have frequently failed to consider these regions' particular demands and aspirations, they are more vulnerable to load shedding and power outages.

2.10.4 The Sustainable Energy Council of South Africa (SEC)

The Sustainable Energy Council of South Africa (SEC) is an organization focused on promoting sustainable energy practices, policies, and technologies within South Africa. In support of the Sustainable Energy Council of South Africa (SEC), Swilling (2017: 14) makes the case that effective governance frameworks are necessary to facilitate the shift to a green economy. According to Wright and Calitz (2020), local governments have a crucial role in facilitating a fair shift to a low-carbon economy, particularly concerning energy development and planning. Furthermore, Martin & Davies (2018: 15) underscore the importance of strong community engagement in renewable energy projects. They contend that a participatory approach to renewable energy development, involving the active participation of local communities and stakeholders, can help guarantee local approval and support for projects, as well as the fair distribution of benefits.

2.11 Barriers faced by the local municipalities in implementing green energy technology policies

Municipalities must be included in the grassroots level of governance carry out national initiatives. According to Brent, Guy, and Mosdell (2012: 20), municipal renewable energy programs must overcome a number of general barriers and hurdles that municipal renewable energy programs must overcome in order to significantly expand their implementation. These barriers include social, political, institutional, technological, and market impediments (Painuly, 2000). These barriers are discussed in detail below

2.11.1 Lack of capacity and expertise

Lack of capacity and expertise is one of the primary barriers the municipalities face. Bekker et al. (2008) draw attention to local governments' difficulties in putting energy policies and programs into practice, even though their main focus is on the rapid

electrification initiative and its effects on electricity access in South Africa. As noted by Bekker *et al.,* (2008: 3128) "local governments often lack the capacity and expertise to manage and coordinate energy services effectively." Prasad (2008: 3907) began by saying that energy sector reform should be pro-poor, meaning that it should consider the particular energy needs of low-income households and spread the benefits of the reform in a fair and socially responsible manner. However, Musango, Brent, and Bassi (2014: 271) restate that strong government leadership is required to expedite the transition to a green economy and that policies and programs should be developed and implemented in a way that ensures the benefits of the shift are distributed equitably throughout society. Local governments will need to expand their capabilities in a number of areas, including environmental management, energy efficiency, and renewable energy technology, in order to put policies and programs that promote a just transition into action (Swilling & Annecke, 2012:124).

2.11.2 Limited funding

Limited funding is a significant barrier for the municipalities in implementing green energy technology policies. Local governments in South Africa get limited funding from national and provincial governments, which might limit their ability to encourage renewable energy development and execute green energy policies (OECD, 2019). According to Ndoro and Kibugi (2019), limited funding for local governments can lead to capacity constraints that hinder their ability to implement green energy policies, including limited staffing and resources for planning, policy development, and implementation. Wealthier towns may have greater resources to support the creation and implementation of green energy policies, while limited funding for local governments can worsen already existing social and economic disparities (Hoggarth & Hunt, 2017). Additionally, Pegels (2010:4951) maintains that a lack of finance may restrict the ability of other players, such as local governments, to promote the development of renewable energy through the creation of policies, project financing, and capacity building. Significant financial obstacles prevent local governments from fully promoting the growth of green energy, such as restricted access to capital markets and a lack of funding from federal and state governments (Pillay & Mahomed, 2018 :27).

2.11.3 Community resistance

People generally resist change, particularly when it disrupts established routines and practices and it is often due to issues like insufficient knowledge, job security, distrust and impact on landscape. According to Wüstenhagen, Wolsink, and Bürer (2007), community resistance is a common obstacle to the development of renewable energy projects and the implementation of policies pertaining to them. They assert that community resistance can result from several factors, such as worries about these projects' social and environmental effects, opposition to changes in local infrastructure and land use, and concerns about how the costs and benefits of these projects will be distributed. Devine-Wright (2009) continues to say that locals attachment to their community and their worries about the possible effects of renewable energy development on their environment and community may be the fundamental causes of community opposition to renewable energy projects. Therefore, Sovacool (2009), lists a variety of variables that may lead to local opposition to renewable energy projects, such as local worries about the effects on the environment and changes to the local scenery as well as local worries about the effects on the local economy, including changes to property values, local opposition to renewable energy projects that are perceived as being foisted on communities without enough engagement or consideration of local goals and values, as well as local concern over the noise, visual, and other effects of these projects. The West Rand District Municipality may more effectively comprehend and lessen community resistance as a barrier through addressing these factors and utilizing academic insights, opening the door for the successful adoption of green energy technology policies.

2.11.4 Lack of infrastructure

The local governments faces infrastructural deficiencies that impede the implementation of green energy technology policies. These deficiencies impact the municipality's capacity to produce, distribute, and sustain green energy technologies. Through pointing out, in particular, that local governments frequently lack the institutional and technical capability to efficiently plan and carry out electrification projects, which might restrict their ability to reach underserved and rural areas (Bekker *et al.,* 2008: 3126). However, Pegels (2010: 4948) argues that in order to overcome this barrier, transmission lines should be extended to remote areas and grid infrastructure should be improved. This would make it easier for

green energy projects to connect to the national grid and will also increase access to dependable electricity. In order to bolster this idea, Cloete (2015:4) reiterates that enhancing grid infrastructure, such as adding transmission lines, substations, and other upgrades, can facilitate the use of renewable energy in South Africa. According to the article by Marrian (2018: 6), a large number of renewable energy projects have had trouble connecting to the national grid, which has caused delays in project development and decreased income for renewable energy producers. South Africa has a large potential for renewable energy, although s Zhou *et al.,* (2022: 1584) still note in their article that "limited grid infrastructure and insufficient energy storage capacity are barriers to renewable energy deployment". To help communities like the West Rand District successfully implement green energy technology policies, these scholars present a thorough analysis of the infrastructure barriers.

2.11.5 Lack of coordination

This issue can manifest in various ways, impacting the planning, execution, and management of green energy projects. Marais explored the governance issues that South Africa's renewable energy growth is confronting, such as coordinating efforts between the national, provincial, and local governments as well as among various players in the renewable energy industry (2019: 109). According to Grobler (2017: 52), towns' ability to carry out renewable energy projects may be hampered by their frequent lack of institutional capacity and funding for efficient stakeholder coordination. The development and implementation of renewable energy in South Africa depend heavily on the efficient coordination of policies and technology, especially when considering decentralized energy systems and local energy requirements (Gogoi & Pandey, 2016: 791). Gogoi and Pandey (2016), emphasize how crucial it is for all economic sectors and levels of government to work together to promote renewable energy development. Molapo & Visser further explain that coordination between many stakeholders can be useful in addressing common obstacles to renewable energy development, including budgetary limitations, regulatory obstacles, and community hostility (2015:1371).

2.12 Theoretical Framework

Green energy has been an essential part of South Africa's energy strategy in recent years, as it may help with concerns related to sustainability and energy security. A regulatory

framework and supportive policies are needed for the advancement and application of renewable energy technologies. This study adopts the rational choice theory and incrementalism.

2.12.1 Rational Choice Theory

Rational Choice Theory helps policymakers understand how individuals and groups might respond to policies based on their perceived self-interest. Coleman (1990) emphasized how rational actors operating within social systems, including those shaped by policy, will make choices based on their perceived self-interest, thus highlighting the importance of understanding incentive structures when designing effective policy implementation. Likewise, Thaler (2015) demonstrated that effective policy implementation requires acknowledging and leveraging predictable human irrationalities, to "nudge" individuals toward better outcomes rather than assuming perfect rationality. Furthermore, Simons (1957) critiqued rational choice theory and proposed bounded rationality, arguing that individuals make decisions with limited information and cognitive constraints, leading them to satisfice rather than optimize. Simons (1957) indicated that bounded rationality explains how people actually make decisions in real-world situations.

