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Assessing the outcomes of green bond-funded projects on renewable energy development and transition to a low-carbon energy system within South Africa - A case study of Nedbank's Renewable Energy Bonds

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ASSESSING THE OUTCOMES OF GREEN BOND-FUNDED PROJECTS ON RENEWABLE ENERGY DEVELOPMENT AND TRANSITION TO A LOW-CARBON ENERGY SYSTEM WITHIN SOUTH AFRICA – A CASE STUDY OF NEDBANK'S RENEWABLE ENERGY BONDS

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand in partial fulfilment of the requirement for the degree of Master of Urban Studies in Sustainable and Energy Efficient Cities

Supervisor: Sechaba Maape **18 June 2025**

DECLARATION

I, Sifiso Mchunu declare that this research report is my own unaided work, except where acknowledged. It is submitted for the degree of Master of Urban Studies at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.



Signature of Candidate

ABSTRACT

The study employed a qualitative approach to assess the outcomes of green bond-funded projects on renewable energy development and the transition to a low-carbon energy system in South Africa. Using Nedbank's 2019 Renewable Energy Bonds as a case study, the study examined how participants interpret and understand the role of green bonds in supporting renewable energy development. South Africa faces significant climate-related challenges, as evidenced by recent extreme weather events that have had catastrophic impacts on communities across the country. With a national goal of achieving net-zero greenhouse gas emissions by 2050 and a commitment to decommissioning coal power stations, South Africa is increasingly looking towards renewable energy solutions.

Green bonds have emerged as an innovative funding mechanism to support South Africa's energy transition and address its urgent energy needs. This study used semi-structured interviews with key stakeholders from the green bond and renewable energy sectors, along with community representatives, to evaluate the impact of green bonds within South Africa's distinct energy and economic landscape. It aimed to capture diverse perspectives on the effectiveness and limitations of green bonds in advancing the country's transition to a low-carbon energy future.

The findings confirmed that green bonds have emerged as a pivotal mechanism for driving renewable energy development and fostering private sector participation in South Africa's transition to a low-carbon economy. By establishing frameworks aligned with global Environmental, Social, and Governance (ESG) standards, green bonds not only enhance transparency but also encourage broader investment in sustainable projects across the country. However, the study highlights critical challenges, including the exclusion of "dirty industries" such as mining, which, despite their substantial emissions, are integral to the economy and essential for financing renewable initiatives. The findings also emphasize the necessity of incorporating socio-economic outcomes into green bond projects to address persistent inequalities and ensure that historically marginalized communities' benefit from renewable energy investments. Stakeholder feedback underscores the barriers posed by high issuance costs, compliance requirements, and practices that favor established entities, which limit market diversity and participation. Therefore, for green bonds to fulfill their potential in South Africa, structural reforms, including government incentives and regulatory changes, are identified as crucial to lower barriers to entry and foster a more inclusive and effective green financing landscape.

Key words: *green finance, green bonds, renewable energy, climate change, carbon emissions, Energy transition*

DEDICATION

This is dedicated to my family: to my parents for instilling in me the values of hard work and dedication, to my mom, Thandi Mchunu, for your sacrifices that enabled us to achieve what you couldn’t, and to my sisters for your unwavering support. Thank you.

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To my friends and family, thank you for your patience and understanding as I dedicated time to furthering my studies. For the moments when I couldn't show up as my best self, I am deeply grateful for your unwavering support and constant reminders that it would all be worth it. "*Surround yourself with only people who are going to lift you higher"* – Oprah Winfrey

To the Mchunu family, thank you for providing me with the encouragement and support to pursue my dreams with confidence and without fear. To my sisters, who have always been my greatest source of motivation, thank you for inspiring me through your hard work and dedication to education. Seeing you achieve your dreams has been one of my greatest joys, and I take immense pride in being your brother.

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To all respondents from the JSE, IDC, Engie, Climate Bonds Initiative, and Growthpoint Properties, thank you for taking the time to engage with me and contribute meaningfully to this study. A special thanks to Sivu Ngcaba for your genuine interest in my research from its inception and for going above and beyond to support the study by securing an interview with the ideal candidate. I also extend my gratitude to Nedbank for the public availability of your green bond performance data, which inspired this case study and significantly enriched the findings.

Contents

1	INTRODUCTION	1
1.1	Overview and Background	1
1.2	Global Growth of Green Bonds	3
1.3	Status Quo of Green Bonds in South Africa	5
1.4	Rational of the Study	5
1.5	Problem Statement	6
1.6	Aim and Objectives of the Research	7
1.7	Research Questions	7
1.8	Expected Findings	8
1.9	Definition of Key Terms	8
1.10	Outline of the Study	10
2	LITERATURE REVIEW	12
2.1	Theoretical Definition of Green Finance	12
2.2	Climate Change Adaption in South Africa and Wider African Context	13
2.3	Climate Change Mitigation in South Africa and Wider African Context	14
2.4	The Development and Structure of South Africa's Economy	15
2.5	The Status Quo of Climate Finance in South Africa and Wider African Context	16
2.6	Motivation for Voluntarily Private Sector Participation in Climate Change Mitigation	17
2.7	Greenwashing and its Impact on Global Emission Reduction Efforts	18
2.8	Relationship between Green Finance and Environmental Pollution	19
2.9	Relationship between Green Finance and Energy Efficiency	20
2.10	Case Studies of Green Bonds in African Context	20
2.10.1	Case Study of First Green Bond Issued in Kenya: Acorn Holdings	21
2.10.2	Case Study of First Green Bond Issued in Nigeria: Nigerian Federal Government	22
2.11	Conceptual Framework	23
2.12	Key Findings and Conclusions	24
3	RESEARCH METHODS	26
3.1	Introduction & Overview	26
3.2	Research Approach	26
3.3	Data Collection	27
3.4	Data Presentation, Analysis and Interpretation	29
3.5	Limitations of Study	32
3.6	Ethical Considerations	32
4	ASSESSING THE INFLUENCE OF GREEN BONDS ON PRIVATE SECTOR PARTICIPATION IN RENEWABLE ENERGY DEVELOPMENT AND CARBON REDUCTION OUTCOMES	33
4.1	Introduction	33
4.2	The Critical Role of Private Sector Participation in Advancing Renewable Energy Development	33

4.2.1 Data Overview 34
4.2.2 Overview of Case Study: Nedbank Renewable Energy Bonds 37
4.2.3 The Need for Profit in the Renewable Energy Sector 39
4.2.4 Currency Risk and South Africa's Green Bond Market 41
4.2.5 Understanding Green Bonds and Their intended Purpose: Insights from Industry Experts 42
4.2.6 Examining Nedbank's 2019 Renewable Energy Bonds: Familiarity and Distinction from Traditional Infrastructure Bonds 43
4.2.7 Innovative Features of Nedbank's Renewable Energy Bonds and Market Differentiators 44
4.2.8 The Role of Nedbank's Renewable Energy Bonds in Encouraging Private Sector Participation in Renewable Energy Development 45
4.2.9 Investor Willingness to Accept Lower Returns for Environmental Benefits 45
4.2.10 Impact of Local Currency Risk on International Interest in Nedbank's Renewable Energy Bonds 46
4.2.11 Strategies to Boost Private Sector Participation and Green Bond Issuance in South Africa 46
4.2.12 Key Findings – Sub Question 1 47
4.3 Assessing the Carbon Reduction Outcomes of Green Bond-Funded projects 49
4.3.1 Data Overview 49
4.3.2 Calculating Avoided Carbon Emissions 51
4.3.3 Nedbank Renewable Energy Bonds – Environmental Impact Reporting 52
4.3.4 Nedbank – Annual Green Bond Impact Reports (2020-2023) 55
4.3.5 Significance of Avoided Carbon Emissions in South Africa's Carbon Reduction Strategy 61
4.3.6 Key Findings – Sub Question 2 64
4.4 Summary of Key Findings and Conclusion. 64

5 LOCAL COMMUNITY OUTCOMES AND STAKEHOLDER PERCEPTIONS OF GREEN BONDS AS A FUNDING MECHANISM FOR RENEWABLE ENERGY DEVELOPMENT 66

5.1 Introduction 66
5.2 Impact of Green Bond-Funded Projects on Local Communities and Their Outcomes 66
5.2.1 Data Overview 67
5.2.2 The Golden Valley Wind Farm Facility 70
5.2.3 Investment Prospects and Economic Opportunities Prior to the Golden Valley Wind Farm 72
5.2.4 Observable Changes in Surrounding Communities Post-Establishment of the Wind Farm Facility 72
5.2.5 Employment and Upskilling Opportunities Generated by the Golden Valley Wind Farm Facility 75
5.2.6 Enhancing Local Community Inclusion and Empowerment in Projects Like the Golden Valley Wind Farm: Recommendations and Reflections. 76
5.2.7 Key Findings – Sub Question 3 77
5.3 Stakeholder Perceptions on the Role of Green Bonds in Supporting Renewable Energy and Low-Carbon Transition in South Africa 78
5.3.1 Data Overview 78
5.3.2 Evaluating the Effectiveness of Green Bonds in Supporting Sustainable Development in South Africa 79
5.3.3 Strengths and Limitations of Green Bonds as Funding Instruments for Renewable Energy Projects in South Africa 80

5.3.4 Barriers to Entry in the South African Green Bond Market 81
5.3.5 Key Factors Behind the Stagnation of South Africa's Green Bond Market in Comparison to Global Growth. 82
5.3.6 Role of Government in Supporting Private Sector Engagement in the Green Bond and Renewable Energy Sectors 83
5.3.7 Key Findings – Sub Question 4 84
5.4 Summary of Key Findings and Conclusion. 85
6 ANALYSIS AND DISCUSSION 87
6.1 Introduction 87
6.2 The Role of Green Bonds in Promoting Transparency, Accountability, and Ethical Investment in South Africa's Climate Finance Landscape 87
6.3 Nedbank's Renewable Energy Bonds and Their Influence on Private Sector Participation in South Africa 88
6.4 Evaluating the Effectiveness of Green Bonds in Supporting Sustainable Development 89
6.5 Evaluating the Carbon Reduction Outcomes of Green Bond-Funded Projects. 90
6.6 Balancing Profit and Environmental Preservation: Challenges and Emerging Trends in Private Sector Engagement with Green Finance 91
6.7 The Socio-Economic Impact of Renewable Energy Projects: Challenges and Opportunities 91
6.8 Overcoming Barriers to Participation in South Africa's Green Bond Market: Stakeholder Perspectives and Strategic Solutions 93
6.9 Conclusion 95
7 CONSOLIDATION OF SUB-FINDINGS AND CONCLUSION 97
7.1 Overview 97
7.2 Encouraging Private Sector Participation: Innovation and Impact of Nedbank's Renewable Energy Bonds 97
7.3 Nedbank's Renewable Energy Bonds: Implications for Carbon Reduction 98
7.4 Community Outcomes Arising from the Golden Valley Wind Energy Facility Funded by Nedbank's Renewable Energy Bonds 99
7.5 Stakeholder Perspectives on Green Bonds and Their Effectiveness and Limitations in South Africa's Renewable Energy Sector 99
7.6 Consolidation of Findings and Conclusion 100
7.7 Recommendations 102
8 REFERENCES 104

Figures

Figure 1 - Green bond market, global diversification of issuers, 2014-2021 (Climate Bonds Initiative, 2021). 4
Figure 2 - Green bond issuances by continent, 2014 -2021 (Climate Bonds Initiative, 2021). 4
Figure 3 - Green Bond Issuers in South Africa (Climate Bonds Initiative, 2021) 5
Figure 4 - Renewable energy costs in ZAR c/kWh across the first five rounds of the REIPPPP (Climate Bonds Initiative, 2021) 6
Figure 5 - South African Energy Mix (Akinbami et al., 2021) 14
Figure 6 - Aggregate green bond issuances in Africa (FSD Africa, 2020) 21
Figure 7 - The conceptual framework 24
Figure 8 - Project finance structure under REIPPPP (Baker, 2015) 28
Figure 9 - Project finance structure under REIPPPP (adapted from Baker, 2015) 41
Figure 10 - Local and Foreign Currency Issuance in Emerging and Developed Markets (Climate bonds Initiative, 2021) 42
Figure 11 - Nedbank Renewable Energy Bonds Google Search Results, Page 1 & 2 54
Figure 12 - Nedbank Annual Green Bond Impact Report, 2020 & 2021 (Nedbank Limited, 2020) (Nedbank Limited, 2021) 56
Figure 13 - Nedbank Annual Green Bond Impact Report, 2022 (Nedbank Limited, 2022) 57
Figure 14 - Nedbank Annual Green Bond Impact Report, 2023 (Nedbank Limited, 2023) 58
Figure 15 - CO_2 emissions avoided by project (2020-2023) 60
Figure 16 - Chart of CO_2 avoided at different levels of green bond-funding in tons/annum 63
Figure 17 - Renewable Energy Indicators, Harmonised Framework for Impact Reporting (The Green Bond Principles , 2024) 69
Figure 18 - Golden Valley Wind Farm. Note: Somerset East was officially renamed to KwaNojoli in March 2023 (Source: Adapted from Google Earth) 71
Figure 19 - Image showing SPAR development and R63 Road through the town of Bedford (Image adapted from Google Maps) 74

Tables

Table 1 - Summary of research questions, data collection, tools, process, and analysis approach 31
Table 2 - Green Bond Issuers in South Africa (Climate Bonds Initiative, 2021) 34
Table 3 - Data overview for sub-question 1 36
Table 4 - Projects funded by Nedbank's Renewable Energy Bond 2 38
Table 5 - Data overview for sub-question 2 50
Table 6 - Summary of Actual CO_2 emissions avoided per annum (tons) 59
Table 7 - CO_2 avoided at different levels of green bond funding in tons/annum 62
Table 8 - Data overview for sub-question 3 68
Table 9 - Data overview for sub-question 4 79

Appendices

Appendix 1 - Research ethics approval 110
Appendix 2 - Climate finance landscape in South Africa 2023 (R billion) (PCC, 2023) 111
Appendix 3 - Eligible projects under the Climate Bonds taxonomy (FSD Africa, 2020). 112
Appendix 4 - Comparison of issuance processes for regular bonds and green bonds (Climate bonds Initiative, 2021) 113
Appendix 5 - Summary template for project-level reporting (World Bank, 2015) 114
Appendix 6 - Summary template for portfolio-level reporting (World Bank, 2015) 115
Appendix 7 – Eskom historical data on electricity generation per power station (Eskom, 2023) 116
Appendix 8 - 50-year plan to decommission Eskom's coal fired power station (Climate bonds Initiative, 2021) 117

Abbreviations and Acronyms

CBI	Climate Bonds Initiative
CO_2	Carbon dioxide
DFI	Development Finance Institution
EE	Energy efficiency
ESG	Environmental, Social, and Governance
GBP	Green Bond Principles
GHG	Greenhouse gas
GWh	Gigawatt hour
ICMA	International Capital Markets Association
IDC	Industrial Development Corporation
IFC	International Finance Corporation
IPP	Independent Power Producers
IRP	Integrated Resource Plan
JSE	Johannesburg Stock Exchange
kW	kilowatt
MDB	Multilateral Development Banks
MW	Megawatt
MWh	Megawatt hour
NERSA	National Energy Regulator of South Africa
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PV	Photovoltaic
REFIT	Renewable energy feed-in tariff
REIT	Real estate investment trusts
REIPPPP	Renewable energy independent power producers procurement program
SDGs	Sustainable Development Goals

1 INTRODUCTION

1.1 Overview and Background

The power crisis at Eskom, South Africa's national electricity supplier, which began in 2008, along with increasing concerns about climate change and global warming have intensified the country's need to accelerate its transition to a low-carbon energy system. Eskom is responsible for the generation of over 95% of South Africa's energy usage with the balance coming from independent power producers (IPPs) and small-scale municipal operations (Akinbami et al., 2021). Until recently, IPPs comprised of factories or mills producing electricity for their own consumption or as a by-product of their operations and occasionally selling surplus electricity to Eskom at an agreed tariff which fed into the national grid (Kenny, 2015). These Power Purchase Agreements (PPAs) were entirely managed by Eskom with limited government involvement in the way of regulatory framework or national policies (Mbatha, 2020).

To foster the adaptation of renewable energy and encourage environmentally sustainable development, the government instituted the Renewable Energy Feed-in Tariff (REFIT) policy which was approved by the National Energy Regulator of South Africa (NERSA) between 2009 and 2011 (Eberhard and Naude, 2016). The REFIT mandated Eskom to purchase electricity generated by eligible renewable energy producers at a pre-determined price that covered the cost of generation plus a tangible return on equity fully indexed for inflation of 17% after tax (NERSA, 2009). Despite earlier interest in renewable energy alternatives and private sector involvement outlined in the government's 1998 Energy Policy White Paper, along with subsequent goals in the 2003 Renewable Energy White Paper (Eberhard and Naude, 2016), it wasn't until NERSA released its REFIT consultation paper in 2008 that South Africa launched its first major renewable energy policy, which attracted significant global investor interest (Ibid).