2.12.2 Incrementalism

Incrementalism emphasizes continuity and feasibility while giving practical changes to the current situation precedence over revolutionary ones (Lindblom, 1959). Keohane and Victor (2016), explain that incrementalism supports consensus-building in international contexts by fostering gradual alignment of policies across diverse political and cultural landscapes. Moreover, Mahoney (200) posits that when new opportunities present themselves, incrementalism permits a gradual departure from long-standing practices, which can both lessen and reinforce path dependency by building upon current policies. Likewise, Hayes (2022) defines incrementalism as a strategy for optimising policy under significant constraints, primarily by leveraging existing knowledge through the expansion of prior policies. The latter approach concentrates on policy alternatives that just slightly alter the current situation. Consequently, substantial policy change is pursued through a sequence of small, serial actions, a process termed "seriality" by Lindblom. In spite of its reluctant persona, incrementalism is nonetheless a useful idea for comprehending how policies are implemented.

This study applies rational choice theory to investigate how local actors' adoption decisions during the policy implementation process are influenced by their assessments of the costs and benefits of green energy technology. Furthermore, Incrementalism provides insight into the analysis by considering how local green energy policy implementation is shaped by pre-existing municipal institutions and progressive changes.

2.13 Conclusion

In conclusion, the preceding review of literature and the outlined theoretical framework, encompassing green energy policy implementation in public administration, definitions of green energy technology, conceptualizations of policy implementation, and the policy implementation process, collectively establish the foundational understanding for this study and were explained in this chapter. An overview of the study research methodology used to examine these complications in the particular context of the West Rand District Municipality will be provided in the upcoming chapter.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

The methodology section, was a crucial component of this research study, outlining the procedures for gathering and analysing data as well as the general research design that guides the inquiry. This chapter details the research methodology, encompassing the research approach, research design, sampling technique, data collection method, inclusion/exclusion criteria, data analysis method, and ethical considerations. The findings and conclusions that follow are based on this thorough methodological overview.

3.2 Research approach

A qualitative approach is used for this study. Qualitative research is a type of research methodology that enables the exploration or investigation of the qualities of relationships, activities, events, or materials (Fraenkel, Wallen & Hyun 2015). Bhandari (2020) adds that a qualitative research methodology provides meaningful insight and generates innovative ideas. In this study, a qualitative research approach shall provide the West Rand Municipality with insightful knowledge of green energy technologies policy implementation and provide a normative idea for advancements in renewable and sustainable energy. Furthermore, with a qualitative approach, this study strived to give a thorough understanding of the structure and processes which advocate the West Rand District Municipality's implementation of green energy technology policy.

3.3 Research design

As a qualitative study, the research adopts a case study research design. Yin (2015) indicates that a research design is a logical course of action and a planned framework encompassing various processes to accomplish the study's goals. Creswell (2018) defined case study research as a qualitative research design that focuses on thoroughly understanding a particular phenomenon or occurrence. George (2023) adds that the design is adopted to investigate the study's research questions. This study uses a case study research design, focused on the West Rand District Municipality. Data is collected for a desktop study of the region's green energy policy implementation process.

3.4 Sampling technique

In this study, a non-probability sampling technique is adopted. Rahi (2017) defined sampling as the practice of gathering data from a research population that the researcher can easily access. In this regard, a purposive sampling method is used in this study. Simmons-Mackie and Lynch (2013:1286) explain that a purposive sampling method is deployed when the sample is deliberate. Oranga *et al.* (2023) add that when using purposive sampling, the sample is chosen based on the researcher's judgment of the most instructive. The research adopts this sampling to ensure that the data collected is relevant, informative, and directly applicable to the research questions, providing a deep understanding of green energy policy implementation within the specific context of the West Rand District Municipality. As such, purposive sampling is used in identifying literature on failed green energy technological advancements in South Africa.

3.5 Data collection method

Cote (2021) stipulates that the methodological procedure of acquiring information about a certain study is known as data collection. This research adopts document analysis as its data collection method. According to Bowen (2009), reviewing and evaluating secondary data in a structured manner is known as a document review. Yin (1994) adds that it is an advantage to use document review because it provides a broad coverage and is less costly than other data collection methods. This is done to understand which energy policy implementation in the West Rand District Municipality. This study reviews IDPs, municipal documents and other provincial and national governments policy frameworks that provide a framework for the safe implementation of technological innovations in renewable energy that have already been adopted in the region.

3.6 Inclusion/Exclusion Criteria

The criteria used to guarantee the quality and applicability of the data gathered for this qualitative investigation are described in detail in this section. Purposive sampling and document examination are used in this study to understand of how the West Rand District Municipality is implementing green energy policies.

The West Rand District Municipality's implementation of green energy policies is examined in this study by reviewing purposively sampled, strategic plans, policy documents, project reports, and official communication from a specified time period which is from the year 2010 till present are among the official sources that are directly related to the municipality's green energy initiatives and are given priority in the document selection process. To ensure data aligns precisely with the study's scope and upholds analytical rigor, the exclusion criteria specifically omitted data deemed inappropriate for the West Rand context, information that was outdated beyond a defined timeframe relevant to recent policy shifts, and sources inaccessible through standard academic channels and local government archives. This focused exclusion strategy ensures that the analysed information is directly pertinent to understanding green energy policy technology implementation within the West Rand District Municipality.

3.7 Data analysis method

Content analysis is employed in this study. Krippendorff (2004), describes content analysis as a method for drawing verifiable conclusions about the settings in which texts were used by analysing the content of texts. In this study, the data that received, including policies on energy in the local government sphere were reviewed and analysed. International Agreements, White Paper, government policy documents and national and innovation law documents, is reviewed to assess the outline of the energy sector, with a particular focus green energy within local government regions. The West Rand District Municipality's municipal records concerning the use of technological innovations within pre-existing green energy policy frameworks were analysed in order to fulfil the study's goal of assessing the implementation of green energy technology policies in the municipality.

3.8 Ethical considerations

Gelman (2018) suggests that ethical dilemmas occur when an action, while advantageous to the researcher or aligned with a supported cause, may disadvantage others or breach established norms. Such dilemmas underscore the importance of ethical considerations in guiding responsible research practices that enhance validity and uphold scientific integrity. Bhandari (2022) reinforces this perspective, asserting that research ethics are essential for maintaining scientific rigor and preserving the credibility of the

researcher. To ensure the highest ethical standards in this study, the following measures will be strictly observed:

- Securing ethical clearance from the Basic and Social Sciences Research Ethics Committee
- Properly acknowledging and citing all sources
- Avoiding plagiarism to maintain originality
- Ensuring research integrity throughout the study
- Avoiding redundant publications

This study upheld academic integrity and scientific rigor while making a significant contribution to the area by abiding by these ethical guidelines.

3.9 Conclusion

In summation, this qualitative case study, employing document review and content analysis, adhered to ethical considerations and applied defined inclusion and exclusion criteria to examine green energy technology policy implementation within the West Rand District Municipality. Additionally, the sampling method was also covered in Chapter 3. This data will be compiled, together with any important findings, in the chapter that follows.

CHAPTER 4 PRESENTATION OF FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the findings from a document analysis of green energy technology policy implementation within the West Rand District Municipality. Employing the methodological framework detailed in Chapter Three, which encompassed content analysis of municipal policy documents, and an examination of deployed green energy technologies, this section presents the findings. Specifically, the ensuing analysis will articulate the key findings in this section.

4.2 Recapping of the research questions

Main research question:

How are green energy technology policies being implemented in the West Rand District Municipality?

Specific research questions:

a What drives the implementation of green energy in the West Rand region?

b What are the key frameworks (institutional, policy and legal) that are guiding the implementation of green energy technologies in the West Rand District Municipality?

c What barriers are faced in implementing green energy technology policies in the West Rand District Municipality?

d What strategies can the West Rand District Municipality adopt to improve green energy technologies policy implementation?

4.3 Data Analysis

In this qualitative study, content analysis was done by the researcher using document review and secondary sources to gather data. Document review, according to Paquette (2020:29), can reveal important information about the present level of a topic's research as well as point out areas that require further investigation. Document review is a critical step in the research process that allows one to identify and examine the present state of knowledge (Veloso, 2018:39), he further emphasized the significance of document review

for research in developing the study questions and hypotheses, as the procedure helps, the procedure helped with spotting the gaps in the literature. According to Maree (2007: 101), this is the process of looking at data with different perspectives and identifying important texts.

In this study these document review steps were followed:

- Content to be analysed chosen in accordance with research questions
- Defining the content's categories (ranging from ministers to government domains and the nature of the involved infrastructure). This entails that document categorization focused on governance levels, policy domains, and infrastructural nature to analyse green energy policy implementation. This is for the reliability of the gathered data.
- Next, the data is coded. Data was coded thematically, categorizing document content by governance levels, policy domains, and infrastructural nature, to identify patterns and relationships within green energy policy implementation. This is to determine which data rules should be followed when collecting data, one or more categories.
- Analyse dependability and consistency.
- Give an analysis and make inferences.

4.4 Presentation of findings

4.4.1 Implementation of Green Energy Technology policies in the West Rand District Municipality

Swilling (2012) argued that a crucial change in economic and social structures is necessary for sustainable development. With the goals of lowering carbon emissions, enhancing energy efficiency, and advancing sustainable development, the West Rand District Municipality (WRDM) employs a few strategies to implement its green energy technology policies. Rasebechele (2022) states that, large municipal institutions have implemented energy strategies by creating organisational structures, coordinating sector-specific activities, and creating policies According to Makhudu (2021), the West Rand District Municipality has started putting solar energy projects into action, which helps the municipality achieve its goal of sustainable development and compliance with South

Africa's green energy legislation. Furthermore, Chilwane et al. (2024) in the “West Rand District Municipality: Adaptation Plan", includes that policies promoting green energy are a crucial tactic for cutting emissions and increasing resistance to the effects of climate change.

4.4.2 Factors that led to the implementation of green energy in the West Rand region

In 2008, the nation experienced its initial controlled local blackouts to alleviate this burden, prompting the pursuit of local solutions alongside national ones (Council for Scientific and Industrial Research (CSIR). 2025). Numerous important variables, such as local socioeconomic circumstances, national energy policy, and environmental concerns, are driving the use of renewable energy in the West Rand region . One of the main motivators is the necessity of addressing climate change and lowering carbon emissions, which has been a national and international concern for South Africa. Baker *et al.,* (2015) explain that the price and supply of energy, which were crucial to municipal budgets, abruptly became unstable, leading to rolling blackouts and a sharp spike in prices that would last into 2016.

4.4.2.1 Economic opportunities and job creation

The existing world and South African economies rely heavily on the unsustainable use of natural resources and fossil fuels, such as coal and oil. South Africa faces a third layer of complexity, unstable energy infrastructure, which makes it impossible for the country to sustain future economic growth or job creation and in addition, the depletion of these natural resources and rising global costs have resulted in the loss of 28 million jobs globally, with one million jobs lost in South Africa alone (DTi 2013:12). According to Borel-Saladin & Turok (2013), the prospect for reducing emissions and creating "meaningful" jobs is what has South Africa interested in the green economy. In South Africa, a working definition of the green economy is:

“One that guarantees socioeconomic progress and the standard of living for both the current and future generations but is independent of resource exploitation and environmental effects. At the end of the day, a sustainable social-ecological system is

ensured by the substantial behavioural shift toward lower ecological footprint lifestyles, state-led development, and commercial activities" (ASSAF 2011:165).

4.4.2.1.1 Economic opportunities in the West Rand District Municipality

Gauteng, South Africa's West Rand, has long been dependent on mining, particularly gold mining. However, to avoid socioeconomic stagnation, economic diversification has become necessary due to the fall in mining activity and the volatility of commodity prices. A good industry for diversification that offers chances for long-term growth is green energy. According to Spencer et al. (2010), one of their study's main conclusions was that a lot of cities, city-regions, and other comparable locations were making significant investments in green technologies, generating green jobs, and getting ready for a post-crisis world with low carbon economies, sustainable growth, green jobs, and improved quality of life. The West Rand District Municipality has started making large investments in green technologies in response to its post-mining economic issues, in line with the transformative techniques observed around the world (Chilwane et al., 2024). This is in line with more general worldwide patterns shown in research, where cities, city-regions, and similar regions are preparing for a low-carbon future by promoting sustainable growth, generating green jobs, and raising living standards. Spencer et al. (2010) additionally, implementing the following broad initiatives can help the Gauteng regio, more especially, the West Rand Region green its economy:

- Food security (lowering food imports and (significantly) raising local food production)
- Energy security (enhancing energy efficiency and expanding the supply of renewable energy to lessen reliance on coal and oil-based energy sources)
- Water security (lowering overall water use by 15% through waste reduction, recycling, public education, and pollution reversal through better management of Gauteng's water resources and related ecosystem services)
- Zero waste (Measures to minimize, recycle, and reuse trash will be implemented by viewing all waste outputs as possible productive inputs.)

- Sustainable mobility (Lessen reliance on oil and cut carbon emissions, public transportation system investments will be increased to achieve a 15% reduction in private vehicle travel.)

4.4.2.1.2 Job creation in the West Rand District Municipality

Green energy policies often create jobs in the West Rand District Municipality and take advantage of the region's resources, climate, and workforce to promote economic growth and environmental objectives. According to Meyer & Marais (2021), in addition to offering immediate job prospects in installation and maintenance, the West Rand District Municipality's renewable energy investments in solar, wind, and biomass also promise long-term growth through the development of green technologies and associated sectors. Policies promoting green energy have opened the door for upskilling initiatives that have prepared locals for new positions in sustainable agriculture, energy efficiency evaluation, and solar system installation (Burger, 2022). These developments have positioned the West Rand District Municipality for a diversified economy that makes use of green technologies by reducing economic vulnerabilities linked to traditional mining and manufacturing industries as well as unemployment. Nel et al. (2021) adds that the West Rand District Municipality can create many local jobs in renewable energy infrastructure by taking advantage of its plentiful solar and wind resources. In the end, South Africa's transformation to a green economy is fuelled by the West Rand District Municipality's successful implementation of green energy regulations, which may serve as a model for green-driven economic growth where environmental preservation and renewable employment creation coexist.