Unfortunately, South Africa was unable to translate this interest into renewable energy investments due to its lack of preparedness in developing the necessary contracting framework for REFIT projects (Eberhard and Naude, 2016). Contributing factors included significant uncertainty around the licensing process, ambiguity in the procurement structure, and minimal support from Eskom for the program (Eberhard and Kaberger, 2016). The program was discontinued in 2011 without any projects being contracted or a single megawatt of power secured. Although the REFIT scheme was never implemented, the publication of the proposed tariffs marked the first clear demonstration of South Africa's commitment to utility-scale renewable energy partnerships with IPPs. The Department of Energy and National Treasury took a more active role in reformulating the government's strategy with the primary objective of increasing private sector involvement in the delivery of renewable energy projects remaining

unchanged. A competitive bidding process was announced by the Department of Energy (DOE) in August 2011. This process would be called the Renewable Energy Independent Power Producer Procurement Program (REIPPPP) effectively serving as a replacement for the REFIT scheme (ibid).

The REIPPPP was introduced to incentivize increased involvement of private sector players in utility scale renewable energy generation through a competitive bidding process where generators could bid to supply electricity to Eskom at an agreed tariff (Eberhard and Naude, 2016). By 2016, the program had contracted 92 projects totaling 6 328 megawatts (MW) and secured a total of US $19 billion worth of investments (ibid). This included notable socio-economic investment such as job creation, skills development and community ownership seeing it hailed as an exemplary policy instrument to capture and sustain private sector participation in renewable energy generation (Eberhard and Kaberger, 2016). The REIPPPP played a crucial role in simplifying renewable energy financing, as shown by the strong backing from South Africa's big four commercial banks—Absa, FirstRand Bank, Nedbank, and Standard Bank which collectively provided the largest share of debt financing for the first two rounds of the program (Baker, 2015). Much of this confidence was attributed to the establishment of the "DOE IPP" unit which consisted of technical staff from the DOE and the Public Private Partnership (PPP) unit from National Treasury that effectively managed the REIPPPP outside of traditional government structures (Martin and Winkler, 2014). The program, particularly in its initial phases, benefitted from sound resourcing and sovereign guarantees, while drawing support from National Treasury, the Development Bank of South Africa (DBSA), and international donor agencies such as the World Bank (Ibid).

On the 10th of June 2021, the president of South Africa, Cyril Ramaphosa, further outlined the government's ambition to unlock significant private sector investment in renewable energy (Bellini, 2021). This was through the announcement of schedule 2 of the Electricity Regulation Act (ERA) which would see the threshold of embedded generation being lifted from 1MW to 100MW. This was a welcome announcement that would facilitate the development of large-scale renewable projects such as wind and solar outside of the REIPPPP which has lost considerable momentum in recent years (Ibid). Furthermore, South Africa ranks among the top 12 highest greenhouse gas (GHG) emitters globally and the highest on the African continent, primarily due to its coal-intensive energy operations. This reality underscores the urgent need for the country to transition toward a greener future (Neumann, 2023). While no official commitment has been made, South Africa has set a goal of reducing GHG emissions to net zero by the year 2050 as part of its Low Emission Development Strategy (Climate Bonds Initiative, 2021). To make this ambitious target possible, it is estimated that South Africa would require financing needs of US$ 55 – 59 billion between the years 2020 – 2030 alone (Neumann, 2023). With limited government

resources, green financing instruments, such as green bonds, have been identified as a potential solution for bridging the funding gap and accelerating the achievement of the country's Sustainable Development Goals (SDGs). South Africa accounted for 73.8% of total green bond issuance among African nations from 2010 to 2021, making it the most active green bond market on the continent (ibid).

Although green bonds are still in their early stages within emerging markets, globally, green bonds have been recognized as a crucial financial instrument for supporting the urgent need for environmentally friendly projects and raising awareness of the SDGs (Chang et al., 2022). According to the World Bank, a green bond is "a debt security that is issued to raise capital specifically to support climate-related environmental projects" (World Bank, 2015 cited in Neumann, 2023, 3). Projects funded by green bonds often include renewable energy initiatives such as wind and solar, resource conservation, green buildings, pollution prevention, and other environmentally focused agendas (Flammer, 2021). With the World Bank issuing the first green bond in 2008, green bonds are considered to still be in their development stage across many regions with the green bond market heavily dependent on private governance regimes and third-party certification standards for their issuing framework (Ibid). The Green Bond Principles (GBP) are the most common voluntary guidelines utilized by issuers, underwriters and investors for the issuance and governance of green bonds (KPMG, undated). Established by the International Capital Markets Association (ICMA), the GBP provide a foundational framework for green bond issuers to evaluate and select eligible projects.

1.2 Global Growth of Green Bonds

The green bond market has experienced exponential growth and momentum over the past 15 years with cumulative global issuances passing the US$ 1 trillion milestone in 2020 (Neumann, 2023). Emerging in 2007-08, the market was largely driven by Multilateral Development Banks (MDB) such as The World Bank and European Investment Bank who were responsible for the first few issuances during the 207-2012 period (OECD, 2015). As the demand for the bonds increased, there was a growing diversity of issuers and investors looking to participate in the market. 2013 and 2014 saw a notable increase in participation from corporations, banks and other private sector issuers which was bolstered by the introduction of the GBP (Ibid). Annual green bond issuances rose from a modest US$ 3 billion in 2012 to a record breaking US$ 297 billion in 2020 (Climate Bonds Initiative, 2021). As demonstrated in **Figure 1**, the increasing diversification of issuers is driving optimistic growth projections, despite the market's already evident success (ibid).

As however depicted in **Figure 2**, a significant portion of all green bond issuances have been concentrated in developed markets with Europe, Asia-Pacific and North America leading the

growth (Climate Bonds Initiative, 2021). Tremendous development has also been witnessed from emerging markets with China being responsible for a high volume of issuances alongside Brazil, India, Chile, and Indonesia who have also shown impressive activity in the market (ibid). Despite minimal contributions to global carbon dioxide emissions and heightened vulnerability to climate change, minimal climate finance has flowed into the African region (Neumann, 2023). This disparity highlights the challenge of accessing necessary resources, yet countries like Kenya, Namibia, Nigeria, and South Africa have successfully participated in the growing green bond market over the past few years (FSD Africa, 2020).

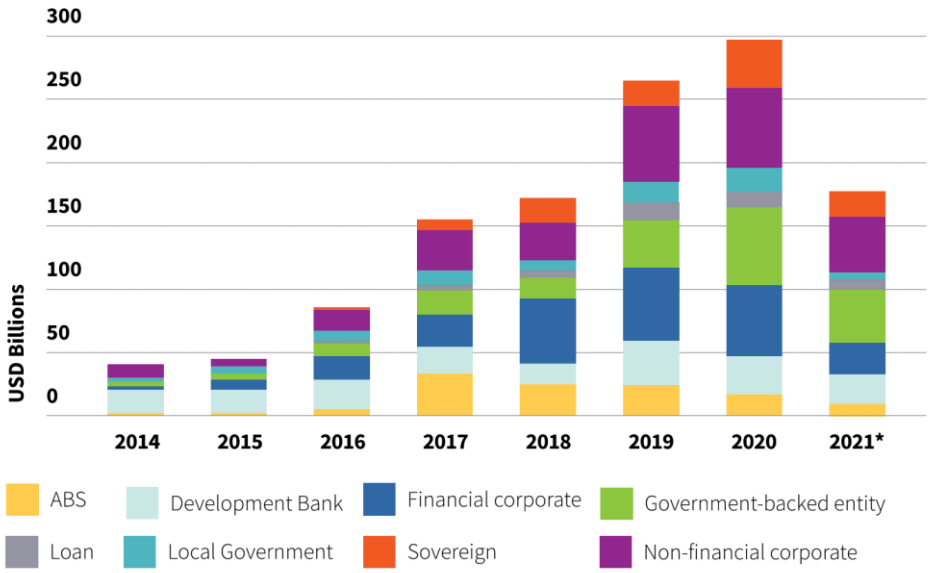


Figure 1 - Green bond market, global diversification of issuers, 2014-2021 (Climate Bonds Initiative, 2021).

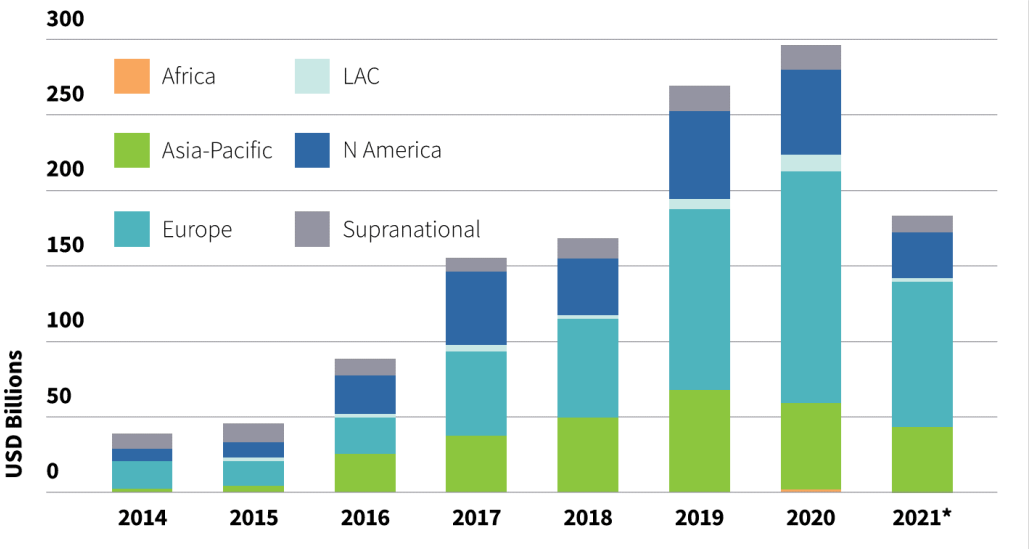


Figure 2 - Green bond issuances by continent, 2014 -2021 (Climate Bonds Initiative, 2021).

1.3 Status Quo of Green Bonds in South Africa

Green bonds have gained traction among domestic and international investors to finance renewable energy projects in South Africa. Notably, in April 2019, Nedbank issued the country's first renewable energy bond from a corporate bank, valued at R1.7 billion, marking the private sector's first Climate Bonds-certified bond (Sustainable Finance Initiative, 2019). Proceeds funded four renewable energy projects, including three solar plants and a wind farm (Nedbank Group, 2019). Building on this success, Nedbank issued a second bond in October 2019, "Renewable Energy Bonds 2," which financed solar facilities in Pofadder, Kimberley, and Zeerust, as well as a wind farm in Cookhouse (ibid). As shown in **Figure 3**, the South African green bond market has experienced limited growth, with only ten issuers listing green bonds on the Johannesburg Stock Exchange (JSE) by 2021. This stagnation contrasts sharply with the rapid expansion observed in markets across Europe, the United States, and China (Neumann, 2023).

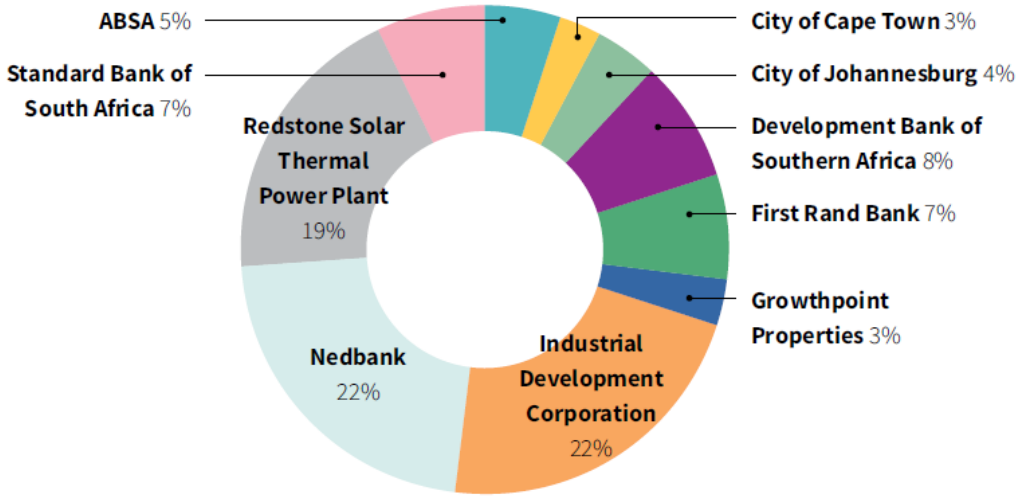


Figure 3 - Green Bond Issuers in South Africa (Climate Bonds Initiative, 2021)

1.4 Rational of the Study

Despite the growing global interest in green bonds as a funding mechanism for environmentally sustainable projects, a significant knowledge gap persists regarding their actual impact on promoting renewable energy development and facilitating the transition to a low-carbon energy system. This gap is particularly pronounced in the South African context, where green bond issuances have stagnated in contrast to global trends. This study aimed to address this gap by assessing the outcomes of green bond-funded projects on renewable energy development and transition to a low-carbon energy system within South Africa. Using Nedbank's 2019 Renewable Energy Bonds as a case study, this study explored the strengths and limitations of green bonds as a funding mechanism for renewable energy development and emissions reduction.

1.5 Problem Statement

The April 2022 floods that devastated KwaZulu-Natal, claiming 435 lives and displacing over 40,000 people, were a harsh reminder of the country's persistent vulnerability to the impacts of climate change (Joubert, 2023). Escalating climate concerns, coupled with an aging fleet of Eskom-operated coal power stations, have left South Africa with little choice but to invest in additional and cleaner energy generation capacity (Climate Bonds Initiative, 2021). The country's ambition to reduce greenhouse gas emissions to net zero by 2050 is highly dependent on its ability to decommission these coal power stations, which account for 42% of total emissions (ibid). Likewise, South Africans have witnessed an unprecedented 650% surge in electricity tariffs between 2007 and 2022, far outpacing inflation (Moolman, 2022).

In contrast, advancements in technology have significantly reduced the cost of renewable energy alternatives such as solar and wind, which have grown exponentially in the global market (Akinbami et al., 2020). The cost reductions associated with renewable energy are also demonstrated by the plummeting of costs across all technologies in the first five rounds of the REIPPPP between 2011 and 2015 (see **Figure 4**) (Climate Bonds Initiative, 2021). South Africa's substantial renewable energy potential makes clean energy solutions both viable and accessible for residential and utility-scale operations (Jain et al., 2017). With the unlikelihood of new coal operations, renewable energy has emerged as the most feasible solution for increasing energy capacity.

However, what remains unclear is whether green bonds are effectively contributing to renewable energy development and supporting South Africa's transition to a low-carbon energy system. Despite their potential, there is limited understanding of the actual outcomes and practical limitations of green bonds within the local energy and socio-economic context.

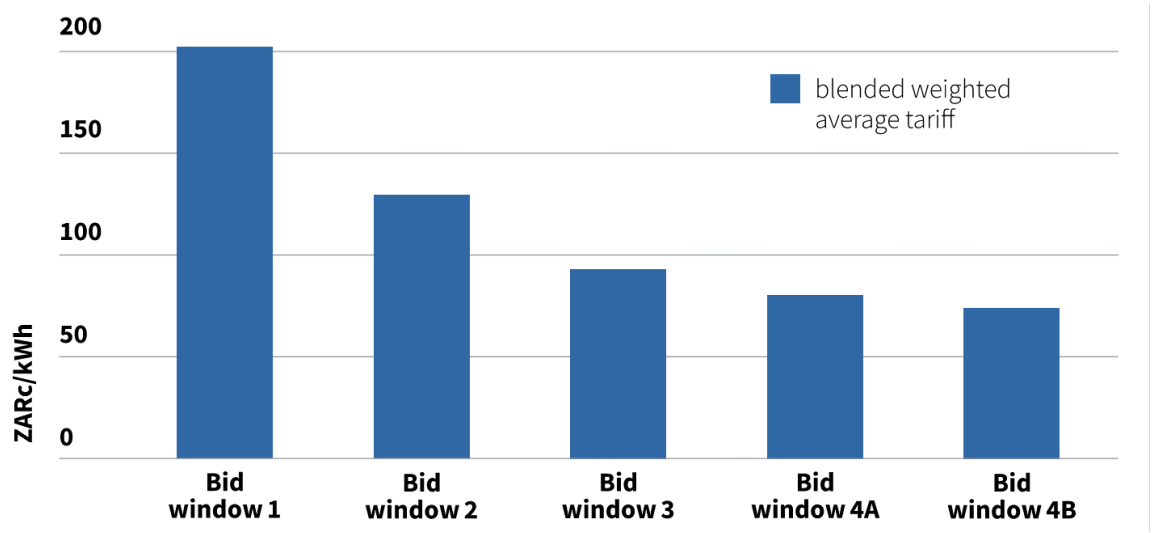


Figure 4 - Renewable energy costs in ZAR c/kWh across the first five rounds of the REIPPPP (Climate Bonds Initiative, 2021)

1.6 Aim and Objectives of the Research

The aim of the study was to determine the outcomes of green bonds as a funding mechanism for advancing renewable energy development and facilitating the transition to a low carbon energy system. Using the case study of Nedbank's 2019 Renewable Energy Bonds, this study assessed the strengths and limitations of green bonds as a funding mechanism for renewable energy development and emissions reduction in South Africa. To achieve this aim, the following objectives were identified to guide the study:

- Investigate the extent to which Nedbank's Renewable Energy Bonds encouraged private sector participation in renewable energy projects.
- Assess the carbon reduction implications of projects funded by Nedbank's Renewable Energy Bonds.
- Assess, through fieldwork engagement, the high-level outcomes in communities surrounding projects funded by Nedbank's Renewable Energy Bonds.
- Examine stakeholder perceptions of the effectiveness and limitations of green bonds as a funding mechanism for renewable energy development and emissions reduction.