4.4.2.2 Government policies and frameworks

In line with national and provincial policy frameworks that prioritize social welfare, economic growth, and sustainable development, the West Rand District Municipality functions similarly to other local governments in South Africa. The municipality encourages job development, climate resilience, and sustainable economic growth by integrating these several national and provincial programs. As a strategic roadmap, the Integrated Development Plan (IDP) links national initiatives like renewable energy and economic diversification with the municipality's objectives (Local Government: Municipal Systems Act, 2000). Musakwa & Van Niekerk (2017) additionally stated that the Local

Economic Development (LED) approach is a key component of this framework since it promotes ecotourism and investments in the green sector, which have been demonstrated to diversify local economies and lessen reliance on conventional industries like mining, especially in the West Rand District Municipality. The West Rand District Municipality has also been impacted by the broad goals of the National Development Plan (NDP) 2030, which have been connected by academics to increased long-term economic resilience and these goals include poverty reduction, climate adaption, and low-carbon growth (Turok, 2014). Baker et al. (2019) conclude through the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), by mentioning that academics point to its ability to boost regional economies and cut emissions, so advancing energy and climate goals. A balanced approach to economic growth is promoted by these frameworks and policies in the West Rand District, where the sustainable development strategy is reinforced by job creation in green industries and environmental stewardship.

4.4.2.3 Technological advancements

Like many other regions throughout the world, the West Rand District Municipality (WRDM) in South Africa has placed a growing emphasis on green energy projects in an effort to promote sustainable development. When putting green energy policies into practice, the district can profit from a variety of technology breakthroughs that range from economic development to environmental sustainability. Baker et al. (2023) indicated that infrastructure for green energy and updated transportation are just two examples of the advancements that are essential to WRDM's sustainability and economic expansion. Furthermore, grid modernization is required for the integration of renewable energy sources. This allows the district to maintain reliable energy distribution and minimize power losses, both of which are critical for the shift to a more sustainable grid (Anderson & Mothibi, 2024).

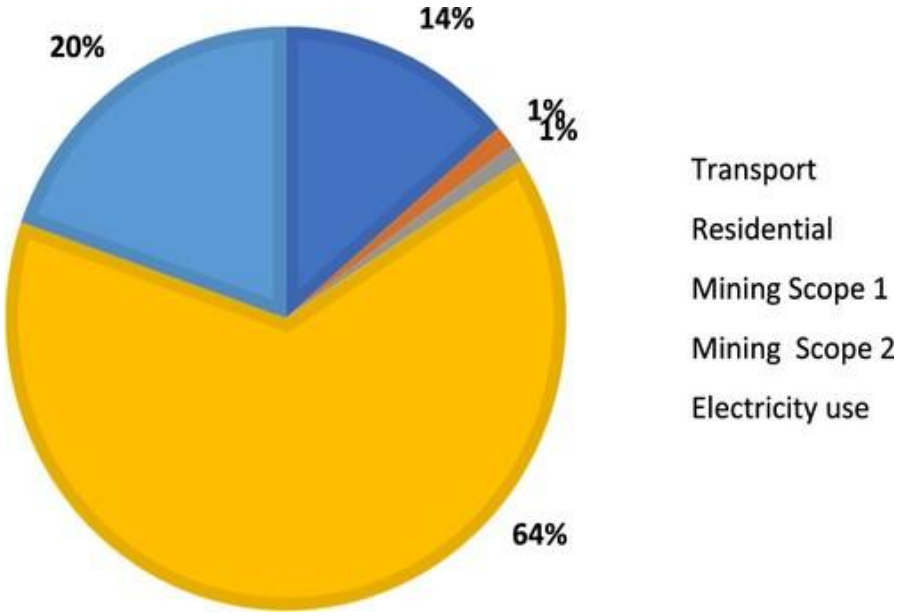
4.4.2.4 Climate change

The relationship between green technological innovation and climate change mitigation is mediated by policy stability, according to Korkut (2022). As the West Rand District Municipality (WRDM) works to slow down climate change and move towards sustainability, implementing green energy policies offers both advantages and

disadvantages. Positively, the study discovered that these measures result in notable decreases in carbon emissions, which enhance public health and air quality (WRDM, 2024). Additionally, the growth of jobs in the renewable energy sector creates economic prospects by diversifying the mining-dependent local economy (Smith & Green, 2022). Furthermore, by stabilizing local energy prices and lowering reliance on imported fossil fuels, renewable energy enhances energy security (Energy Policy Institute, 2023). Additionally, by lowering pollutants and landfill waste, bioenergy projects that utilize organic or agricultural waste aid in environmental rehabilitation (Anon, 2023).

The implementation of green energy policies, however, presents West Rand District Municipality with several difficulties. Government subsidies or partnerships are crucial for providing financial support for renewable infrastructure because its high upfront costs might put a burden on local budgets (Finance & Energy Quarterly, 2022). Job losses in this historic industry also underscore the necessity for job retraining programs as the area shifts away from mining (Miller, 2024). According to the WRDM Planning Committee (2023), the successful integration of renewable energy sources into the current grid necessitates storage systems and infrastructural modifications. Furthermore, if massive projects like solar farms are in locations that are sensitive to agriculture or the environment, they may cause land-use conflicts (Agricultural Land Use Report, 2023). Lastly, environmental issues arising from the extraction and disposal of materials for renewable technologies require cautious handling (Environmental Impact Review, 2024).

Figure 4 1: West Rand District Municipality's overall Greenhouse Gas (GHG)



Sectoral contributions to the West Rand District Municipality's overall Greenhouse Gas (GHG) emissions in 2019–2020 (%). Range of the scope of 1 emission is direct emissions. Two emissions are indirect emissions resulting from the use of electricity.

Source: Rasebechele, et al. 2024:7

The last discovery regarding climate change is in terms of GHG emissions as illustrated in Figure 4.1. The accuracy and comprehensiveness of the assessment are limited by the substantial gaps in data that are revealed during the compilation of the GHG emission inventory for the WRDM. This clarifies the challenges of accounting for greenhouse gas emissions in South Africa in general. Data on emissions from opencast mines, especially those run by small quarries, was practically non-existent (Rasebechele, *et al.,* 2024:7). This prevents a thorough comprehension of how these mining operations affect the ecosystem.

4.4.3 Important institutional policies and legal frameworks guiding the implementation of green energy technologies in the West Rand District Municipality

The combination of institutional policies and legal frameworks have a significant impact on the successful adoption of green energy technologies in municipalities. These regulatory frameworks are essential governing instruments that influence the extent,

velocity, and success of renewable energy projects in the West Rand District Municipality. National, provincial, and local policies work together to provide a regulatory framework that supports sustainable energy solutions while addressing opportunities and problems unique to each location.

4.4.3.1 The National Development Plan 2030

The 2018 announcement of the current National Development Plan (NDP) established an ambitious plan for this investment and recognized the obvious need for significant public investment in Ireland, with an initial commitment of approximately €116 billion (later updated to €165 billion in the 2021-2030 NDP) aimed at raising public investment to 5% of Gross National Income (GNI), a level that the Irish Fiscal Advisory Council (2021) notes is "high by both historical and international standards for Ireland" (Irish Fiscal Advisory Council, "Ireland's next ramp-up in public investment," 2021; Government of Ireland, "National Development Plan 2018 - 2027"). When the updated NDP and a fresh set of projects were introduced in 2021, the demands were once more outlined. The National Development Plan 2030 was established by the South African government 10 years ago (NPC, 2012). Chigova (2021: 1069) indicates that the NDP's main goal is to eradicate poverty and reduce inequality by 2030 by bringing South Africans together, releasing their energies, developing an inclusive economy, strengthening the state's capacity, and empowering leaders to collaborate to tackle difficult issues.