1.7 Research Questions

The primary research question that directed this study was stated as follows:

What are the outcomes of green bond-funded projects on renewable energy development and transition to a low-carbon energy system within South Africa: A case study of Nedbank's Renewable Energy Bonds.

The following sub-questions were applied to address the primary research question and guide data collection:

1. Within the specific framework, innovation, and ring fencing of proceeds that distinguish green bonds from traditional infrastructure bonds, to what extent was Nedbank's Renewable Energy Bonds able to encourage private sector participation in renewable energy development?
2. What are the implications in relation to carbon reduction that emerged from Nedbank's Renewable Energy Bonds that ring-fenced the use of proceeds to fund projects that can demonstrate a reduction in carbon emissions?

3. What have been the outcomes in the communities surrounding the 120 MW Golden Valley wind energy facility in which Nedbank's Renewable Energy Bonds created a funding opportunity for the private sector to participate in such projects?

4. How do stakeholders perceive the effectiveness or limitations of green bonds as a funding instrument for renewable energy development and emissions reduction in South Africa?

1.8 Expected Findings

The study anticipated that green bonds would play a pivotal role in facilitating renewable energy development by bridging the funding gap for South Africa's low-carbon energy transition. As a dependable investment option grounded in environmental, social, and governance (ESG) criteria, green bonds were expected to stimulate private sector participation and drive interest in sustainable development initiatives. The adoption of the GBP was believed to enhance confidence in the issuance process and ensure measurable reductions in carbon dioxide emissions. However, given South Africa's socio-economic context, it was recognized that green bonds might not fully address critical issues of inequality and access. Despite this, they were expected to significantly contribute to the country's energy transition by attracting investments and establishing a robust framework for project selection.

1.9 Definition of Key Terms

Access: The ability or opportunity to obtain resources, information, financial support, and equal opportunities necessary to participate in or benefit from broader development and sustainability efforts.

Carbon dioxide: Carbon dioxide (CO_2) is a heat-retaining gas produced through the burning of fossil fuels and other natural processes. It makes up the largest portion of greenhouse gas emissions and is a leading contributor to climate change.

Community: A group of people living in the same geographic area or sharing common interests, often connected through social, economic, or cultural ties.

Effectiveness: Refers to the extent to which green bonds achieve their intended objectives, including promoting private sector participation in renewable energy, supporting sustainability, and contributing to carbon reduction targets.

Greenhouse gas emissions: Greenhouse gases, originating from both human activities and natural processes, are atmospheric gases that retain heat, making the planet warmer and contributing to climate change.

Independent Power Producer: Independent Power Producers (IPPs) are private entities that own and operate electricity generation facilities, supplying power to governments, utilities or end-users.

Inequality: Refers to the uneven distribution of resources, opportunities, and power within a society, often resulting in the exclusion or marginalization of certain groups from full economic, social, and developmental participation.

Just Energy Transition: A just energy transition entails moving from the current energy system to a more sustainable one while prioritizing the well-being of the most vulnerable.

Load shedding: The scheduled interruption of electricity supply, typically lasting 2 to 12 hours per day, to prevent grid collapse during power shortages.

Low carbon energy system: A low-carbon energy system reduces greenhouse gas emissions through the utilization of renewable sources like wind and solar energy, alongside enhanced energy efficiency measures.

Outcomes: Refer to the observable results, impacts, or consequences of green bond-funded projects, including effects on renewable energy development, carbon reduction, private sector participation, and socio-economic changes.

Power Purchase Agreement: A Power Purchase Agreement (PPA) typically represents a contract for long-term electricity supply between two entities, often involving a power producer and a customer.

Residential scale: Residential-scale energy refers to energy systems designed for individual homes or small communities, often incorporating renewable technologies and energy-efficient practices.

Stakeholder: An individual or group with an interest or involvement in an activity, decision, or outcome, whose perspectives and actions can influence results. This includes community members affected by or engaged in the process.

Utility-scale: utility-scale refers to renewable energy projects typically exceeding 1 to 10 megawatts in size, directly supplying power to utilities by feeding it into the national grid.

1.10 Outline of the Study

The study is organized into seven chapters, followed by references and appendices. A summary of each chapter's content is outlined below:

Chapter 1 introduces the study, covering its background, rationale, aim, and objectives. It discusses the emergence and global growth of green bonds, as well as their status and unique challenges in South Africa. The chapter also outlines the problem statement, key research questions, expected findings, and definitions of key terms.

Chapter 2 reviews literature on green bonds, highlighting their role in improving energy efficiency and facilitating the transition to a low-carbon energy system. Findings indicate that green bonds can attract investment for sustainable development, with an emphasis on the importance of institutional support and socio-economic factors. A conceptual framework is also presented to illustrate key themes essential for promoting renewable energy development in South Africa.

Chapter 3 describes the research strategy and methodology employed in the study. It provides a rationale for the selected research approach and outlines the tools used for data collection and analysis to generate the findings. Additionally, this chapter discusses the study's limitations, highlighting various challenges encountered, along with ethical considerations.

Chapter 4 investigates sub-questions 1 and 2 of the study. It analyses how Nedbank’s Renewable Energy Bonds have promoted private sector involvement in renewable energy development and situates green bonds within South Africa’s renewable energy context. The chapter further assesses the carbon reduction outcomes of projects financed by green bonds, making use of published environmental performance data as the primary source of information.

Chapter 5 addresses sub-questions 3 and 4, focusing on the impact of green bond-funded projects on local communities, utilizing semi-structured interviews and secondary data for validation. It also explores stakeholder perceptions of green bonds in supporting renewable energy and facilitating South Africa's low-carbon transition, emphasizing their strengths and limitations as a funding mechanism.

Chapter 6 presents a thematic analysis of the findings from Chapters 4 and 5, highlighting the role of green bonds in transparency, the impact of Nedbank's Renewable Energy Bonds on private sector engagement, and their effectiveness in sustainability and carbon reduction. It also examines socio-economic impacts, barriers to market participation, and proposes strategic solutions.

Chapter 7 summarizes the study's findings on green bonds as a funding mechanism for renewable energy and the transition to a low-carbon energy system, focusing on Nedbank's 2019 Renewable Energy Bonds. It highlights their role in private sector participation, carbon emission reductions, and socio-economic outcomes. The chapter concludes with recommendations to address the challenges identified in the research.

2 LITERATURE REVIEW

The literature review chapter explores several fundamental themes that underpin the scope of the research as well as exploring previous studies, locally and internationally, on the subject matter. The theoretical definition of green finance is provided as a point of the departure for the literature. Key themes identified include climate change mitigation and adaptation in South Africa and wider African context, structure of the South African economy, status quo of climate finance in South Africa and wider African context, motivation for voluntarily private sector participation, greenwashing and its impact on emission reduction efforts, the relationship between green finance and environmental pollution as well as the relationship between green finance and energy efficiency. The literature concludes by looking at two case studies where green bonds were used to fund sustainable initiatives in Kenya and Nigeria respectively.

2.1 Theoretical Definition of Green Finance

Increasing worries about climate change and sustainable development have contributed to significant research on green finance over recent years. Scholarly literature attributes a significant portion of this research and development (R&D) to the joint commitment of 195 countries to the Paris Climate Agreement and adaptation of the SDGs (Khan et al., 2022). The Paris Agreement saw participating nations commit to keeping "the increase in the global average temperature to well below 2 ^{0}C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 ^{0}C above pre-industrial levels" (UNFCCC, 2015, P3 cited in Hafner et al., 2020). On the back of this, countries and regions have established ambitious targets to achieve net zero emissions by a defined period. For instance, the United Kingdom (UK) has established targets to generate 75% of its energy from renewable sources by 2030 and has recently been recommended by the independent Committee on Climate Change (CCC) to adopt a target of achieving net zero emissions by 2050 (Hafner et al., 2020). Other nations have made similar commitments under the Paris Agreement, signed at COP21 in 2015.

To achieve these targets, traditional sources of finance such as infrastructure finance and government expenditure will not be enough (Hafner et al., 2020, citing Ernst & Young, 2010). Green finance has been identified as a critical avenue for closing the funding gap and securing private and institutional investment in sustainable energy infrastructure (Hafner et al., 2020). Scholars such as Khan et al. (2022, 586) inform us that "Appropriate green finance can reduce harmful environmental footprints and improve environmental quality because its main objective is the trade-off between the growing versus the greening economy". However, Khan et al. (2022) also mentions that despite the vast interest on the topic of green finance, there's still no universally accepted definition of the concept. According to Wu et al. (2024,1) green finance refers to "economic activities aimed at supporting environmental enhancement, addressing

climate change, and promoting the efficient utilisation of resources". While this definition broadly refers to economic activities, this study is specifically focused on the financial instruments and mechanisms that facilitate investment in renewable energy and low-carbon initiatives. They further highlight that green finance involves providing financial services for projects in sectors such as energy efficiency (EE), renewable energy, environmental protection, green buildings, and eco-friendly transportation (ibid). The International Finance Corporation (IFC) defined green finance as investment solutions that protect the environment, allow for economic success, and uphold social justice (Hafner et al., 2020). While Berensmann and Lindenberg (2019, cited in Goel, 2023, 1787) define green finance as "the acquisition and use of finances for projects that save the environment while providing lenders or investors with a reasonable return". From the studied literature, it is apparent that there's no real consensus on what qualifies as green finance. We in fact made aware by Frimpong et al. (2022) that different interpretations of green finance mirror the aspect of the concept that holds significance to the researcher. For this research, the definition provided by Wu et al. (2024) has been adopted as the definition of green finance. Green finance is also commonly referred to as "climate finance", "sustainable finance", "environmental finance" or "green investment" (Goel, 2023). Green finance categories include green bonds, green credit, green insurance, and carbon finance (Liang and Yang, 2024).

2.2 Climate Change Adaption in South Africa and Wider African Context

Many scholars consider Africa to be at the forefront of the climate change discussion. Despite contributing the least to global GHG emissions, less than 5%, Africa is recognised as the most vulnerable region to the threat of climate change (Finn and Cobbinah, 2023). Climate change is expected to severely impact food security, water resources, public health, and increase extreme events and droughts across the continent (Adenle et al., 2017). The April 2022 floods in KwaZulu Natal, which claimed 435 lives, highlighted South Africa's vulnerability to such threats (Joubert, 2023). For this reason, "adaptation," focusing on resilience and reducing vulnerability to climate change, is a regional priority (ibid). While there is no uniformly accepted definition of resilience, Walker and Salt (2006, 1) inform us that resilience refers to "the ability of a system to absorb disturbances and still retain its basic function and structure". Resilience is universally recognised as a fundamental pillar for sustainable development, forming part of the United Nations SDGs (Harrision et al., 2014). This has been acknowledged by the City of Johannesburg which structured its Growth and Development Strategy with resilience as one of its fundamental principles (ibid).

At a national level, the South African Government has produced the National Climate Change and Adaptation Strategy (NCCAS) which is intended to provide a unified perspective on climate

change adaptation and resilience. The primary purpose of the NCCAS is the establishment of focal points essential for the realization of effective climate change adaptation within South Africa (NCCAS, 2019). The document draws on the country's National Development Plan (NDP) (2012) and the National Climate Change Response Policy (NCCRP) (2011). The primary goal of the NDP is to eradicate poverty throughout the nation by 2030, while concurrently safeguarding the environment and fostering economic development. The NDP takes little consideration of climate change and its potential impact on the attainment of these goals. As will be discussed in the next section, climate change is considered more holistically in the NCCRP which was produced with the objective of addressing both climate change adaptation and mitigation in South Africa's transition towards a lower-carbon society (ibid). The literature shows that climate change adaptation must integrate social, environmental, and economic development for a sustainable transition. This is especially crucial in South Africa, where the economy depends on energy-intensive sectors like mining, agriculture, and fossil fuel-based power generation, as shown in **Figure 5** (NCCAS, 2019).

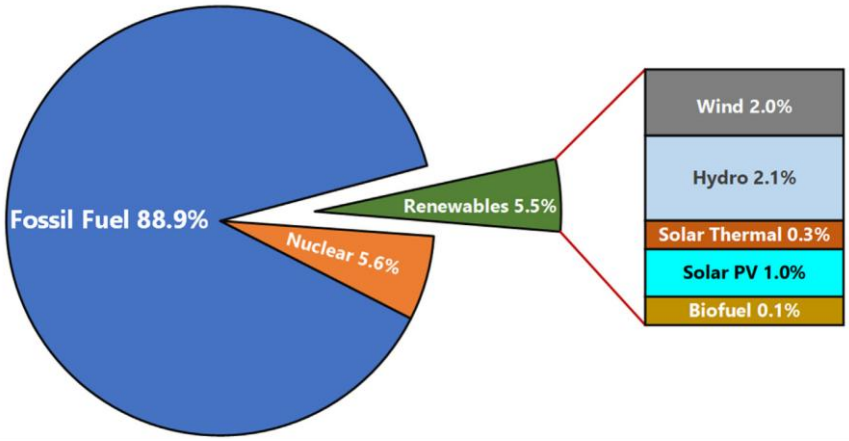


Figure 5 - South African Energy Mix (Akinbami et al., 2021)

2.3 Climate Change Mitigation in South Africa and Wider African Context

As opposed to climate change adaptation which considers built in capacity to cope with climate change, climate change mitigation considers efforts to reduce climate change by reducing GHG emissions (Cai et al., 2020). According to the United Nations Development Programme (UNDP), such efforts include shifting to renewable energy sources, promoting energy efficient practises, protecting the environment, preserving critical ecosystems, and cultivating regenerative agricultural practises (UNDP, 2024). However, as per Carrico et al. (2014), recent findings within the scientific community have concluded that climate change effects are already taking place due to existing GHG concentrations which guarantee further warming. This has prompted dual efforts by policy makers and scientist alike to acknowledge climate change adaptation measures alongside climate change mitigation (ibid). Despite contributing minimally to global GHG

emissions, African countries are expected to help reduce future emissions, highlighting a societal injustice due to their heightened vulnerability (Winkler, 2018).

As the leading GHG emitter in the African continent and in the top 12 globally, South Africa has established ambitious targets to reduce its contribution to global GHG emissions (Neumann, 2023). The South African government has committed itself to the phased decommissioning of its coal power stations with the long-term vision of increased integration of greener technologies such as renewable energy into the country's energy mix (Mokgotho and Mokoele, 2022). In 2010, the national government formulated the Integrated Resource Plan (IRP) to advance the adoption of renewable energy sources within the country. The IRP had established a goal of ensuring renewable energies constituted 14% of South Africa's total generation capacity by the year 2030. The IRP was later strengthened by the establishment of the REIPPPP in 2011, which introduced IPPs into the renewable energy mix. As previously mentioned, the NCCRP was also established in 2011 to ensure mitigation strategies for all sectors contributing to the country's GHG emissions. The NCCRP primarily focuses on the electricity sector, proposing renewable energy solutions, carbon pricing instruments and energy-efficiency programmes in achieving a reduction in GHG emissions (ibid). Despite the introduction of the IRP, REIPPPP, and NCCR between 2010 and 2011, their success remains limited. While these programs have long-term goals, South Africa continues to be a top GHG emitter and has faced ongoing power outages since 2008 (Bezuidenhout, 2022). This highlights the urgent need to accelerate mitigation efforts and achieve measurable progress.

2.4 The Development and Structure of South Africa's Economy

South Africa's economic structure highlights the necessity of integrating mitigation policies with development goals (Winkler and Marquand, 2011). The dependence on fossil fuel industries, particularly coal mining, is deeply rooted in the country's rich natural resources. In 2018, coal mining employed over 92,000 people nationwide and contributed R247.7 billion in sales (Minerals Council, undated). Among its G20 peers, South Africa has the highest proportion of electricity generated from coal, at 89%, and the highest carbon intensity of exports globally (Climate Bonds Initiative, 2021). The transition to a low-carbon economy is further hindered by development challenges, including high levels of inequality, unemployment, inadequate infrastructure, and the failure to meet the basic needs of the population (ibid). These factors make the green transition particularly complex, as it must balance decarbonisation with the imperative to protect jobs and support economic stability.

Historically, South Africa's development has been defined by its dependence on resource extraction and energy-intensive, capital-driven sectors. By 1980, mining employed over 710,000

people, representing 28% of the total active labour force and contributing a remarkable 28% to the country's gross domestic product (Nisbet, 1981). The country's mining roots date back to 1866 with the discovery of diamonds near Kimberley, followed by the discovery of gold two decades later in the Witwatersrand. The demand for efficient communication spurred the development of rail networks, while the growing need for power created a demand for coal as a primary energy source. Coal has since remained the dominant energy provider for the country's mines and industries to this day (ibid). Thus, the Climate Bonds Initiative (2021) highlights South Africa's significant potential to become the first coal-dependent economy among developing countries to transition successfully to a low-carbon economy. This potential stems from the centrality of coal in the nation's economic structure and the substantial green financing required to ensure a transition that is both equitable and just.