The study finds that the West Rand District Municipality aligns its policy implementation strategies with the National Development Plan's (NDP) overarching goal of eradicating poverty and reducing inequality by 2030, focusing on fostering community participation, driving an inclusive local economy, enhancing institutional capacity, and promoting collaborative leadership to address complex challenges within the region. According to the National Planning Commission (2012), the West Rand District Municipality has shown that it is in line with the objectives of the National Development Plan (NDP) 2030 by implementing the following significant steps:

- Fostering Inclusive Economic Growth
- Enhancing Community Participation
- Building Institutional Capacity

- Promoting Collaborative Leadership

4.4.3.2 The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)

The South African government created the Renewable Independent Power Producer Program to acquire and secure a more sustainable energy mix, shifting the nation away from fossil fuels and toward more sustainable power and the program is regarded as one of the most aggressive, having attracted over $200 million in foreign investment (Alcock 2023:1). Department of Energy (2020) adds that the West Rand District Municipality's strategy for implementing policies has been greatly influenced by the Renewable Energy Independent Power Producer Procurement Program (REIPPPP), which the South African government created to move the nation toward a more sustainable energy mix. The study discovered that the initiative must strike a balance between the need for energy creation and black empowerment. It is difficult to balance these demands, which is why South African President Cyril Ramaphosa loosened these restrictions such as the removal of the licensing threshold for embedded generation , doubling the amount of new generation capacity procured through Bid Window 6 of the REIPPPP and encouraging private sector investment, hindered the expansion of the green energy sector and impacted the nation's energy security (Chetty *et al.,* 2023: 225). The WRDM's revised green energy policies, aligning with national reforms, aim to bolster energy security and foster inclusivity by engaging Black-owned businesses and attracting renewable energy investment. The municipality has ensured the involvement of Black-owned businesses in energy projects and established a climate that is conducive to investments in renewable energy by utilizing these reforms. This strategy strikes a compromise between meeting local energy needs and advancing more general goals of socioeconomic transformation that align with South Africa's national aspirations.

4.4.3.3 The Integrated Resource Plan (IRP)

The West Rand District Municipality aligns its energy initiatives with national goals by addressing energy security, integrating green energy, and promoting socio-economic development through the Integrated Resource Plan (IRP) (Department of Mineral Resources and Energy, 2019). According to Turner et al. (2024:1), in addition to building more power plants (hard path supply options), IRP aims to help think about improved

end-use efficiency and the provision of more localized generation, like rooftop solar power (soft path demand-side options), to help provide utility services, like energy, to a growing city and the method keeps changing as utility planning gets more complicated and must handle greater unpredictability, including that caused by climate change.

In keeping with national objectives for energy security and sustainability, the study found that the West Rand District Municipality has prioritized the integration of renewable energy sources, such as solar and wind power, in order to connect its energy policies with the IRP (Council for Scientific and Industrial Research (CSIR), 2023). The effective achievement of IRP aims at the local level is impacted by the municipality's policy implementation issues, which include capacity limitations, financial constraints, and the requirement for better collaboration with national and provincial government entities ((Department of Mineral Resources and Energy,2019). Furthermore, West Rand District Municipality IDP (2023), problems of the IDP range from governance and structural challenges to inadequacies in local capacity to oversee renewable energy projects. The literature reviewed in Chapter 2 of this study has specifically identified inadequate infrastructure, local economic restrictions, and a lack of coordination across various governmental levels as impediments to the full implementation of green energy projects.

4.4.3.4 The White Paper on Renewable Energy (2003)

The White Paper on Renewable Energy (2003) detailed South Africa's strategy for incorporating renewable energy into the country's energy mix, highlighting the potential benefits for environmental sustainability, socioeconomic growth, and energy security (Department of Minerals and Energy, 2003). Bekker et al. (2012) adds that the White Paper established the groundwork for energy transition strategies in local municipalities such as the West Rand District Municipality by promoting decentralized renewable energy projects, assisting local energy initiatives, and creating a favourable policy environment for municipal energy planning. The Department of Energy (2015a) indicated that the 1998 and 2003 White Papers (WP) on Energy and Renewable Energy were South Africa's two main energy policies following the 2008 financial crisis.

According to the Department of Energy (1998:9), securing the supply (of energy) through variety is one of the White Paper's many economic and social policy goals. The West Rand District Municipality's energy strategies have been directly influenced by the White

Paper on Renewable Energy (2003), which places a high priority on diversifying the energy supply. Through embracing this principle, the municipality has reduced its dependency on coal-based energy by implementing renewable energy projects like solar and biomass initiatives, ensuring a more sustainable and dependable energy mix for the area. In the West Rand, these efforts have also had socioeconomic effects, such as fostering rural electrification and generating local job possibilities in the field of green energy. In addition to supporting the White Paper's diversification objective, this strategy is in keeping with the district's Integrated Development Plan, which highlights green energy as a driver of both environmental sustainability and economic prosperity (West Rand District Municipality, 2023).

4.4.4 Challenges faced by the West Rand District Municipality in implementing of green energy technology policies

Implementing green energy technology policy is extremely difficult for the West Rand District Municipality, which is indicative of larger structural and governance problems that many South African municipalities face. The implementation of renewable energy objectives at the local level is hampered by these issues, which include a lack of funding, insufficient technical know-how, and disjointed intergovernmental cooperation (Musango *et al.,* 2022; Baker & Phillips, 2019). Furthermore, insufficient infrastructure and socioeconomic inequality make it more difficult to integrate green technologies, highlighting the necessity of increased capacity-building and strategic alliances to successfully overcome these obstacles (Eberhard, 2014; West Rand District Municipality IDP, 2023).

4.4.4.1 Financial Constraints and Lack of Funding

The Cooperative Governance and Traditional Affairs (2013), indicate that operations and maintenance of municipal infrastructure assets, including roads, sanitation, and electricity delivery, are inadequate in the Gauteng sector. According to Parida et al. (2014), investment in municipal infrastructure asset maintenance in South Africa requires a replacement value of not less than R200 billion in 2014. Nevertheless, adopting a more sustainable asset management investment mechanism necessitates a thorough operations and maintenance plan as well as a strict budgetary allowance (Bikam,2019).

Both the public and private sectors are naturally reluctant to invest in green technologies due to the magnitude of the investment, the high risks, and the gradual and unpredictable economic benefits and for the development and implementation of green technologies, financial access is essential. The study discovered that the WRDM demonstrates the public and private sectors' hesitancy to participate in green technologies because of the high expenses, dangers, and unpredictable financial rewards. Musango et al. (2022) point out that the development and execution of renewable energy projects in South African municipalities are severely hampered by a lack of funding. For the West Rand District Municipality, this problem is exacerbated by current infrastructure deficiencies and financial limitations, which make it challenging to draw in green energy investments. It is quite difficult for municipalities in underdeveloped nations to obtain funding for new infrastructure.

4.4.4.2 Grid Infrastructure and Energy Access

Implementing green energy policy is greatly impacted by the difficulty of grid infrastructure and energy access, especially in places like the West Rand District Municipality (WRDM). Renewable energy sources, which frequently need sophisticated grid technologies to handle fluctuating supply and assure stability, are challenging to integrate due to South Africa's grid infrastructure's age and limited capacity. According to Eberhard *et al.,* (2021), discovered that one of the main challenges to achieving the full potential of renewable energy at the local level is poor connectivity capabilities and insufficient grid access. More recently the study found that for South Africa to attain a more sustainable and resilient energy future, it will be crucial to keep funding green energy projects and working to upgrade grid infrastructure and energy efficiency (Kumba *et al.,* 2024).

The study illustrates that grid infrastructure and energy access are major issues for the West Rand District Municipality (WRDM), which is necessary to meet South Africa's green energy targets and ensure a robust and sustainable energy future. The West Rand District Municipality's capacity to improve grid infrastructure is limited by a lack of funding and technical know-how, according to policy implementation analysis.