2.5 The Status Quo of Climate Finance in South Africa and Wider African Context

Climate change impacts are expected to occur sooner in African countries, making adaptation measures and funding more urgent (NCCAS, 2019). It is estimated that close to US$ 100 billion a year could be required to finance climate change adaptation measures in Africa by the year 2050, while the NCCAS (2019) informs us that South Africa could require anything between R34 billion and R298 billion between 2020 and 2030 alone to finance its adaptation response. According to Neumann (2023), an enormous gap ranging from US$ 99.9 to 127.2 billion exists for climate change mitigation across the continent to allow it to achieve its target of net zero emissions by 2050. While pledging a yearly climate finance contribution of US$100 billion to developing nations at COP15, wealthy countries have failed to deliver on this promise leaving the climate funding situation across developing nations in complete disarray (ibid).

Likewise, South Africa's NCCRP reiterates its status as a "developing nation" requiring international assistance as envisaged by the United Nations Framework Convention on Climate Change (UNFCCC) (DEA, 2011). According to the Presidential Climate Commission (PPC), international resources only accounted for 9% of tracked climate finance between 2019-2021 with 91% coming from domestic sources (PCC, 2023). 86% of South Africa's domestic contribution came from the private sector with commercial sources such as banks making up 92% of this contribution and the remainder being split between NGOs, donors, corporates, philanthropists, and households (bid). Public sector funding can be traced to direct provisions made from the national budget through the South African government's Medium Term Expenditure Framework (MTEF) and Development Finance Institutions (DFIs) (NCCAS, 2019). DFIs such as the African Development Bank, World Bank and Development Bank of Southern Africa (DBSA) have also contributed to South Africa's climate change initiatives (PCC, 2023). Despite the private sector's involvement, South Africa remains far from reaching the requisite

funding levels needed to meet its Nationally Determined Contributions (NDCs). Efforts are needed to expand private sector participation in South Africa's market and attract international resources. Green bonds could help by drawing domestic and international investors to the renewable energy sector. However, a challenge remains in increasing participation, with only 10 issuers listing green bonds on the JSE as of June 2021 (Neumann, 2023).

2.6 Motivation for Voluntarily Private Sector Participation in Climate Change Mitigation

The climate change discussion spans all sectors and markets. Achieving the goals of the Paris Agreement requires a unified, comprehensive approach across all sectors. The need for increased private sector participation in climate change mitigation has been stressed in section 2.5. Rising societal concerns about climate change have increased pressure on the private sector to integrate sustainable practices into their operations. We were in fact made aware by de Jongh and Mollmann (2014, 639) that "To remain competitive and profitable, companies will have to incorporate climate change and environmental awareness into their business strategies". It was highlighted that failure to do so could be detrimental to future business operations as pressure mounts from a growing population of environmentally conscious consumers and customers (ibid). Similarly, the World Bank has heightened the responsibility on corporations and nations to consider the environment across all their activities or face a complete exclusion from receiving future support from the entity (Frimpong et al., 2022). Globally renowned banking corporations such as Hong Kong-Shanghai Banking Corporation (HSBC), BNP Paribas and Deutsche Bank have all recently updated their strategic corporate policies to adopt environmentally friendly products. These banking giants have also signalled their intention to halt funding to corporations or individuals whose actions lead to environmental degradation (ibid).

In South Africa, Nedbank has committed to halting all financing towards the construction of any new coal dependent power station (Nedbank Group, 2019). Likewise, FirstRand Bank has also signalled its intention to cease funding of any new coal mines beyond 2026, backtracking on their initial stance of continuing to support coal in the South African market (Reuters, 2021). This highlights the significance of societal awareness and demonstrates how external pressures can incentivize the private sector to fulfil their role in mitigating climate change. According to Reyers et al. (2010), the relationship between the natural environment and business falls under Corporate Sustainability literature. They inform us that Banerjee (2002) identified three themes to understand private sector motivation for participating in environmental issues. These themes underscore the connections between stakeholder management, primarily influenced by concerns over legitimacy; strategic connections, where financial viability dictates decisions; and paradigm shifts, where moral obligations are believed to be the primary motivating factor. Authors such as

Dyllick and Hockerts (2002) argue that long term business sustainability is a product of a combined focus on the three dimensions of sustainability, which is the environmental, social, and economic (Dyllick and Hockerts, 2002. Cited in de Jongh and Mollmann, 2014). The aforementioned authors make the case that a single focus on economic stability will produce short term returns at the expense of the long-term sustainability of business operations (ibid). A study by Liang and Yang (2024) found that the peer effect of ESG disclosure of information can motivate other players within the same sector to adopt similar disclosure practises. According to de Jongh and Mollmann (2014), the voluntary nature of corporate action limits impact, with environmental issues often treated as an afterthought in South Africa. A shift in mindset is needed to make environmental considerations and proper disclosure standard practice for meaningful climate action in the private sector.

2.7 Greenwashing and its Impact on Global Emission Reduction Efforts

In response to mounting global concerns around climate change and environmental responsibility, enterprises have either voluntarily adopted or been mandated to implement and disclose their environmental practices (Garcia and Negre, 2023). Similarly, the capital market and consumer demand for eco-friendly products and services have surged in recent years, prompting an increasing number of companies to promote the environmental benefits of their offerings (Delmas and Burbano, 2011). This trend has led to an increase in corporations engaging in greenwashing, misleading consumers about the true environmental impact of their products (ibid). While no universally accepted definition exists, greenwashing involves selectively disclosing information and presenting poor environmental performance in a positive light (Ghitti et al., 2023). Garcia and Negre (2023) inform us that the drivers of greenwashing can be broadly classified into internal/organisational drivers and external/environmental drivers. External drivers include pressure from market actors (consumers and investors) and non-market actors (NGOs and regulators). While internal drivers would include organisational inertia and firm incentive structures amongst others (ibid).

In the context of green bonds and sustainable development, greenwashing can have detrimental impacts on global climate change efforts. According to Delmas and Burbano (2011), greenwashing can significantly undermine investor confidence in environmentally responsible corporations, thereby weakening the market for socially responsible investments. A study conducted by Zhang et al. (2022) from 2010 to 2018 concluded that greenwashing had a negative impact on environmental performance within private sector companies. Scholarly research has shown that reducing instances of greenwashing relies heavily on improving the transparency of environmental performance and increasing awareness about greenwashing (Delmas and Burbano, 2011). For this reason, Liang and Yang (2024) have stressed the importance of encouraging

positive and active disclosure of ESG information. They have identified green finance as a crucial factor in enhancing ESG information disclosure which can encourage organisations in the same industry to collectively improve the quality of their disclosures (ibid). This underscores the significance of the GBP framework, utilised by entities like Nedbank, which ensures greater transparency and process visibility throughout the green bond issuance process. A recent study conducted by Wang and Shen (2024) using ESG disclosures from listed firms in China was able to demonstrate that issuing green bonds can significantly reduce corporate greenwashing practises.

2.8 Relationship between Green Finance and Environmental Pollution

As a bridge between the environment and economy, green finance is poised to play a vital role in facilitating green transformation and achievement of SDGs. This section explores the nexus between green finance and environmental pollution through an analysis of existing literature. According to Khan et al. (2022), despite the growing popularity of green finance, very few scholars have examined the empirical relationship between green finance and environmental quality. A study conducted by Khan et al. (2022) investigated the impact of green finance on the ecological footprint (EF) of twenty-six different economies across the Asian region. Their findings concluded that green finance significantly reduced the EF and carbon dioxide emissions within the sampled economies (ibid). Similarly, a study conducted by Zhou et al. (2023) used panel data from thirty provinces across China between the period of 2007 to 2020 to investigate how green finance impacts environmental pollution across these regions. Their study found that green finance reduced environmental pollution by enhancing green technology innovation, stimulating industrial structure upgrading and strengthening environmental regulation (ibid). Bakry et al. (2023) explored the relationship between environmental performance and green finance in seventy-six developing countries between 2010 and 2019. Their research revealed significant and inhibitory impacts of both green finance and renewable energy on carbon dioxide emissions, highlighting the importance of promoting these initiatives further (ibid). From a South African perspective, this study holds significance as one of the first studies conducted to investigate the green finance and carbon dioxide nexus in developing countries with other studies mainly focusing on China. The evidence presented suggests a consensus in the literature that green finance plays a significant role in reducing carbon dioxide emissions. This is supported by Goel (2023, 1791) who mentions that “successful implementation of green financing efforts will make enhancing environmental reputation and reinforcing environmental care a reality rather than a pipe dream”.

2.9 Relationship between Green Finance and Energy Efficiency

It is essential for South Africa to transition from a coal-dependent economy to a low-carbon one to significantly reduce its GHG emissions (Akinbami et al., 2020). Enhancing EE is a key strategy for reducing GHG emissions. This section explores its link to green finance. Yu et al. (2022) lets us know that enhancing EE in conjunction with renewable energy sources can result in reductions of emission levels by 37% and 32% respectively. Highlighting the importance of the topic, Quang and Thao (2022, 385) mention that "the need to improve energy efficiency as an essential factor for achieving the Sustainable Development Goals through green financing is one of the most important issues worldwide". A study conducted by Zhang et al. (2023) using data from China's prefecture-level cities between the period of 2005 to 2020 investigated the relationship between green finance, EE and technological innovation. The study found that green finance was instrumental in stimulating EE within the research region. The study also found that while green finance played a role in improving technological innovation, EE was only improved by high quality innovation of green technology (ibid).

Similarly, Quang and Thao (2022) conducted a study to investigate how green finance, using green bonds as a proxy, promoted EE within ASEAN member countries between the period of 2017 to 2020. Green bonds were the first green finance instrument developed in this region and were issued for the first time in 2017. ASEAN member countries consist of Indonesia, Brunei, Malaysia, Cambodia, Myanmar, Laos, Vietnam, Thailand, Singapore, and the Philippines. The study illustrated that with each 1% increase in the issuance volume of green bonds, EE rose by nearly 0.42%. This is consistent with the findings made by Yu et al. (2022) and supports the outcomes of other literature such as Naeem et al. (2021) and Mensi et al. (2021) who's studies demonstrated the positive benefits of green bond issuances on increasing EE and overall environmental protection (ibid). The 2017-2020 study period highlights the immediate impact of green bonds on EE, offering valuable insights for South Africa's still-developing green bond market. These findings suggest significant potential to enhance EE in the country's energy sector.

2.10 Case Studies of Green Bonds in African Context

The green bond market has seen an increase in activity within the African continent, although still some distance behind the volumes issued by wealthier nations, countries such as Nigeria, Kenya, and South Africa have demonstrated enormous potential for green bonds in the continent (FSD Africa, 2020). **Figure 6** illustrates the total green bond issuances across the African continent as of 2020, showing both the number of issuances and their cumulative value in US$ million for each country (FSD Africa, 2020). The following sections examine two case studies showcasing the use of green bonds to finance green projects in Kenya and Nigeria.

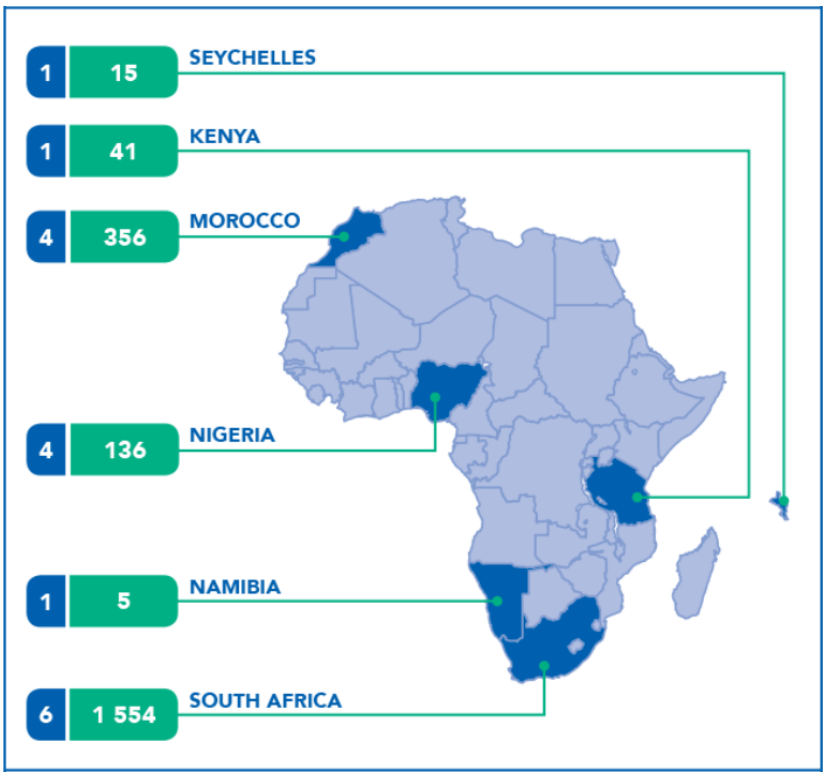


Figure 6 - Aggregate green bond issuances in Africa (FSD Africa, 2020)

2.10.1 Case Study of First Green Bond Issued in Kenya: Acorn Holdings

Similar to South Africa, the Kenyan government has set ambitious targets for transitioning to a low-carbon economy. This ambition has been evident in significant policies like the Green Economy Strategy and Implementation Plan (GESIP) initiated in 2016 (Ngwenya and Simatele, 2020). A notable component of the GESIP involves the recognition of green finance tools like green bonds to bolster the nation's journey towards sustainable growth. The GESIP paved the way for the launch of the Kenyan Green Bonds Programme (GBPK) in March 2017 which looked to facilitate the introduction of a local green bond market. The programme was instrumental in the launch of Kenya's first corporate green bond worth US$ 40 million in August 2019 by Acorn Holdings, a real estate development firm (FSD Africa, 2020). The green bond was used to finance the construction of environmentally friendly student accommodation for 5000 students in the capital of Kenya, Nairobi (ibid). Ngwenya and Simatele (2020) highlight that the issuance of this green bond demonstrates how multi-stakeholder partnerships can effectively create platforms to achieve environmental goals. This is particularly significant, as such a partnership played a crucial role in establishing the enabling environment for the bond's issuance through the GBPK framework.

However, Magale (2021) notes that Kenya's green bond market remains sluggish despite viable projects, with interviews revealing key factors inhibiting its growth. Some of the issues identified include a widespread lack of awareness amongst key stakeholders in the market, a poor emphasis

on sustainable investing, limited institutional capacity and expertise of practitioners, insufficient tools to manage investor risks and the relatively high costs associated with the issuance and monitoring of green bonds(ibid). Relating this to the South African context where green bonds have demonstrated more growth, Magale (2021) mentions how the emphasis on responsible investing has been fundamental in fostering green bonds in the country (ibid). He uses the JSE as a case example which established a green bond segment in 2017 to offer private investors a platform to invest in environmentally friendly projects (Sustainable Finance Initiative, 2019). Likewise, the Pension Funds Act Regulation 28 in South Africa mandates the incorporation of ESG factors into the investment portfolio of pension funds, highlighting the significance of institutional backing for sustainable investing (Magale, 2021). This case study demonstrates how a multi-stakeholder approach can unlock funding for climate projects in underserved regions and highlights the need for education, responsible investing, and proactive issue resolution to support the growth of the green bond market.

2.10.2 Case Study of First Green Bond Issued in Nigeria: Nigerian Federal Government

As a signatory to the Paris agreement, Nigeria has established ambitious targets as part of its NDCs by committing to a achieving a reduction of 20% below the business-as-usual approach by 2030 and an additional 47% reduction conditional on receiving financial assistance (Oshiomah, 2022). The Climate Policy Initiative has estimated that Nigeria would require a 550% increase in climate finance if it is to meet its climate change objectives by 2030 (Climate Bonds Initiative, 2022). However, Nigeria faces challenges in bearing the transition costs due to high poverty, inadequate infrastructure, and the need for a robust export-driven economy (Oshiomah, 2022). This has shaped its climate policies, emphasizing the diversification of climate financing and attracting private capital for a low-carbon transition (Ngwenya and Simatele, 2020). In 2016, the Nigerian Federal Government recognised green bonds as a means of sustainable financing leading to the establishment of the Nigerian Green Bonds Framework. This resulted in the issuance of the first green bond in 2017 by the Federal Government of Nigeria which was Africa's first sovereign green bond worth US$ 29 million and receiving certification with the Climate Bonds Standard. Three green projects were funded with the proceeds, namely the Energising Education Project, an Afforestation Project, and a RE Micro Utility Programme (ibid).

The Energising Education Project provided renewable power to universities and hospitals through off-grid solar power plants, adding 12.5MW and improving safety with streetlighting (Oshiomah, 2022). The National Afforestation Programme aimed to combat desertification, drought, and land degradation while enhancing ecotourism and rural livelihoods. Additionally, the RE Micro Utility Programme demonstrated the viability of decentralized mini-grids, with a 60KW grid in

Torankawa providing reliable power to 1,750 people, supporting both households and small businesses (ibid). Some of the factors inhibiting the growth of Kenya's green bond market, as identified by Magale (2021), have been addressed in Nigeria. This includes the establishment of a Nigerian Green Bond Market Development Programme which has promoted the acceleration of the local green bond market by providing regulatory support for the creation of listing requirements and guidelines, developing a network of local and licensed green bond verifiers, and providing support and transactions training (Climate Bonds Initiative, 2022). The programme has supported the generation of US$ 41.7 million and upskilling of over five hundred practitioners in Nigeria's capital markets (ibid). This highlights the need for strong institutional support and a sustainable investing culture to grow local green bond markets that contribute to climate initiatives.

2.11 Conceptual Framework

The conceptual framework, as illustrated in **Figure 7**, provides a structured lens through which the dynamics of South Africa's energy transition can be understood. It maps the relationships between the country's energy and climate challenges, the evolution of policy and institutional responses, the introduction of green bonds as a financial instrument, and the enabling conditions that support their implementation. The framework also highlights the mechanisms through which green bonds drive environmental and social outcomes. These outcomes are assessed through principles of equity and justice to ensure that the transition is not only sustainable but also inclusive and fair. Ultimately, the framework culminates in holistic sustainability outcomes, including thriving and functional ecosystems, resilient communities, equitable access to resources, and sustainable economic livelihoods.

This framework supports the research by linking theoretical principles with practical mechanisms and measurable outcomes, ensuring a comprehensive approach to evaluating green bond-funded projects. It aligns directly with the study's focus on Nedbank's Renewable Energy Bonds, providing a conceptual structure for analysing stakeholder perceptions, carbon reduction impacts, and community-level outcomes. By illustrating the interconnectedness of policy, finance, and sustainability, the framework serves as a critical tool for understanding how green bonds can contribute to South Africa's low-carbon energy transition.

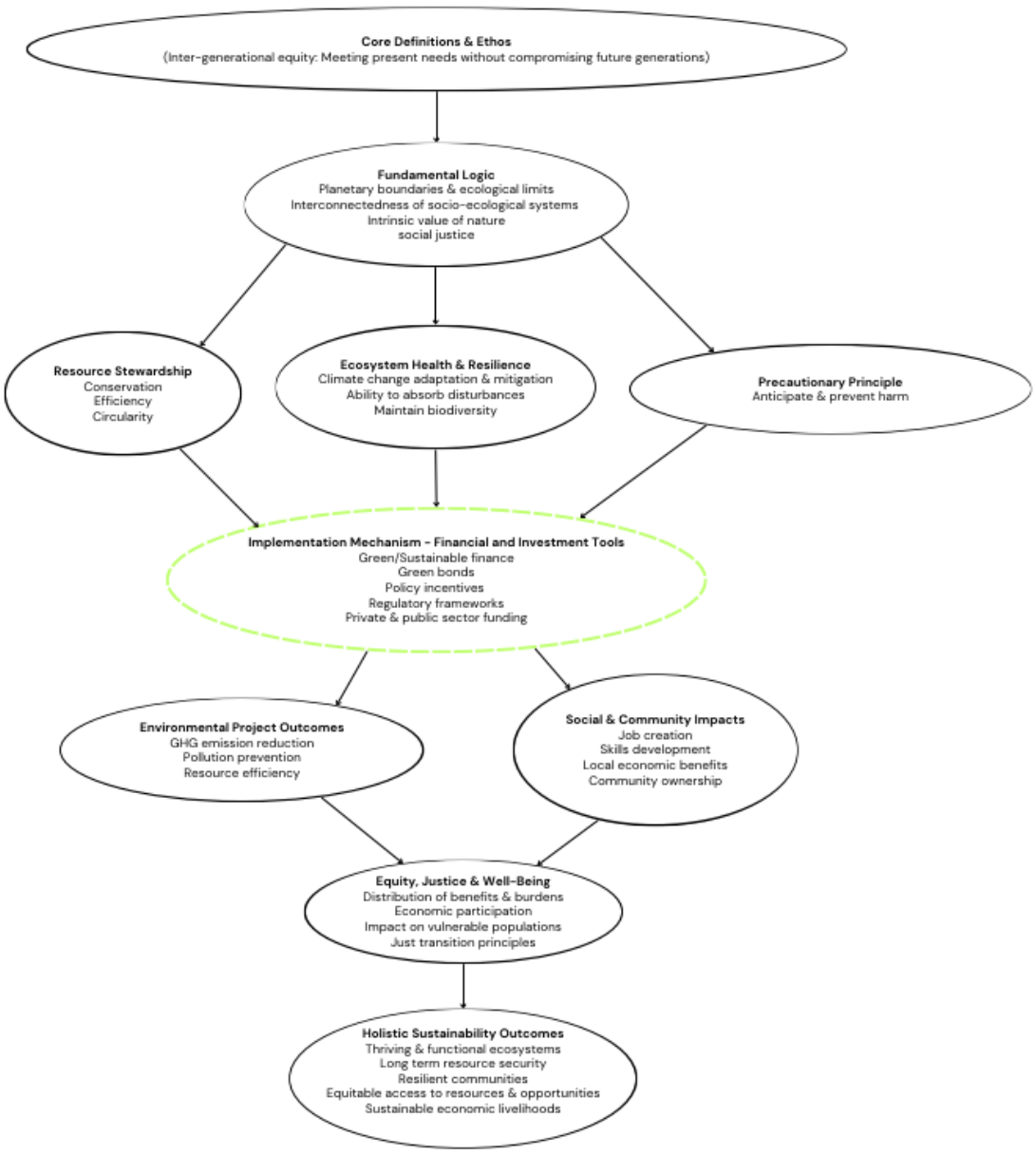


Figure 7 - The conceptual framework

2.12 Key Findings and Conclusions

This literature chapter highlights the potential of green bonds as an innovative mechanism to support the transition to a low-carbon energy system and reduce GHG emissions. The Paris Climate Agreement and SDGs, endorsed by 195 countries, have driven global efforts to limit temperature rise to below 2°C above pre-industrial levels. South Africa has reinforced its commitment through policies like the NCCAS and NCCRP, aimed at enhancing climate resilience and reducing GHG emissions. This chapter highlights the urgent need for increased green financing in Africa to achieve the region's 2050 net-zero target. Innovative mechanisms like green bonds present promising opportunities to boost investments and attract new funding for sustainable development.

The literature explores how to encourage voluntary private sector participation in climate change mitigation, emphasizing the importance of increased societal awareness and external pressures. It also highlights that raising awareness and improving the quality of ESG disclosures are key to combating the rise of greenwashing. Greenwashing can seriously undermine emission reduction efforts by eroding investor confidence and weakening the market for socially responsible investments. In this context, stricter disclosure requirements for green bonds are seen as a key advantage, effectively reducing corporate greenwashing.

We also find that green finance plays a key role in reducing environmental pollution and improving EE. Specifically, green bonds drive the adoption of green technologies, renewable energy, and sustainable development, leading to lower carbon emissions. The literature highlights the growing significance of green bonds in Africa, with case studies from Kenya and Nigeria demonstrating their potential to finance sustainable projects. Kenya's first green bond by Acorn Holdings and Nigeria's sovereign green bond showcases successful multi-stakeholder collaborations and regulatory support. These examples emphasize the importance of institutional backing, awareness, and responsible investing in advancing green bond markets, offering valuable insights for South Africa.

3 RESEARCH METHODS

3.1 Introduction & Overview

This chapter outlines the research methodology, which is divided into five sections: the research approach, data collection, data analysis and interpretation, study limitations, and ethical considerations.

The initial section introduces the research methodology adopted for the study and explains the rationale for selecting this approach to address the research question. The research approach is crucial to the study as it ensures the systematic and rigorous investigation necessary for valid and reliable results. The next section details the data collection process, categorizing the data into primary and secondary sources. This is followed by a section on data analysis and interpretation, detailing the methods employed to analyse the data and extract meaningful insights essential for addressing the research question. Lastly, the chapter concludes with an examination of the study's limitations and the ethical considerations.

3.2 Research Approach

A qualitative research approach was followed to assess the outcomes of green bond-funded projects on renewable energy development and transition to a low-carbon energy system. By definition, “Qualitative research is a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data (Hammersley, 2013, 1 quoting Bryman, 2008). Qualitative research is particularly well-suited for the exploration of how individuals experience, understand, and interpret a topic of interest (Hammersley, 2013). This approach proved highly beneficial for the study, which sought to evaluate the outcomes of green bond-funded projects as perceived, understood, and interpreted by professionals with extensive expertise in the green bond and renewable energy sectors, as well as by members of the local communities directly affected by these projects. To achieve this, the study carefully selected a data collection method appropriate for its objectives and intentionally identified participants with rich, first-hand experience of the subject matter. This included both industry professionals and local community members who could provide valuable, diverse insights to comprehensively address the research questions.

Unlike quantitative methods that rely on numerical data and statistical analysis, qualitative research allowed for a nuanced exploration of how individuals perceive and interpret the outcomes of green bond-funded projects on renewable energy development and the transition to a low-carbon energy system (Watson, 2015). By emphasizing detailed and descriptive data, qualitative methods provided a deeper understanding of complex issues that quantitative

approaches might overlook, such as the factors influencing how people view and understand green bonds in the South African context. This approach was essential for capturing the diverse perspectives and insights of participants, thereby offering a holistic view of the impacts of green bonds beyond numerical metrics.

3.3 Data Collection

The study mainly relied on data collected from primary sources, with secondary sources included to provide additional insights and context where necessary. Semi-structured interviews served as the primary data collection method, enabling the capture of first-person narratives from carefully selected participants. The participants included stakeholders from the JSE, CBI, DFIs, Real estate investment trusts (REIT), and renewable energy sector, all selected for their ability to offer valuable insight stemming from their involvement and interaction with green bonds. Similarly, participants who could offer insights into Nedbank's Renewable Energy Bonds and their outcomes were carefully identified and interviewed as part of the study, which focused on a case analysis of this specific green bond issuance. The study consisted of three participant groups, namely private sector representatives, non-profit organisations, and community representatives.

Semi-structured interviews were conducted either in-person or online, based on the participants' preferences. In-person, face-to-face interviews were conducted at the participants' workplace or nearby café, ensuring a comfortable and convenient setting for each participant. Face-to-face interviews offered significant advantages, as they allowed for the observation of non-verbal cues like facial expressions and body language, adding a more personal and insightful dimension to the responses. They also facilitated immediate clarification of questions and allowed for the addition of follow-up questions, creating a more dynamic interview process that ultimately enhanced the depth and quality of the qualitative data collected. At the start of each interview, participants were asked for their consent to record the session using a mobile device. The recordings were then used to transcribe the interview responses accurately. When face-to-face interviews were impractical due to geographical and scheduling constraints, online methods were employed instead. All online interviews were conducted via Microsoft Teams, where participants were asked for permission to record and transcribe the sessions. All participants were interviewed as experts, drawing on their individual experiences and perceptions, rather than on the policies or activities of their organizations.

The interview questions were thoughtfully designed to encourage participants to provide detailed and comprehensive responses. This approach aimed to gather valuable insights and perspectives that could be effectively utilized to answer the research questions and deepen the overall understanding of the study's objectives. As previously noted, the study involved three distinct

participant groups. A representative from the CBI was interviewed in their capacity as a member of a non-profit organization. The remaining participants, excluding those from the community representative group, were all drawn from the private sector. To evaluate the impact of green bond-funded projects on surrounding communities, interviews were conducted with two participants from the community representative group linked to the Golden Valley Wind Farm facility. These participants were identified through a referral from a project developer representative, who connected the researcher with individuals actively involved in social programs in the region and familiar with community experiences. In this context, a community representative refers to someone who is able to speak on behalf of the local community and provide insights into how the projects are experienced by people living in the area.

The Golden Valley Wind Farm, where these community representatives are based, is a 120 MW renewable energy project located in the Eastern Cape and operates under the REIPPPP framework, which uniquely requires a minimum level of community ownership. **Figure 8** illustrates the role of Black Economic Empowerment (BEE) and local community representatives in project ownership within the REIPPPP (Baker, 2015). This community ownership requirement is a strategic provision ensures that socio-economic objectives remain paramount within South Africa's evolving energy transition landscape (ibid).

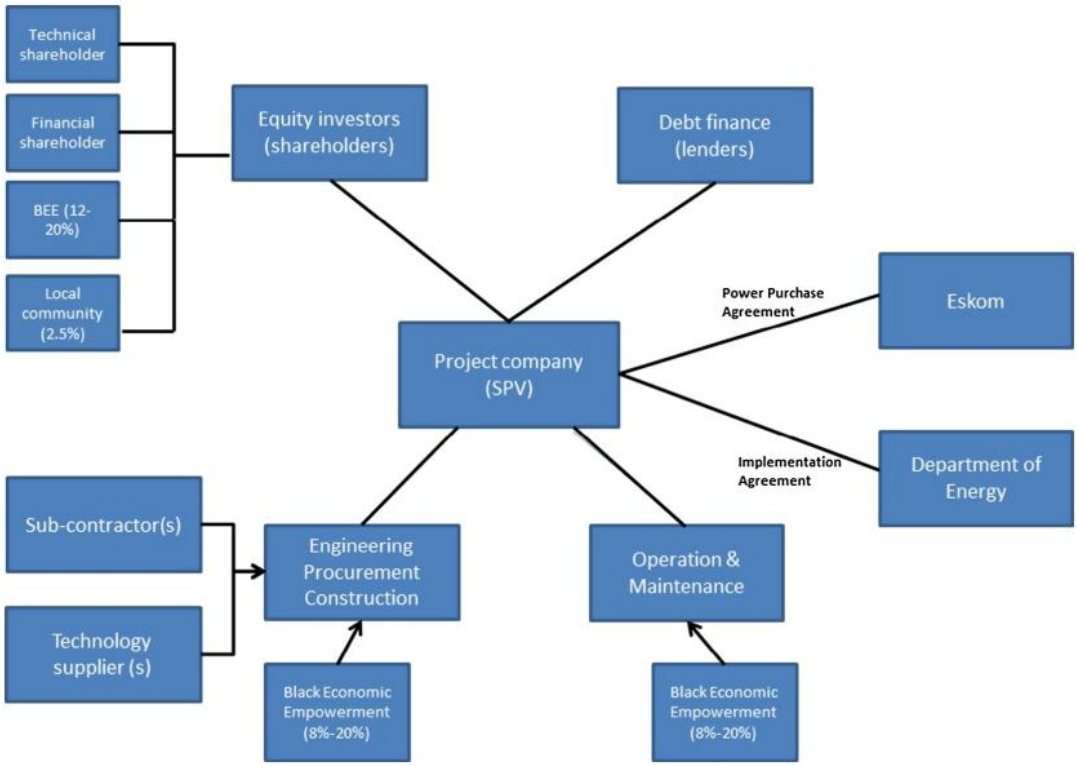


Figure 8 - Project finance structure under REIPPPP (Baker, 2015)

Secondary data was used to provide depth to the study, including the evaluation of carbon dioxide implications associated with green bond-funded projects, sourced from Nedbank's Annual Green Bond Impact Reports, specifically the "actual CO_2 emissions avoided" figures published from 2020 to 2023.

3.4 Data Presentation, Analysis and Interpretation

The data presentation was structured around the study's four sub-questions, ensuring that each relevant aspect of the primary research question was thoroughly and comprehensively addressed. Each sub-question was designed to thoroughly investigate a specific theme critical to achieving a comprehensive understanding of the role of green bond-funded projects in renewable energy development and the transition to a low-carbon energy system. Systematically identifying and categorizing the themes within the sub-questions allowed for the development of a more in-depth and multi-layered understanding of the key factors that must be considered in addressing the main research question. Insight from the literature review, which informed the development of the study's conceptual framework, was further utilized to refine and address specific subtopics within the sub-questions.

Sub-questions 1 and 2 are addressed in Chapter 4, each clearly divided into distinct sub-sections. Section 4.2 strategically sets the foundation for the study by offering an overview of the case study, which serves as the backbone of the research, and contextualizing green bonds within South Africa's renewable energy sector. This section also addresses Sub-question 1 by presenting findings from participant interviews, organized into key subtopics that are critical for answering the primary sub-question. Section 4.3 draws on secondary data from various sources to evaluate the carbon reduction outcomes of green bond-funded projects in South Africa. The methodology for addressing this sub-question is developed and thoroughly explained in this section, with supporting sources provided to justify the approach taken in the study.

Sub-questions 3 and 4 are addressed in Chapter 5, each clearly divided into distinct sub-sections. Section 5.2 examines the impact of green bond-funded projects on local communities. It begins with a brief overview of the Golden Valley Wind Farm, one of the projects financed by Nedbank's Renewable Energy Bonds. The section then presents findings from interviews with local community members, organized into key subtopics that serve as the basis for answering the main sub-question. The fieldwork is strategically concluded in Section 5.3 which investigates stakeholder perceptions on the role of green bonds in supporting sustainable development in South Africa. This section effectively shifts from more focused themes to a holistic perspective, allowing for a nuanced understanding of how green bonds are perceived by industry professionals. It examines the strengths and weaknesses of the green bond market and offers

recommendations for improvement, aiming to encourage greater participation and enhance its capacity to make meaningful contributions to carbon emissions reduction.

Findings from the fieldwork presented in Chapters 4 and 5 are analysed in Chapter 6 of the study. This chapter conducts a thematic analysis based on the findings from the fieldwork. By presenting the analysis in a separate chapter, the research highlights critical connections across different sub-questions and identifies similarities in perspectives or inconsistencies in the findings—insights that may have been overlooked had the analysis been included within the fieldwork chapters. The analysis and discussion follow a systematic approach designed to extract key insights and patterns from the data, drawing on the literature review to support the discussion of the findings.

Table 1 presents the study's sub-questions, detailing the corresponding primary and secondary data requirements, collection methods, and tools. Additionally, it summarizes the data analysis and processing strategies employed to address the sub-questions and support the overall findings of the study.