4.4.4.3 Resistance from residents and public awareness

Resistance is the state in which governance systems naturally erect obstacles to implementation that hinder flexibility, adaptability, and change (Shamsuddin,2020:1). In the wake of recent studies on homeowners' sustainable behaviour, even when people are environmentally conscious and willing to act sustainably, they may still not change their behaviour because they expect inconveniences and face other psychological obstacles (De Vries, Rietkerk, & Kooger, 2019). Furthermore, Esiri et al. (2023:228) added that how the public feels is a major factor in how well the energy transition goes and how people and communities perceive the costs, advantages, and repercussions of these changes for their own lives as well as the larger economy will determine whether public opinion favours or opposes the implementation of renewable energy regulations.

Campaigns for public knowledge are essential for reducing opposition because they build community trust and guarantee that policies are in line with local socioeconomic realities. The lack of resources, however, makes it difficult for West Rand District Municipality to create and implement successful instructional programs, which feeds locals' mistrust of green energy initiatives. According to Esiri et al. (2023: 230) indicated that as awareness of climate change and the negative environmental effects of fossil fuels has developed over the past few decades, resident support for green energy has usually increased. The West Rand District Municipality indicates that the government has created ward committees, imbizos, community development workers, and open government participation as avenues for community engagement (South Africa. Department of Public Service and Administration, 2014).

The European Institute for Public Participation (EIPP, 2019) stated that the primary reasons for limited public involvement are low interest in participating, lack of qualified facilitators, expense, and language barriers. The study discovered that the lack of community engagement in governance poses a significant problem for the WRDM, especially when it comes to issues of basic service delivery like electricity and water (Rankoana 2023:255).

4.4.4.4 Regulatory and Bureaucratic Hurdles

In the West Rand District Municipality (WRDM), as in other South African municipalities, regulatory and bureaucratic obstacles have presented major obstacles to the adoption of green energy policy. These elements have made it more difficult for the WRDM to take advantage of the potential offered by renewable energy sources and build a more sustainable energy future for the area. According to studies initiated by scholars such as Msimanga and Sebitosi (2014), Swilling, M, et al. (2020) and the West Rand District Municipality (2023) challenges that influence regulatory and bureaucratic obstacles include the following:

- Prolonged Regulatory Processes
- Fragmentation Across Government Levels and
- Inadequate Resource Allocation

The West Rand District Municipality's ability to successfully adopt green energy technologies is greatly impacted by a mix of institutional policies and legal frameworks. According to Griese *et al.,* (2021), municipalities like the West Rand District Municipality, where comparable capacity and bureaucratic barriers may limit progress in renewable energy initiatives, can greatly benefit from the issues highlighted, such as fragmented policies and complex regulatory processes impeding distributed renewable energy implementation.

4.4.5 Strategies adopted by the West Rand District Municipality to improve green energy technologies

The West Rand District Municipality (WRDM) has implemented several initiatives to improve green energy technology and tackle issues such as infrastructural deficiencies, climate resilience, and the integration of green energy sources. The district's long-term development and climate adaptation plans include these projects, which are motivated by the main objectives of South Africa's renewable energy laws (West Rand District Municipality, 2023). According to the (CSIR, 2023), it is easier to incorporate and prioritize climate change adaptation and resilience measures into different planning mechanisms and processes when these methods are adapted.

4.4.5.1 Renewable Energy Independent Power Producer Procurement Programme (REIPPPP or REI4P)

The South African government's main program to encourage the growth of renewable energy and diversify the nation's energy mix is the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP or REI4P). McDaid et al., (2016:5) state that launched in 2011, the Renewable Energy Independent Power Producers Programme Process (REI4P) was one of the government's major initiatives for addressing climate change. Its goal was to deploy 3,725 MW of green power by 2016. In line with West Rand District Municipality's objectives of sustainable development and lowering dependency on conventional energy sources, the REIPPPP promotes projects in undeveloped areas. Within WRDM's jurisdiction, REIPPPP projects can be extremely important in advancing green energy given the district's emphasis on addressing climate resiliency and fostering sustainability. However, the West Rand District Municipality has not benefited much from the REIPPPP projects thus far, the program provides a way for the district to improve its green energy environment.

4.4.5.2 Public-Private Partnerships

Public-Private Public (PPP) is described as an agreement between a private party and a public-sector organization in which the private party uses state property in accordance with the PPP agreement and performs a function that is typically provided by the public sector (National Treasury, n.d). Within the West Rand District Municipality (WRDM), a Public-Private Partnership (PPP) is a cooperative agreement in which private organizations collaborate with the municipality to manage public assets or provide services, utilizing the efficiency of the private sector to improve public service delivery (National Treasury,2024). Furthermore, West Rand District Municipality (2024) adds that through these agreements, private companies are given access to municipal property to carry out tasks that are typically handled by the public sector, including building infrastructure or producing energy, as specified by the PPP framework. West Rand District Municipality can draw in investment, distribute project risks, and advance socioeconomic development in accordance with the district's Integrated Development Plan thanks to this approach.

4.5 Conclusion

In conclusion, the findings presented in this chapter illuminate the complex interplay of factors influencing green energy technology policy implementation within the West Rand District Municipality. The analysis reveals a nuanced landscape where national policy aspirations encounter localized realities shaped by stakeholder engagement, institutional capacity, and socioeconomic contexts, ultimately impacting the trajectory and efficacy of policy enactment. The next chapter provides the summary of findings, recommendations and concludes the study.

CHAPTER 5 SUMMARY, RECOMMENDATION AND CONCLUSION.

5.1 Introduction

The study's results were emphasized in the previous chapter. This chapter provides an effective summary of the results of the West Rand District Municipality's implementation of a green energy technology policy. Along with summarizing the research in depth, the chapter will also highlight the key findings. Additionally, Chapter 5 will offer pertinent suggestions derived from the research.

5.2 Summary of main findings

The purpose of the study was to analyse how the West Rand District Municipality implemented green energy technology policies. The study's summary of the findings is given according to the following order of the research objectives:

Objective 1: To analyse how green energy technology policies are being implemented in the West Rand District Municipality.

Objective 2: To assess the drivers that led to the implementation of renewable energy in the West Rand region,

Objective 3: To investigate the key institutional policies and legal frameworks guiding the implementation of green energy technologies in the West Rand District Municipality,

Objective 4: To understand the barriers faced by the West Rand District Municipality in implementing of green energy technology policies and

Objective 5: To analyse the strategies adopted by the West Rand District Municipality to improve green energy technologies

5.2.1 The West Rand District Municipality's implementation of green energy technology policies.

The West Rand District Municipality's (WRDM) adoption and alignment of its green energy policies with national frameworks are demonstrated by the findings. It evaluates the state of implemented projects including waste-to-energy programs, biogas, and solar

energy as well. Important obstacles that affect the success of these programs were also emphasized in the study, such as budgetary limitations, legal restrictions, technical ability constraints, and public awareness problems. Moreover, the study also assessed the socioeconomic and environmental advantages of green energy projects, including the creation of jobs, increased energy security, and a decrease in carbon emissions. In light of these results, scholars can point out that in order to improve the municipality's green energy implementation, it needs to strengthen policy enforcement, establish alternate funding sources, promote public-private partnerships, and increase community involvement.

5.2.2 Drivers influencing the West Rand region's adoption of green energy.

Numerous technological, policy, and economic issues impact the West Rand region's development of renewable energy. The viability of green energy initiatives is largely dependent on the cost of renewable energy technology in comparison to conventional fossil fuels, the availability of government subsidies, and private sector investment. In addition, the success of national and local energy strategies, the existence of clear regulations and regulatory support, and other factors influence the rate and scope of renewable energy adoption. Nonetheless, obstacles like drawn-out approval procedures and uneven policy enforcement could impede development.