Table 1 - Summary of research questions, data collection, tools, process, and analysis approach

Research Question	Data collection, tools, and process	Data analysis approach
Sub-question 1: Within the specific framework, innovation, and ring fencing of proceeds that distinguish green bonds from traditional infrastructure bonds, to what extent was Nedbank's Renewable Energy Bonds able to encourage private sector participation in renewable energy development?	**Primary data**: Semi-structured interviews were conducted with stakeholders from the JSE and CBI, focusing exclusively on participants with specific insights into the case study project related to Sub-question 1. **Secondary data**: Secondary data from pertinent sources was utilized to contextualize the findings and enrich the quality of the fieldwork.	The data analysis approach for the stakeholder interviews followed a systematic process aimed at extracting key insights and patterns. Findings from the interviews were carefully reviewed to identify recurring themes and topics. Qualitative techniques were employed to organize the data into meaningful themes.
Sub-question 2: What are the implications in relation to carbon reduction that emerged from Nedbank's renewable energy bonds that ring-fenced the use of proceeds to fund projects that can demonstrate a reduction in carbon emissions?	**Secondary data**: The secondary data was sourced from various reports and methodologies related to green bonds and greenhouse gas emission reductions, including Nedbank's Annual Green Bond Impact Reports and Eskom's Historical Electricity Generation per Plant data.	A comprehensive analysis of the secondary data was conducted, involving a review of published environmental performance data. This included using charts to visualize relationships between different variables, employing graphs to project future green bond funding scenarios, and discussing these findings in relation to South Africa's climate finance objectives.
Sub-question 3: What have been the outcomes in the communities surrounding the 120 MW Golden Valley Wind Farm facility in which Nedbank's renewable energy bond created a funding opportunity for the private sector to participate in such projects?	**Primary data**: Semi-structured interviews were conducted with two community members and employees at the Golden Valley Wind Farm, providing rich firsthand insights into the project's outcomes. **Secondary data**: Secondary data from pertinent sources was utilized to contextualize the findings and enrich the quality of the fieldwork.	The data analysis approach for the community member interviews followed a systematic process aimed at extracting key insights and patterns. Findings from the interviews were carefully reviewed to identify recurring themes and topics. Qualitative techniques were employed to organize the data into meaningful themes.
Sub-question 4: How do stakeholders perceive the effectiveness or limitations of green bonds as a funding mechanism for renewable energy development and emissions reduction in South Africa?	**Primary data**: Semi-structured interviews were conducted with three stakeholders who have firsthand experience with green bonds, including two participants from the IDC and one from Growthpoint Properties.	The data analysis approach for the stakeholder interviews followed a systematic process aimed at extracting key insights and patterns. Findings from the interviews were carefully reviewed to identify recurring themes and topics. Qualitative techniques were employed to organize the data into meaningful themes.
Main Research Question: Assessing the outcome of green bond-funded projects on renewable energy development and transition to a low-carbon energy system within South Africa: A case study of Nedbank's Renewable Energy Bonds.	By answering sub-questions 1 to 4 as outlined above, the main research question for the study will be answered.	

3.5 Limitations of Study

The primary data for the study was gathered through semi-structured interviews with carefully selected industry stakeholders, emphasizing the importance of participant quality. However, due to time constraints, participant availability, and the study's scope, a larger group of participants could have offered a broader perspective, potentially revealing issues not raised by the current pool. Similarly, difficulties in securing interviews with Nedbank representatives directly involved in the green bond issuance led the study to rely on participants with indirect involvement, exposure, or knowledge of the issuance. While obtaining firsthand insights would have significantly enriched the research, potential bias would need to be disclosed and carefully monitored to ensure objectivity. The study is primarily based on a case study of Nedbank's 2019 Renewable Energy Bond issuance. Although other banks like Standard Bank and Absa, non-financial institutions such as Growthpoint Properties, and municipalities like the City of Cape Town have also issued green bonds, the limited scope of this research did not allow for the comprehensive comparison needed across various companies or sectors. A comparison of the outcomes from various green bond issuances would have added greater depth to the study and allowed for an investigation into the consistency of the findings. Nonetheless, the findings from this study are anticipated to provide a strong foundation for assessing the overall effectiveness of green bonds in South Africa. This is further reinforced by the use of common frameworks and third-party certification processes consistently applied by all green bond issuers in the country.

3.6 Ethical Considerations

The study adhered to the ethical guidelines set by the University of the Witwatersrand, with all required documentation completed to ensure compliance with the university's ethical standards. The ethics clearance, which formed the foundation of the data collection process, is included in **Appendix 1** for reference. All participants involved in the interview process were informed about the research, and a formal consent form was provided before the interviews took place. To encourage open and honest communication, participants were assured that the interviews would focus solely on their personal opinions rather than those of their respective organizations. Additionally, they were informed that their responses would remain completely anonymous, and that the information gathered would be used exclusively for academic purposes. To ensure the objectivity of the research, the analysis of the data takes into account the positionality of all participants.

4 ASSESSING THE INFLUENCE OF GREEN BONDS ON PRIVATE SECTOR PARTICIPATION IN RENEWABLE ENERGY DEVELOPMENT AND CARBON REDUCTION OUTCOMES

4.1 Introduction

This chapter addresses sub-questions 1 and 2 of the study. It begins with Section 4.2, which answers sub-question 1 by examining the extent to which Nedbank's Renewable Energy Bonds have encouraged private sector participation in renewable energy development in South Africa. Additionally, Section 4.2 sets the stage for the rest of the study by contextualizing green bonds within both South Africa's renewable energy landscape and the broader global climate change framework.

Section 4.3 addresses sub-question 2 of the study, which evaluates the carbon reduction outcomes of projects funded by green bonds. Using secondary data, this section examines the claims of enhanced transparency, the alignment of disclosed information with the GBP, and the effectiveness of green bond-funded projects in contributing to South Africa's carbon reduction goals. Finally, section 4.4 concludes the chapter.

4.2 The Critical Role of Private Sector Participation in Advancing Renewable Energy Development

South Africa has reiterated its dedication to limiting global temperature rise to 1.5°C, as stipulated by the Paris Agreement, through its NDCs (PCC, 2023). Over the last twenty years, South Africa has incorporated climate resilience, climate change, and sustainability into its comprehensive policy and development framework, encompassing a range of national and sectoral policies, plans, and strategies. The country's aim to transition to a low-carbon economy reflects the recognition of the need for a more sustainable and resilient economic model that can support broader development goals (ibid). Despite these policy pledges and recent surge in climate funding, as discussed in section 2.5, South Africa remains significantly short of the necessary funding levels to achieve its climate change objectives.

According to the Presidential Climate Commission's report on the South African Climate Finance Landscape in 2023 PCC (2023, 2):

"***Climate finance in South Africa needs to increase by at least three to fivefold from the current annual average of R131 billion***. *Estimates suggest that South Africa requires on average R334 billion per year to meet its net zero goal by 2050, and R535 billion per year to meet its NDC target by 2030*".

Appendix 2 provides a diagram illustrating the landscape of South Africa's climate finance in 2023. The diagram reveals that 91% of the country's climate finance originated from domestic sources, with the private sector accounting for 86% of this. Within the private sector, commercial sources, including banks, made up 92% of the total contribution. With limited scope for increased public sector funding from the national budget, it is crucial to urgently expand private sector participation in the local market while actively attracting resources from the international community. Green bonds can support South Africa's renewable energy sector by attracting domestic and international investors. Despite their global growth, South Africa's green bond market has slowed, with limited growth in private sector participation. By 2021, only 10 issuers had listed green bonds on the JSE (see **Table 2**).

Table 2 - Green Bond Issuers in South Africa (Climate Bonds Initiative, 2021)

Name	Contribution (%)	Sector
City of Cape Town	3	Municipality
Growthpoint Properties	3	Property
City of Johannesburg	4	Municipality
Absa	5	Banking
Standard Bank of South Africa	7	Banking
First Rand Bank	7	Banking
Development Bank of Southern Africa	8	Development Finance Institution
Redstone Solar Thermal Power Plant	19	Solar Power Plant
Industrial Development Corporation	22	Development Finance Institution
Nedbank	22	Banking

Sub-question 1 examines the urgent need to expand climate finance by assessing the effectiveness of green bonds in driving private sector participation in renewable energy development, compared to traditional infrastructure bonds. The methodology includes a case study overview, a review of secondary data on profitability and risk, and an analysis of primary data obtained through semi-structured interviews.

4.2.1 Data Overview

This section of the report addresses sub-question 1 of the study, with the corresponding data presented in **Table 3**. Primary data for this sub-question were obtained through semi-

structured interviews with key professionals from both the JSE and the CBI. PVT-1 shared their perspective as a primary market associate at the JSE, Africa's largest stock exchange and a key platform for listing green bonds. Likewise, PVT-2 was interviewed as a senior sustainable debt analyst at the CBI which is the most recognised green bond certification standard. Secondary data was used to contextualize the findings and enhance the quality of the fieldwork.

Table 3 - Data overview for sub-question 1

Research sub-questions and overall research question	Secondary data collected	Primary data collected
Sub-question 1 Within the specific framework, innovation, and ring fencing of proceeds that distinguish green bonds from traditional infrastructure bonds, to what extent was Nedbank's Renewable Energy Bonds able to encourage private sector participation in renewable energy development?	**Key Themes** • Overview of case study: Nedbank Renewable Energy Bonds • The need for profit in the renewable energy sector • Currency risk and South Africa's green bond market **Data Sources** • Sustainable Finance Initiative, Case Study: Nedbank Innovation through green investment, 2019. • Nedbank, Group overview, undated. • FSD Africa, Africa Green Bond Toolkit, 2024. • Climate Bonds Initiative, Nedbank Limited issues first private sector Climate Bonds Certified green bond in South Africa, 2019. • Nedbank Group, South Africa's first commercial bank green bond, 2019. • Baker, The evolving role of finance in South Africa's renewable energy sector, 2015. • Climate Bonds Initiative, Green bonds In South Africa: How green bonds can support South Africa's energy transition, 2021.	**Key Themes** • Understanding Green Bonds and their intended purpose • Examining Nedbank's 2019 Renewable Energy Bonds • Innovative features of Nedbank's Renewable Energy Bonds and market differentiators • The role of Nedbank's Renewable Energy Bonds in encouraging private sector participation in renewable energy development • Investor willingness to accept lower returns for environmental benefits • Strategies to boost private sector participation and green bond issuance in South Africa **Data Sources** • PVT-1 (Primary Market Associate at the JSE) • PVT-2 (Senior Sustainable Debt Analyst at the CBI)
Overview on data analysis process	Through comparative data analysis, key themes from secondary sources and interview data were corroborated and correlated, leading to the identification of sub-findings related to the various elements of the sub-question.	

4.2.2 Overview of Case Study: Nedbank Renewable Energy Bonds

Nedbank Limited is a prominent player in South Africa's financial sector, counted among the esteemed "big four" commercial banks alongside First Rand Bank, Standard Bank, and Absa. Forming part of the Nedbank Group, Nedbank predominantly caters to the South African market but has also expanded its footprint within the African continent operating in countries such as Mozambique, Malawi, Swaziland, Zimbabwe, Lesotho, and Namibia within the SADC region (Sustainable Finance Initiative, 2019). The bank's strategic partnership with Ecobank Transnational Incorporated (ETI) has also given it access to Central and West Africa with operations in Kenya and Angola respectively (Nedbank, undated). In 2019, Nedbank achieved a significant milestone by becoming the first South African private sector entity to issue a Climate Bonds certified renewable energy bond, setting a precedent for other private sector participants in the local market to follow (FSD Africa, 2020).

The South African first renewable energy bond was launched at the JSE on the 24th of April 2019 by way of auction receiving bids worth R5.5 billion and raising an incredible R1.7 billion from an initial target of R1 billion (Climate Bonds Initiative, 2019). The bond's 3.28-times oversubscription showcased strong investor demand, attracting bids from local investors and foreign-backed impact funds (Nedbank Group, 2019). Nedbank boosted investor confidence with a robust bond framework, certified by the CBI and verified by the Carbon Trust (Sustainable Finance Initiative, 2019). Already established as a leader in South Africa's renewable energy sector, Nedbank had committed R42 billion to REIPPPP projects and leveraged this involvement to identify suitable projects for bond financing (ibid).

The renewable energy bond proceeds funded the construction of four solar and wind projects identified by the bank (Climate Bonds Initiative, 2019). Renewable Energy Bonds 2 was subsequently launched on the JSE's green segment in October of the same year following the success of the first bond (Nedbank Group, 2019). The 4 times oversubscribed bond attracted bids from over 25 different investors raising an impressive R1 billion to fund investments in solar and wind. The funded projects included the development of two 75 MW solar facilities in the towns of Pofadder and Kimberley in the Northern Cape, as well as a separate 75 MW solar facility near Zeerust in the North West province. A single 120 MW wind farm located near the town of Cookhouse, Eastern Cape completed the list of projects funded (ibid). The renewable energy bonds showcased Nedbank's leadership in financing South Africa's transition from coal to a low-carbon

economy while reducing CO2 emissions. **Table 4** highlights the four projects funded by Nedbank's Renewable Energy Bond 2.

Table 4 - Projects funded by Nedbank's Renewable Energy Bond 2

	**Zeerust Solar Power Station** **Capacity: 75 MW** **Location: Zeerust, Northwest Province** **Image: courtesy of Zeerust Solar**
	**Matla A Bokone Solar** **Capacity: 75 MW** **Location: Kimberley, Northern Cape Province** **Image: courtesy of Engineering News**

	**Konkoonsies II Solar PV** **Capacity: 75 MW** **Location: Pofadder, Northern Cape Province** **Image: courtesy of bte renewables**
	**Golden Valley Wind Farm** **Capacity: 120 MW** **Location: Cookhouse, Eastern Cape** **Image: courtesy of BioTherm Energy**

4.2.3 The Need for Profit in the Renewable Energy Sector

Using secondary data on private sector funding, this section offers insights into prevailing attitudes toward the profitability of renewable energy projects in South Africa. By reviewing relevant literature and the structures in which green bonds are deployed, the section explores how private sector participants view profit and environmental preservation. The researcher hypothesizes that, despite growing environmental awareness among private sector entities, profit continues to be the primary driver of investment decisions.

Figure 9 illustrates the typical structure for funding renewable energy projects in South Africa, known as "project finance". Of the 64 projects approved in the first three rounds of the REIPPPP, 56 were project-financed (Baker, 2015). Project finance has become a key method for securing long-term, capital-intensive funding for private projects, especially in the rapidly growing energy sector. The process involves the raising of capital for large infrastructure projects by combining contributions from equity investors with loans from debt providers such as banks. As can be seen in **Figure 9** renewable energy projects are usually structured on a 70:30 equity to debt ratio of the total CAPEX for the project. In South Africa, an 80:20 split has occasionally been employed to lower funding costs by increasing the proportion of debt (ibid). In simple terms, renewable energy projects rely heavily on debt financing, often borrowed from major banks like Nedbank and international DFIs. Since this funding is in the form of debt, it must be repaid with interest.

To raise the necessary capital for providing debt financing, financial institutions can issue green bonds. Green bonds attract investments from a wide variety of private sector constituents, both local and international (Nedbank Group, 2019). Green bonds are one of many instruments used by debt providers to raise capital with their proceeds being exclusively allocated to green initiatives. Although the climate change agenda has prompted many private sector organizations to align their brands with sustainable practices, it would be inaccurate to consider green bonds as instruments based solely on environmentalism. From the structure in which green bonds are utilised, it is evident that issuers must balance the goals of environmental preservation with the pursuit of sustainable financial returns. A bank representative interviewed by Baker (2015, 150) expressed the bank's perspective on funding renewable energy projects as follows:

"*Firstly, the project has to make financial sense and generate a required rate of return. Our main concern as lender is to have our debt repaid. Secondly, we look at the personal merits of the client, their capacity, expertise, people skills, equity and likelihood of them appealing to the stakeholders*".

This strongly indicates that private institutions involved in renewable energy projects prioritize financial gains over environmental goals, with issuers and investors in green bonds focusing on achieving reasonable financial returns as the primary consideration.

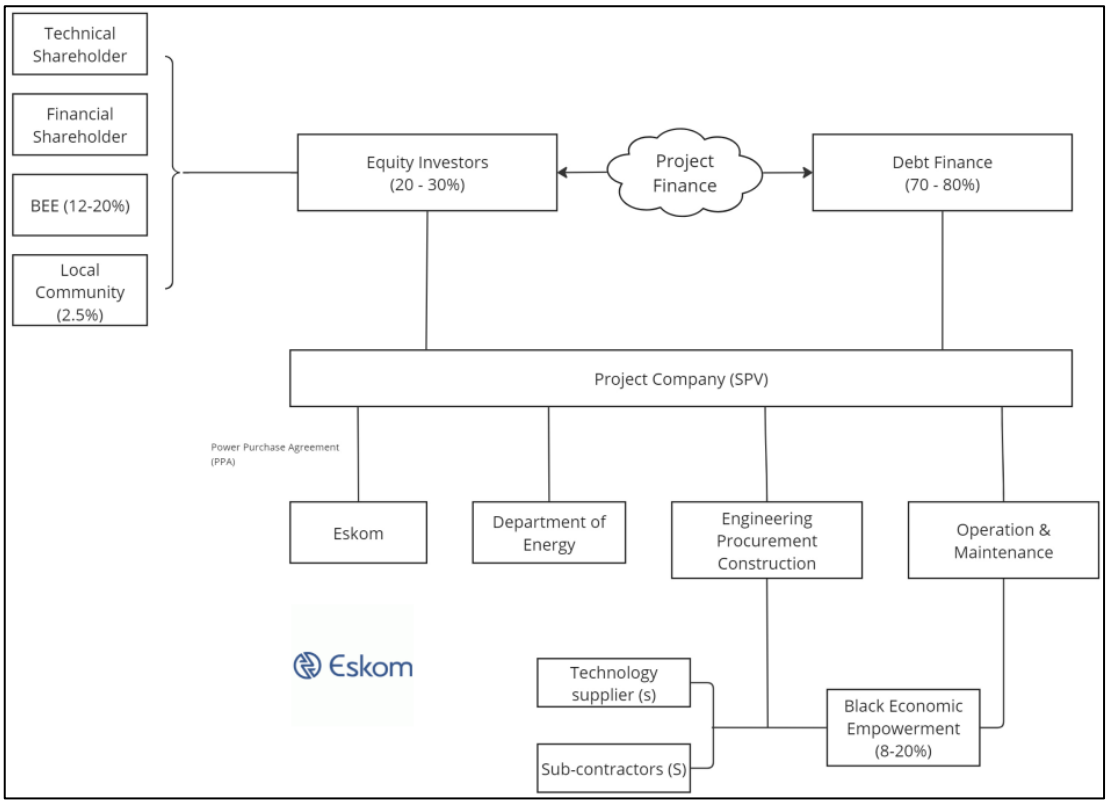


Figure 9 - Project finance structure under REIPPPP (adapted from Baker, 2015)

4.2.4 Currency Risk and South Africa's Green Bond Market

Understanding currency risk is essential for assessing the effectiveness of green bonds in attracting private sector investment in renewable energy projects. This is especially true for foreign investors considering investments in green bonds issued locally and traded in the South African Rand (ZAR). According to the Climate Bonds Initiative (2021), emerging market countries have predominantly issued their green bonds in foreign currencies to access international capital. As illustrated in **Figure 10**, South Africa has been an exception to this trend, with the majority of its green bond issuances denominated in ZAR (ibid). This is significant because many global funds are unable to invest in rand-denominated instruments. However, the emphasis on sustainability can sometimes outweigh the risks associated with local currency (Nedbank Group, 2019). This was evident in Nedbank's Renewable Energy bond where global funds requested a dollar-denominated option (Sustainable Finance Initiative, 2019). Nevertheless, some investors were willing to overlook the currency risk due to the sustainability aspect of the investment (ibid). Mitigating the volatility of the South African Rand, caused by both domestic and international disturbances, may be necessary to attract more international investors to the local market.

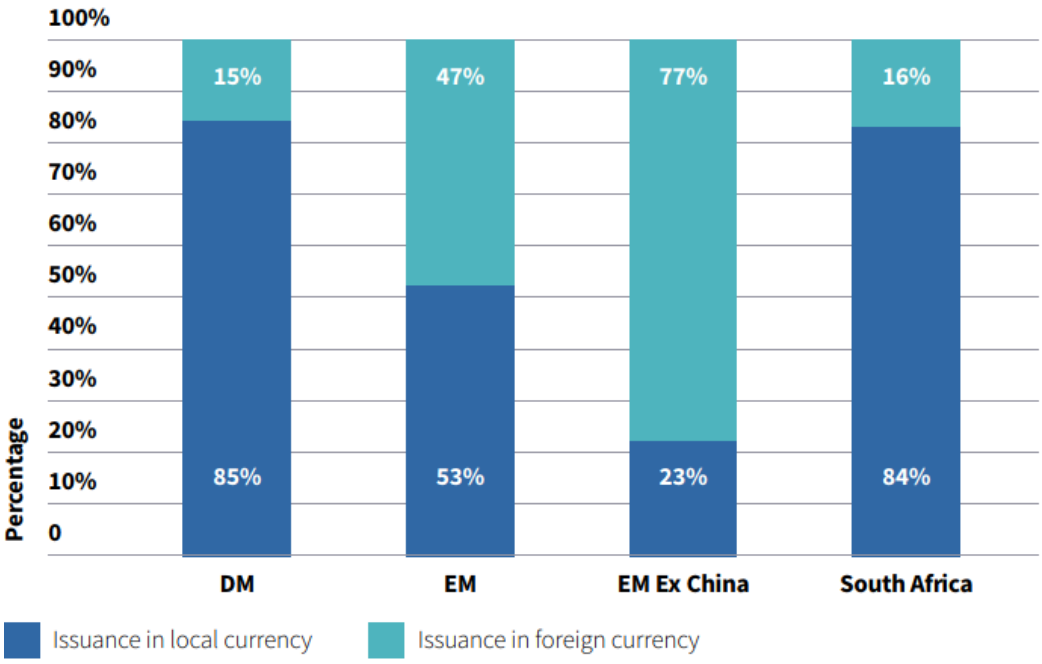


Figure 10 - Local and Foreign Currency Issuance in Emerging and Developed Markets (Climate bonds Initiative, 2021)

4.2.5 Understanding Green Bonds and Their intended Purpose: Insights from Industry Experts

According to PVT-1, green bonds are commonly known as "use of proceeds" bonds. This type of bond requires issuers to specify that the capital raised will be directed toward green projects, such as renewable energy initiatives or water conservation efforts. The issuer must provide proof that the funds are utilized as intended, ensuring transparency and accountability. PVT-1 further categorized green bonds alongside social, sustainability, and transition bonds, all of which are also considered use-of-proceeds bonds. In contrast, sustainability-linked bonds offer more flexibility; issuers can use the capital for any purpose but must meet specific key performance indicators (KPIs) to benefit from favorable pricing terms. For instance, a sustainability-linked bond might involve a commitment to build a set number of green buildings, with the bond's coupon rate adjusting based on whether the issuer meets this target. PVT-1 noted that green bonds are particularly popular within the sustainability segment, partly due to the assurances provided by financial institutions like Nedbank.

PVT-2, on the other hand, emphasized the regulatory framework governing green bonds. They explained that the qualification of a bond as green involves self-labeling by the issuer, which could be a utility company, bank, or other entities. This self-labeling process must adhere to guidelines set out by the GBP from the ICMA. These principles outline

what qualifies as a green bond, the types of projects eligible for financing, and the necessary disclosure and compliance requirements. PVT-2 distinguished between two primary objectives of green bonds, climate change mitigation and adaptation. Mitigation refers to projects aimed at reducing the impact of climate change, such as the deployment of electric vehicles and solar panels. Adaptation focuses on addressing the existing impacts of climate change, including measures like wildfire and flood defense, and reinforcing infrastructure to withstand extreme weather conditions.

4.2.6 Examining Nedbank's 2019 Renewable Energy Bonds: Familiarity and Distinction from Traditional Infrastructure Bonds

PVT-1 acknowledged their familiarity with Nedbank's 2019 renewable energy bonds after conducting some research, despite not having been directly involved in the issuance process at the time. They noted that the fundamental processes for issuing green bonds have largely remained consistent since 2019. Additionally, PVT-1 highlighted that Nedbank has continued to engage in the green bond market, with new issuances occurring either late last year or early this year. PVT-1 also mentioned the possibility of some bonds being unlisted, which underscores the evolving nature of green bond issuance in the market.

PVT-2 shared a more detailed perspective revealing their involvement through the Green Bond Data Team, which screens and certifies green bonds at the CBI. They affirmed awareness of Nedbank's 2019 bonds due to their team's role in assessing and certifying the issuance of the bonds. PVT-2's role involved verifying that the bonds adhered to specific screening criteria and ensuring that the projects financed were aligned with these criteria. They explained that the bonds in question were used to finance solar and wind projects, and their certification provided an assurance to the market regarding the bonds' adherence to Climate Bonds standards.

In distinguishing Nedbank's renewable energy bonds from traditional infrastructure bonds, both professionals noted key differences. PVT-1 emphasized that green bonds are earmarked specifically for green or climate-related activities, in contrast to traditional infrastructure bonds, which can fund a wide array of projects such as bridges and roads. Furthermore, green bonds must comply with the ICMA principles, setting a stringent framework for their use. In contrast, traditional infrastructure bonds do not necessarily follow such specific standards.

PVT-2 supported this view by illustrating that while traditional “vanilla” bonds can be used for a variety of purposes, including general corporate spending, green bonds are required to finance projects that have environmental benefits. They highlighted that even companies traditionally associated with non-green sectors, such as oil companies, can issue green bonds as long as the funds are directed towards environmentally friendly projects, like installing solar panels.

4.2.7 Innovative Features of Nedbank’s Renewable Energy Bonds and Market Differentiators

According to PVT-1, Nedbank’s Renewable Energy Bonds were “trailblazers” in the South African market. Specifically, they informed us that Nedbank’s green bonds were the first of its kind to be listed on the JSE for renewable energy, marking a significant milestone in the country’s green finance landscape. Although other green bonds had been issued prior to this, none had specifically focused on renewable energy, positioning Nedbank as the first bank to take this bold step. This pioneering move helped to differentiate the bond from other financial instruments at the time and set a precedent for future renewable energy-focused bonds.

PVT-2 took a slightly different approach, stating that while the projects financed by the bond, solar and wind, are quite common in the global green bond market, the CBI certification added a unique aspect to Nedbank’s green bond. According to PVT-2, only about 5% of green bonds globally receive CBI certification, making this an exclusive and differentiating factor. The certification serves as a "stamp of approval" that verifies the bond’s alignment with stringent environmental standards, thus adding an extra layer of credibility and trust for investors. While the certification process is not mandatory, PVT-2 noted that the issuer has the option to pursue it, and doing so can enhance the bond’s market appeal and possibly affect its pricing.

However, PVT-2 also mentioned that the issuance of green bonds typically incurs higher transaction costs. These include the need for specialized consultants to draft the green bond framework, second-party verifiers to confirm the legitimacy of the framework, and potentially higher fees from underwriters. Despite these additional costs, many issuers are motivated by the reputational and ESG benefits, with PVT-2 noting that "*a lot of issuers issue green bonds for reputation, for ESG purposes*."

4.2.8 The Role of Nedbank's Renewable Energy Bonds in Encouraging Private Sector Participation in Renewable Energy Development

According to PVT-1, Nedbank played a crucial role in promoting private sector participation in renewable energy through its green bond. As one of the first South African banks to issue renewable energy bonds, Nedbank was able to set a precedent that encouraged other financial institutions to join the market. This leadership contributed significantly to the private sector's growing involvement in renewable energy financing, with PVT-1 noting that "a lot of the banks subsequently issued green bonds following Nedbank's lead." As a result, banks have become the largest issuers of green bonds, driving much of the growth in this financial segment. Although real estate developers, particularly through REITs, have become key participants in the green bond market, banks remain the dominant players in issuing these bonds. Moreover, PVT-1 highlighted that despite economic challenges such as high interest rates and a general slowdown in sustainability-linked asset classes, green bonds have continued to show healthy growth.

In addition to Nedbank's role, PVT-1 pointed to South Africa's ongoing energy challenges, particularly the country's struggle with load-shedding, as a key factor contributing to the popularity of renewable energy bonds. According to PVT-1, the energy crisis has driven a surge in renewable energy projects, which, in turn, has led to a rise in the use of financial instruments like green bonds and green loans. They mention that "*From 2018 to 2023, we saw a marked increase in renewable energy loans, coinciding with peak load-shedding issues,".* The challenging energy landscape has, in turn, increased the appeal of renewable energy investments and bolstered private sector participation in the green bond market.

4.2.9 Investor Willingness to Accept Lower Returns for Environmental Benefits

The extent to which investors are willing to accept lower returns for environmental benefits is currently somewhat limited. According to PVT-1, "*trustees and pension fund holders are looking for returns and assessing a portfolio's performance; they are not focused on solving energy issues."* This suggests that the primary motivation for many investors remains financial performance rather than environmental impact. Nonetheless, PVT-1 noted a potential shift in investor attitudes due to changing demographics. Younger investors, who are more attuned to environmental issues, might be more willing to accept lower returns if the investments align with their values. This shift could be influenced by global trends and pressures, which are increasingly demanding more environmentally sustainable investments.

However, PVT-2 acknowledged that while financial returns are still important, some investors are willing to prioritize environmental benefits. PVT-2 noted that green bonds might offer lower risk due to their financing of energy-efficient and climate-resilient projects, which could reduce operational costs and enhance asset attractiveness. Moreover, PVT-2 emphasized that responsible investors, who are committed to sustainable investment practices, may accept lower returns in exchange for the environmental benefits of green bonds. Additionally, the growing popularity of ESG-labelled bonds, particularly in regions like Europe, reflects a broader trend where investors are increasingly required to allocate a portion of their portfolios to green investments to meet sustainability commitments.

4.2.10 Impact of Local Currency Risk on International Interest in Nedbank's Renewable Energy Bonds

According to PVT-1, the JSE only permits rand-denominated issuances, which inherently incorporates local currency risk into the bond pricing. Despite this, PVT-1 suggested that local currency risk does not significantly deter international investors. The rationale behind this view is that rand-denominated bonds adequately price in local risks, offering yields that compensate investors for the associated uncertainties. PVT-1 further elaborated that international investors are already accustomed to participating in South African financial markets, particularly in government bond issuances. While international engagement in South African corporate bonds and equities is less common, there is still notable activity. This existing familiarity with the local market conditions and the compensation through higher yields mitigate the potential deterrent effect of currency risk. PVT-1 therefore concluded that the local currency risk associated with the South African rand has limited impact on the level of international interest in local bonds.

4.2.11 Strategies to Boost Private Sector Participation and Green Bond Issuance in South Africa

PVT-1 outlined several strategies to strengthen private sector engagement in green bond issuance. They emphasized the importance of increased training for potential and existing issuers to enhance their understanding of the sustainability finance landscape, beyond just green bonds. This educational initiative aims to make more issuers aware that they can participate and list bonds without being listed themselves, potentially boosting market activity. Additionally, PVT-1 noted that the high costs associated with issuing bonds often deter issuers. To address this issue, they proposed the creation of financial and technical assistance programs to support issuers in the sustainability sector, with the expectation

that such an initiative will be launched in the near future. Government incentives, such as tax breaks for green bond issuers, were also suggested to make issuance more attractive.

PVT-2 contributed insights on the structural and regulatory factors affecting green bond issuance. They highlighted the necessity of having a substantial pool of green assets to support a thriving green bond market. "*If you are issuing green bonds, I think your economy needs to have a pool of green assets. You need to have assets that are eligible for green financing, like electric vehicles, solar panels, waste management systems, and so on. Without a sufficient pool of green assets, there cannot be many green issuances."* They pointed out that banks play a crucial role as facilitators in green financing. Banks can issue green bonds and use the proceeds to fund various green projects, thereby supporting the broader green asset pool.

PVT-2 also expressed confidence in the future growth of the green bond market, attributing it to global commitments to the Paris Agreement and the current trend of interest rate cuts in major economies. They noted that lower financing costs, combined with strong regulatory commitments to limit global temperature increases, are expected to drive higher green bond issuance. They mentioned that "*To reach that goal, or at least come close to it, we need a lot of green financing*."

4.2.12 Key Findings – Sub Question 1

This section has provided a comprehensive overview of the role and impact of Nedbank's Renewable Energy Bonds in fostering private sector engagement in renewable energy development within South Africa. Interviews with PVT-1 and PVT-2 revealed the pioneering role Nedbank played as the first private sector entity in South Africa to issue a Renewable Energy Bond. By obtaining CBI certification, Nedbank significantly distinguished its bond, setting a standard that encouraged other private sector players, particularly banks, to follow suit. Similarly, we identified the alignment of green bonds with global ESG objectives, as well as the critical need for increased green financing to support the goals set by the Paris Agreement, aimed at limiting global temperature rise to 1.5°C.

However, participants highlighted the ongoing need to balance profit with environmental objectives, noting that financial returns remain a primary concern for private sector players, despite existing climate change agendas. We also made aware of persistent challenges, such as the high costs associated with issuing green bonds, which have discouraged broader participation in the market. The research reveals the need for

additional strategies to boost private sector involvement and address barriers to green bond issuance. Key solutions proposed include enhanced training, financial support, and regulatory incentives. Nonetheless, the outlook for green bond issuances remains optimistic, with global climate change commitments, evolving investor attitudes, and recent interest rate cuts, all contributing to positive momentum in the market

The next section will build on these findings by evaluating the carbon reduction outcomes of green bond-funded projects, with a focus on the alignment of these outcomes with the GBP and their effectiveness in meeting South Africa's carbon reduction objectives.

4.3 Assessing the Carbon Reduction Outcomes of Green Bond-Funded projects

According to KPMG (undated), evaluating the impact of projects funded through green bond proceeds continues to be a significant challenge in the market. One of these challenges is evaluating the carbon reduction implications of such projects. The GBP Impact Reporting Working Group, under ICMA, has created guidelines with suggested metrics to report the environmental impact of green bond-funded projects, based on the project type (ibid). The taxonomy for eligible projects according to the CBI has been provided in **Appendix 3**. It is expected that investors will increasingly demand higher-quality assessments and disclosures of environmental performance in the coming years (KPMG, undated). Unlike regular bonds, green bonds must publish environmental impact reports and other disclosures, including KPIs and the methodologies used for calculating carbon dioxide emissions, providing investors with increased overall transparency. A comparison of the issuance process for regular and green bonds is provided in **Appendix 4**. This section will make use of published environmental performance data from Nedbank's renewable energy bonds to evaluate the carbon reduction outcomes of green bond-funded projects. The purpose of this assessment is threefold: first, to evaluate the general availability of disclosures, thereby confirming claims of increased transparency; second, to use the disclosed information to evaluate the congruency of the disclosed information with the requirements of the GBP; to assess the carbon reduction outcomes an increase in green bond funding could have on South Africa's low-carbon energy transition.