The region needs a dependable electricity grid and enough technical know-how to enable renewable energy projects, thus technological and infrastructure preparedness is another crucial component. Adoption can be accelerated by research projects, skilled workforce availability, and green technology innovation. Public perception, awareness, and readiness to adopt renewable energy solutions can either speed up or slow down implementation, therefore social acceptance and community involvement are also very important. Misinformation or worries about land usage may cause resistance, thus programs to raise awareness and educate the public are crucial to their success.

Furthermore, the findings of the study indicated that the environmental factors and worries about energy security are two more factors that affect the use of renewable energy. Certain renewable energy sources' feasibility is determined by the availability of natural resources, such as solar and wind potential. There is also a pressing demand for alternative energy solutions because of the area's dependence on Eskom and regular

load shedding. To guarantee a sustainable energy transition, addressing these issues calls for enhanced infrastructure investment, improved policies, and more robust public-private partnerships.

5.2.3 The institutional policies and legal frameworks guiding green energy technology implementation in the West Rand District Municipality.

The study findings indicate that several institutional policies and regulatory frameworks are guidelines for the West Rand District Municipality's adoption of green energy technology. It is anticipated that the energy policies and sustainability plans of the WRDM are in line with provincial and federal renewable energy programs, including the National Energy Act and the Integrated Resource Plan (IRP). These regulations specify the municipality's responsibilities for establishing goals for renewable energy, encouraging sustainability, and providing financial aid or tax breaks to promote the use of green energy. However, there might be discrepancies in the local implementation and enforcement of these policies.

Green energy in WRDM is governed by national laws including the Renewable Energy Independent Power Producer Procurement Program (REI4P) and the Electricity Regulation Act. Grid integration, autonomous power generation, and the construction of renewable energy systems are all governed by municipal bylaws. However, the adoption of green energy may face major obstacles due to regulatory barriers, bureaucratic hold-ups, and ambiguous legal requirements. Another factor is institutional capacity, in order to supervise the implementation of policies, the municipality needs sufficient governance frameworks, technical know-how, and monitoring systems.

Notwithstanding current regulations, the study reveals that a number of obstacles prevent WRDM from effectively implementing green energy. Those include inconsistent policies, financial limitations, and legal ambiguities that could deter private sector involvement or restrict renewable energy projects driven by communities. Furthermore, zoning constraints, land-use rules, and environmental regulations may have an impact on project development. Strengthened regulatory enforcement, better institutional coordination, policy reform, and strategic alliances with the corporate sector and civil society are all necessary to meet these problems. Through strengthening governance capabilities and

improving legal frameworks, WRDM can foster an atmosphere that is more supportive of green energy projects.

5.2.4 The barriers preventing the West Rand District Municipality's adoption of green energy technology policies.

The study found that the adoption of green energy policy in the West Rand District Municipality (WRDM) is hampered by several barriers. These barriers are attributed by limited local resources, reliance on government funding, and the high upfront expenditures of renewable energy infrastructure. Further impeding growth is the absence of financial incentives and private sector investment.

The study findings indicate that the challenges also arise from policy and regulatory hurdles, such as ambiguous local policies, drawn-out approval procedures, and discrepancies between national, provincial, and local laws. It is challenging for WRDM to completely adopt green energy solutions due to restrictions on independent power generation and grid integration. The procedure is made more difficult by institutional and governance issues. The municipality may lack the technical know-how, strong enforcement capabilities, and intergovernmental cooperation required to execute green energy regulations successfully. Adoption and implementation of policies is also delayed by political will and changing priorities.

Furthermore, the study found that the additional challenges include inadequate infrastructure, a lack of public awareness, and opposition from the community as a result of false information or economic worries. Increased financing, legislative changes, technical training, and public awareness campaigns are needed to address these issues and encourage the use of renewable energy.

5.2.5 Strategies for improving green energy technology implementation in the West Rand District Municipality.

The WRDM has implemented strategic programs and policy measures to advance green energy technologies. As stipulated in section 4.4 Chapter 4 of this study, these efforts include implementing sustainability plans to promote clean energy growth and coordinating local policies with national renewable energy frameworks like the IRP.

Additionally, the municipality is trying to make laws more straightforward and to foster an atmosphere that encourages private sector participation in renewable energy.

Countless renewable energy projects have been started, such as waste-to-energy initiatives that use landfill gas and biogas technology, as well as solar energy systems for street lighting and municipal buildings. In order to diversify its portfolio of renewable energy sources, WRDM has also looked at wind and hydro energy pilot projects and collaborated with NGOs and independent power producers (IPPs). Additional evidence of the energy sector's modernization may be seen in investments in smart grid technologies, battery storage, and electric car infrastructure.

Although WRDM has made progress, it still faces obstacles like funding constraints, legal restrictions, and the requirement for more robust public-private partnerships to expand green energy projects. When trying to overcome these challenges, more community involvement in sustainable energy initiatives, better enforcement of policies, and an expansion of funding sources are needed.

5.3 Conclusions

The study's focus was on the West Rand District Municipality's implementation of green energy technology policy. Its main objective was to evaluate the sustainability, obstacles, and advancements of the municipality's renewable energy projects. Policy acceptance, regulatory frameworks, infrastructural preparedness, budgetary limitations, and community involvement in green energy initiatives were among the study's main focuses. The study also examined implementation hurdles, variables affecting the effectiveness of policies, and suggestions for enhancing the region's adoption of renewable energy.

The study concludes that although the West Rand District Municipality has taken action to adopt policies pertaining to green energy technologies, these efforts have been sluggish and uneven because of a few obstacles. Along with launching solar, waste-to-energy, and smart grid initiatives, the municipality has matched its policies with national renewable energy frameworks like the Integrated Resource Plan (IRP). However, these efforts have not been fully realized due to a lack of clear implementation strategies and low institutional ability.

Financial limitations are one of the biggest challenges noted because WRDM mostly depends on government grants, funding, and outside investments, all of which are frequently insufficient. The municipality finds it challenging to expand its projects due to the high upfront expenditures of renewable energy infrastructure and the weak private sector involvement. Additionally, the municipality's capacity to effectively transition to sustainable energy solutions is constrained by legislative obstacles and bureaucratic hold-ups that impede down the approval and implementation of green energy plans.

The analysis revealed that there are major obstacles due to infrastructure and technology constraints. Technical knowledge in green energy technology is still lacking, and the region's energy grid is not entirely prepared to incorporate renewable energy sources. Additionally, there is little community involvement and public understanding of renewable energy projects, which causes opposition or sluggish adoption. Misinformation, land-use issues, and a dearth of incentives deter businesses and communities from embracing green energy initiatives.

The study suggests expanding financial support through alternate funding sources, like green bonds and private-sector investments, to enhance the implementation of green energy policies. Improving institutional capacity, investing in technical training, expanding public awareness campaigns, and streamlining regulatory procedures are all essential elements in hastening the adoption of renewable energy. The municipality has the potential to overcome current obstacles and build a more sustainable and energy-efficient future for the area by promoting public-private partnerships and guaranteeing improved policy enforcement.

5.4 Recommendations

Findings from this study on the WRDM's adoption of green energy technology regulations show important gaps and opportunities that can have a big impact on the sustainability, scalability, and efficacy of green energy projects. The latter part now makes recommendations to promote green energy advancement in the area based on an examination of the WRDM's green energy technology policy execution, including its drivers, governing frameworks, implemented improvement measures, and obstacles faced.

5.4.1 Improvements to Implementation Processes

There is a need for more organised and coordinated strategies, according to the examination of the West Rand District Municipality's implementation of green energy technology policies. To solve this, the recommendation is that uniform implementation policies and procedures be created and adopted by all pertinent municipal departments engaged in green energy projects. These policies ought to specify roles and duties in detail, set deadlines for significant events, and specify protocols for cooperation and communication between departments. A more successful adoption of green energy solutions within the municipality could result from the creation of specialized project management teams with particular knowledge of renewable energy technologies. This would also guarantee that projects are completed on schedule and within budget, greatly improving the efficiency and effectiveness of policy execution.

5.4.2 Improve Intergovernmental Collaboration.

Coordinated efforts at many governmental levels are frequently necessary for green energy projects. Some of these recommendations are:

- Forming official intergovernmental task forces to coordinate green energy plans and objectives.
- Improving the channels of communication between local, provincial, and federal agencies, both horizontally and vertically.
- Preventing policy fragmentation by facilitating collaborative planning sessions and integrated development frameworks.

5.4.3 Making Use of Implementation Drivers.

The evaluation of the elements influencing the adoption of renewable energy in the West Rand region by the study most likely revealed important driving forces behind early adoption. Strategically utilizing and amplifying these recognized drivers is essential to further speeding up the shift to green energy. If environmental conscience was a major consideration, for example, the municipality may fund public awareness initiatives that emphasize the advantages of renewable energy for the local environment, such as better

air quality and a decreased dependency on fossil fuels. Similar to this, if financial incentives were important, the municipality should investigate and advertise current financial support systems and possibly create new ones to increase the accessibility and appeal of green energy technologies to citizens and businesses. This way, it can capitalize on the incentives that have already shown themselves to be successful.

5.4.4 Boosting Legal and Policy Frameworks

The examination of the institutional rules and regulations governing the adoption of green energy technologies might have identified areas in which the current framework could be improved for more effect. To determine any discrepancies or holes, we advise a thorough examination of current municipal ordinances and how well they match provincial and government green energy policies. In light of this review, the municipality ought to give top priority to creating more detailed and supportive local regulations that directly facilitate the implementation of different green energy technologies. For example, simplified permitting procedures for small-scale solar installations or unambiguous grid connection guidelines. Furthermore, enhancing the legal and planning departments' capacity will guarantee that these frameworks are interpreted and enforced effectively, creating an atmosphere that is more favourable to the adoption of green energy.

5.4.5 Adopt Resilient Frameworks for Monitoring and Evaluation (M&E).

Efficient M&E frameworks guarantee that policies produce the desired results. Which can include:

- The creation of key performance indicators (KPIs) to assess the sustainability, efficacy, and efficiency of green energy initiatives.
- Evaluating economic, social, and environmental advantages through frequent impact assessments.
- Employing monitors and real-time data collection systems to monitor developments and guide necessary policy changes.

5.4.6 Addressing Implementation Barriers

Strategic and focused actions are required to address the highlighted obstacles to the West Rand District Municipality's adoption of green energy technology policy. For instance, the municipality should aggressively pursue a variety of funding options, such as submitting grant applications on a national and international level, approaching private sector investors, and looking into creative financing methods, if a lack of funds were a major barrier. Furthermore, the municipality should work with academic institutions or specialized groups to organize training programs for local technicians and prioritize this if a lack of technical competence was a major obstacle. This will help to build the skills base that the region needs. The West Rand District Municipality may greatly increase its ability to successfully employ green energy technology policies by tackling these obstacles head-on with proactive and well-defined initiatives.

In summary, the recommendations made in this section offer a thorough road map for enhancing the West Rand District Municipality's adoption of green energy technology policies. They tackle the various issues the study found, such as financial limitations, fragmented governance structures, institutional capability shortages, and low stakeholder participation. These ideas seek to advance both long-term sustainability and policy efficiency by supporting strategic interventions such improved intergovernmental cooperation, sustainable funding models, strong monitoring and evaluation frameworks, and community-driven methods. Ultimately, by providing practical, evidence-based approaches that can guide subsequent studies, inform policy reforms, and spur revolutionary change in local government contexts dealing with comparable energy transition challenges, this section adds to the growing conversation on green energy governance.

5.5 Future research.

Extending the knowledge derived from this investigation into the West Rand District Municipality's green energy technology policy implementation, subsequent research could fruitfully examine novel aspects of renewable energy governance. Potential avenues include longitudinal analyses of the socioeconomic impacts of green energy uptake, assessments of the interplay between technological innovation and policy

efficacy, and comparative studies across municipalities to elucidate the factors influencing the progression towards sustainable energy systems in varied settings.

Analyses that compare various municipalities both domestically and abroad may provide important information about the factors that influence and hinder the effective application of policies in certain contexts. Through these investigations, best practices and flexible tactics appropriate for a range of socioeconomic, political, and environmental contexts would be identified (Meadowcroft, 2011; Sovacool, 2016). Municipalities with extensive stakeholder engagement procedures and solid institutional capacities, for instance, may be more successful in implementing green energy policies than those with disjointed governance systems or inadequate resource allocation ((Bulkeley & Betsill, 2013). Policymakers aiming to create flexible, inclusive, and contextually appropriate energy policies in response to global sustainability goals will benefit from the practical lessons that comparative and longitudinal approaches will provide in addition to enhancing the theoretical understanding of green energy governance.

Finally, with the goal to further comprehending the dynamics of policies in various contexts, future research on the West Rand District Municipality's adoption of green energy technology policies should use a multidisciplinary, comparative, and longitudinal perspective. Studies that examine the changing interactions of governance systems, technology, and socioeconomic variables can produce important insights that guide more flexible, inclusive, and sustainable energy policy on a local and international level.

5.6 Conclusion

The West Rand District Municipality's adoption of green energy technology policies has been thoroughly examined in this research through the use of a document review approach. Although there are policy frameworks in place to encourage the adoption of green energy, the research showed that a lack of unified policies and poor stakeholder coordination hinder their implementation. Although there is a lot of talk about policies at higher levels of government, the analysis showed that inconsistent policy implementation and budget allocation hinder the actual deployment of green energy technologies at the municipal level. This highlights how important it is to increase intergovernmental cooperation and capacity-building programs to close the gap between policy and practice.

Critical insights into the complex dynamics driving the adoption of renewable energy have been obtained by this study through its methodical examination of the West Rand District Municipality's implementation of green energy technology policies. The results shed light on several important elements that together influence the green energy transition scenario in this area, including institutional readiness, political will, environmental demands, and financial incentives. Additionally, both enabling and restricting aspects were found in a detailed analysis of important institutional policies and legal frameworks, with regulatory complexity usually showing up as a major roadblock. The study also found significant obstacles to the successful application of green energy policy, such as persisting socio-political concerns, budgetary limitations, and a lack of technical skills. These empirical findings highlight the need for policy interventions that put strong stakeholder involvement, regulatory process simplification, and persistent long-term political will at the forefront in order to improve the success of green energy projects. Despite the difficulties noted, the report also emphasizes the West Rand District Municipality's resilience and adaptability in implementing a number of creative tactics to support the adoption of green energy technologies. These consist of the proactive development of community-based awareness initiatives, the development of cooperative relationships with business sector organizations, and the smart utilization of donor financing. In summation, this dissertation's conclusions suggest that overcoming current obstacles and achieving long-term green energy goals require a thorough and multifaceted strategy that incorporates strategic policy reform, cooperative stakeholder collaboration, and focused capacity building projects. Therefore, this study provides useful empirical understanding of the challenges of implementing renewable energy policies and offers relevant suggestions for practitioners and politicians working to promote sustainable energy transitions in similar local contexts.

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