4.3.1 Data Overview

This section of the report addresses sub-question 2 of the study, with the corresponding data presented in **Table 5**. The assessment relied exclusively on secondary data sources, utilizing a comprehensive methodology to analyse the carbon reduction outcomes of green bond-funded projects. The research sub-question was broken down into three focused sub-analysis topics, as previously discussed, to enable a thorough response to the main sub-question. The secondary data sources employed for this analysis are provided in **Table 5**.

Table 5 - Data overview for sub-question 2

Sub-question 2: What are the implications in relation to carbon reduction that emerged from Nedbank's renewable energy bonds that ring-fenced the use of proceeds to fund projects that can demonstrate a reduction in carbon emissions?			
Data	**Sub-analysis 1**	**Sub-analysis 2**	**Sub-analysis 3**
Focused analyses to address research sub-question	Evaluating the availability of environmental performance disclosures and verifying the claim of increased transparency.	Assessing the congruency of disclosed information with the requirements of the Green Bond Principles (GBP).	Analysing the carbon reduction outcomes associated with green bond-funded projects and their ability to influence South Africa's low-carbon energy transition.
Secondary data sources	▪ Google, Reputable search engine. ▪ Nedbank Limited, Annual Green Bond Impact Report (2020 – 2023). ▪ The Green Bond Principles. Handbook, Harmonised Framework for Impact Reporting, June 2024. ▪ World Bank. Green Bonds, Working Towards a Harmonized Framework for Impact Reporting, November 2015. ▪ European Commission, Innovation Fund Annex C: Methodology for calculation of GHG emission avoidance. ▪ International Journal of Sustainable Development and Planning. Empirical Analysis of "GHG Emission Avoidance" Calculation for Selection of Sustainable Environmental Projects. ▪ Eskom, Historic Electricity Generation per Plant, 2023.		
Overview on data analysis process	By answering sub-analysis 1 to sub-analysis 3, the main research sub-question will be answered.		

4.3.2 Calculating Avoided Carbon Emissions

This section details a methodology for determining the GHG emissions avoided from green projects. The methodology was established through a comprehensive literature review of available approaches, resulting in the selection of two documents deemed most relevant and applicable to the study. These documents are:

1. European Commission, Innovation Fund Annex C: Methodology for calculation of GHG emission avoidance
2. Empirical Analysis of "GHG Emission Avoidance" Calculation for Selection of Sustainable Environmental Projects. International Journal of Sustainable Development and Planning.

Although the GBP offer voluntary guidance for green bond issuers and outline requirements for impact reporting, they do not provide a specific methodology for calculating avoided GHG emissions. The following is stated in the Green Bond Principles (2024,9) Harmonised Framework for Impact Reporting handbook:

"For the calculation of indicators, where there is no single commonly used standard, issuers may follow their own methodologies while making these available to investors. For the calculation of greenhouse gas (GHG) emissions reduced/avoided, for instance, there are a number of calculation methodologies both within and across the institutions. While there are on-going efforts to harmonise GHG accounting methodologies for relevant sectors among a broad group of IFIs, given the current differences in calculation approaches, reporting GHG data based on a uniform, consistent and published methodology remains a challenge"

The following two equations have been sourced from the referenced documents.:

1. $\boldsymbol{GHG\ emmission\ avoidance} = Ref_y - Proj_y$

Where:

Ref_y = GHG emissions in year y in the absence of project, in tCO_2e

$Proj_y$ = GHG emissions related to the project activity and site for the year y, in tCO_2e

2. **Absolute GHG emission avoidance**, determined by estimating the annual emissions avoided from the beginning of operations over a 10-year period, as calculated using the following equation:

$$\Delta\, GHG_{abs} = \sum_{y=1}^{10} \left(Ref_y - Proj_y\right)$$

Where:

ΔGHG_{abs} = Total GHG emissions prevented by the project's operation over its first ten years, in tCO_2e.

According to the European Commission (2021), the GHG that must be taken into consideration include nitrous oxide (N2O), methane (CH4), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and Carbon Dioxide (CO_2) which is considered the most prominent GHG contributing to climate change.

4.3.3 Nedbank Renewable Energy Bonds – Environmental Impact Reporting

The GBP require issuers such as Nedbank to disclose a list of projects funded by green bond proceeds. This includes a summary of each project, the allocated funds, and the anticipated environmental benefits on an annual basis. The Green Bond Principles (2024, 8) Harmonised Framework for Impact Reporting outlines the following requirements for issuers reporting at either the individual project or portfolio level:

"Depending on the process put in place for the allocation of proceeds, it is recommended that issuers either provide a list of projects to which green bond proceeds have been allocated, or report solely on a portfolio level"

Where confidentiality constraints limit the amount of detail that can be disclosed, green bond issuers are required to report at the portfolio level. **Appendix 5** provides an illustrative summary template for project-level reporting, while **Appendix 6** offers an illustrative template for portfolio-level reporting.

Environmental impact reporting is a crucial step in assessing the carbon emissions avoided by green bond-funded projects. To ensure that this process is properly executed and that the requirements set forth by the GBP are adhered to in practice and not just in theory, this research examines whether Nedbank has provided the necessary environmental disclosures as mandated by the GBP. The initial step involved evaluating the ease of accessing environmental disclosures as required by the GBP for Nedbank's

Renewable Energy Bonds. It is important to note that the researcher was already familiar with Nedbank's Annual Green Bond Impact Reports from previous research conducted on this case study. In this context, the researcher assumed the role of an interested stakeholder or investor in Nedbank's Renewable Energy Bonds, seeking to find environmental disclosures related to the issuance. From the perspective of an interested stakeholder, including members of the public, the following three steps were assumed to be the initial course of action to obtain relevant information on the green bond issuance:

1. Open a reputable and recognised search engine (Google Chrome was used for this study).
2. Search for "Nedbank Renewable Energy Bonds."
3. Review the search results for links to Nedbank's environmental disclosures.

Figure 11 displays the first page of the Google search results. In this figure, we can identify that the fifth and sixth search results are titled "Annual Green Bond Impact Report" and "Nedbank Ltd Green Bond Impact Report 2021," respectively. Clicking on these search results leads to Nedbank's Annual Green Bond Impact Reports for 2021 and 2023. These reports contain the stipulated green bond disclosures as set forth by the Harmonised Framework for Impact Reporting and discussed in section 4.3.4.

The search results also verify the claim of increased transparency, as the required reporting for the renewable energy bonds can be found with minimal difficulty and is easily accessible to the public. An alternative approach involved navigating the Nedbank website directly to locate the reports. This method proved significantly more challenging, as the researcher was unable to locate the Green Bond Annual Impact Reports using this approach.

Nedbank Renewable Energy Bonds

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Figure 11 - Nedbank Renewable Energy Bonds Google Search Results, Page 1 & 2

4.3.4 Nedbank – Annual Green Bond Impact Reports (2020-2023)

This section provides a summary of the Annual Green Bond Impact Reports related to Nedbank's Renewable Energy Bonds. Specifically, it evaluates the disclosed carbon emissions data, assesses its congruence with the stipulated reporting requirements, and uses this analysis to observe the efficacy of green bonds in facilitating a reduction in carbon emissions. The researcher located Nedbank's Annual Green Bond Impact Reports for the years 2020 and 2022 by entering the phrase "Nedbank Annual Green Bond Impact Report 202X," where "X" represents the specific year, into a recognised search engine. Google Chrome was used for the purpose of this study.

Figure 12 through **14** present summaries of the green bond impact reports for the years 2020 to 2023 respectively. Nedbank has disclosed their green bond information at the project level rather than at the portfolio level, providing detailed information for each of the four projects in their reports. The Following disclosures have been provided for each year:

1. Green Bond Issuer, in this case Nedbank Limited.
2. Value of green bond proceeds allocated to finance renewable energy projects.
3. Green Bond Rating, Moody's. Disclosed for 2022 and 2023 only.
4. Impact Metric:
    - Electricity generation per R1mn note holding.
    - CO_2 emissions avoided per R1mn note holding.
5. Project name and details:
    - Matla A Bokone Solar, formerly known as Droogfontein 2 Solar
    - Konkoonsies II
    - Zeerust
    - Golden Valley
6. Original scheduled commercial operation date (COD).
7. Commercial operation date achieved.
8. Total note proceeds allocated per project.
9. Actual electricity generation per R1mn note holding.
10. Actual CO_2 emissions avoided per R1mn note holding.

Nedbank Annual Green Bond Impact Report (2020)

The notional value of the note proceeds have been used to finance eligible renewable energy projects – Sustainable Development Goal 7			
Renewable Energy	**Total**	**Wind**	**Solar**
Renewable Energy Green Bond Issuance Proceeds (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)
Financing to Eligible Green Projects (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)
Unallocated Proceeds in Permitted Assets (ZAR)	-	-	-

	Droogfontein 2 Solar (RF) Proprietary Limited ("Droogfontein")	Ramizone (RF) (Pty) Ltd ("Konkoonsies II")	RE Capital 2 (RF) Proprietary Limited ("Zeerust")	Amstilite (RF) (Pty) Ltd ("Golden Valley")
Project	75 MW Solar plant facility located to the north of the town of Kimberley in the Northern Cape	75 MW Solar PV Facility, located in the town of Pofadder in the Northern Cape	75 MW Solar PV facility near Zeerust in the Northern West, South Africa	120 MW wind farm located near the town of Cookhouse in the Eastern Cape
Original Scheduled Commercial Operations Date (COD)	March 2020	March 2020	June 2020	November 2020
COD Achieved or to be Achieved	March 2020	June 2020[1]	December 2020[2]	February 2021[2]
Total note proceeds allocated per project	R666 527 455	R468 668 907	R572 065 444	R954 738 194
Actual electricity generation per R1mn note holding	**70.80 MWh**	**11.60 MWh**	**Under construction**	**Under construction**
Actual CO2 emissions avoided per R1mn note holding	**67.26 tons**	**11.02 tons**	**Under construction**	**Under construction**

Nedbank Annual Green Bond Impact Report Summary (2021)

The notional value of the note proceeds have been used to finance eligible renewable energy projects – Sustainable Development Goal 7			
Renewable Energy	**Total**	**Wind**	**Solar**
Renewable Energy Green Bond Proceeds (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)
Financing to Eligible Green Projects (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)
Unallocated Proceeds in Permitted Assets (ZAR)	-	-	-

	Droogfontein 2 Solar (RF) Proprietary Limited ("Droogfontein")	Ramizone (RF) (Pty) Ltd ("Konkoonsies II")	RE Capital 2 (RF) Proprietary Limited ("Zeerust")	Amstilite (RF) (Pty) Ltd ("Golden Valley")
Project	75 MW Solar plant facility located to the north of the town of Kimberley in the Northern Cape	75 MW Solar PV Facility, located in the town of Pofadder in the Northern Cape	75 MW Solar PV facility near Zeerust in the Northern West, South Africa	120 MW wind farm located near the town of Cookhouse in the Eastern Cape
Original Scheduled Commercial Operations Date (COD)	March 2020	March 2020	June 2020	November 2020
COD Achieved	March 2020	June 2020	1 January 2021	30 April 2021
Total note proceeds allocated per project	R666 527 455	R468 668 907	R572 065 444	R954 738 194
Actual electricity generation per R1mn note holding	**53.90 MWh**	**34.55 MWh**	**61.07 MWh**	**COD achieved, awaiting LTA report**
Actual CO2 emissions avoided per R1mn note holding	**51.206 tons**	**32.83 tons**	**58.02 tons**	**COD achieved, awaiting LTA report**

Figure 12 - Nedbank Annual Green Bond Impact Report, 2020 & 2021 (Nedbank Limited, 2020) (Nedbank Limited, 2021)

DMTN Programme Details		
Issuer	Nedbank Limited (NBL)	Nedbank Group Limited (NGL)
Ratings	Moody's: National Scale Long Term: Aa1.za Standard & Poor's: National Scale Long Term: zaAA	N/A
DMTN	R75bn JSE-Listed DMTN Programme	R40bn JSE-Listed DMTN Programme
Listing	Sustainability Segment of the JSE	Sustainability Segment of the JSE

Issuer	Bond Code	Issue Date	Maturity / Call Date	Green Bond Issued	Amount applied	Status	Impact Metric	
Renewable Energy Bond (Senior Unsecured)								
							Electricity generation per R1mn note holding	CO2 emissions avoided per R1mn note holding
NBL	NBG01G	30-Apr-19	29-Apr-22	R616 000 000	R616 000 000	Matured	Details Tabled Below	
NBL	NBG02G	30-Apr-19	30-Apr-24	R715 000 000	R715 000 000	Fully applied by end 2020		
NBL	NBG03G	30-Apr-19	30-Apr-26	R331 000 000	R331 000 000	Fully applied by end 2020		
NBL	NBG04G	30-Apr-19	25-Oct-22	R495 000 000	R495 000 000	Matured		
NBL	NBG05G	25-Oct-19	25-Oct-24	R505 000 000	R505 000 000	Fully applied by end 2020		

The notional value of the note proceeds have been used to finance eligible renewable energy projects – Sustainable Development Goal 7			
Renewable Energy	**Total**	**Wind**	**Solar**
Renewable Energy Green Bond Proceeds (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)
Financing to Eligible Green Projects (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)

	Droogfontein 2 Solar (RF) Proprietary Limited ("Droogfontein")	Ramizone (RF) (Pty) Ltd ("Konkoonsies II")	RE Capital 2 (RF) Proprietary Limited ("Zeerust")	Amstilite (RF) (Pty) Ltd ("Golden Valley")
Project	75 MW Solar plant facility located to the north of the town of Kimberley in the Northern Cape	75 MW Solar PV Facility, located in the town of Pofadder in the Northern Cape	75 MW Solar PV facility near Zeerust in the Northern West, South Africa	120 MW wind farm located near the town of Cookhouse in the Eastern Cape
Original Scheduled Commercial Operations Date (COD)	March 2020	March 2020	June 2020	November 2020
COD Achieved	March 2020	June 2020	1 January 2021	30 April 2021
Total note proceeds allocated per project	R666 527 455	R468 668 907	R572 065 444	R954 738 194
Actual electricity generation per R1mn note holding	77.76 MWh	92.45 MWh	74.77 MWh	58.43 MWh
Actual CO2 emissions avoided per R1mn note holding	73.87 tons	87.83 tons	71.03 tons	55.51 tons

Figure 13 - Nedbank Annual Green Bond Impact Report, 2022 (Nedbank Limited, 2022)

DMTN Programme Details		
Issuer	Nedbank Limited (NBL)	Nedbank Group Limited (NGL)
Ratings	Moody's: National Scale Long Term: Aa1.za Standard & Poor's: National Scale Long Term: zaAA	N/A
DMTN	R75bn JSE-Listed DMTN Programme	R40bn JSE-Listed DMTN Programme
Listing	Sustainability Segment of the JSE	Sustainability Segment of the JSE

Issuer	Bond Code	Issue Date	Maturity / Call Date	Green Bond Issued	Amount applied	Status	Impact Metric	
Renewable Energy Bond (Senior Unsecured)								
							Electricity generation per R1mn note holding	CO2 emissions avoided per R1mn note holding
NBL	NBG01G	30-Apr-19	29-Apr-22	R616 000 000	R616 000 000	Matured	Details Tabled Below	
NBL	NBG02G	30-Apr-19	30-Apr-24	R715 000 000	R715 000 000	Fully applied by end 2020		
NBL	NBG03G	30-Apr-19	30-Apr-26	R331 000 000	R331 000 000	Fully applied by end 2020		
NBL	NBG04G	30-Apr-19	25-Oct-22	R495 000 000	R495 000 000	Matured		
NBL	NBG05G	25-Oct-19	25-Oct-24	R505 000 000	R505 000 000	Fully applied by end 2020		

The notional value of the note proceeds have been used to finance eligible renewable energy projects – Sustainable Development Goal 7			
Renewable Energy	**Total**	**Wind**	**Solar**
Renewable Energy Green Bond Proceeds (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)
Financing to Eligible Green Projects (ZAR)	**2 662 000 000**	954 738 194 (36%)	1 707 261 806 (64%)

	Droogfontein 2 Solar (RF) Proprietary Limited ("Droogfontein")*	Ramizone (RF) (Pty) Ltd ("Konkoonsies II")	RE Capital 2 (RF) Proprietary Limited ("Zeerust")#	Amstilite (RF) (Pty) Ltd ("Golden Valley")
Project	75 MW Solar plant facility located to the north of the town of Kimberley in the Northern Cape	75 MW Solar PV Facility, located in the town of Pofadder in the Northern Cape	75 MW Solar PV facility near Zeerust in the Northern West, South Africa	120 MW wind farm located near the town of Cookhouse in the Eastern Cape
Original Scheduled Commercial Operations Date (COD)	March 2020	March 2020	June 2020	November 2020
COD Achieved	March 2020	June 2020	1 January 2021	30 April 2021
Total note proceeds allocated per project	R666 527 455	R468 668 907	R572 065 444	R954 738 194
Actual electricity generation per R1mn note holding	53,85 MWh	134,14 MWh	75,75 MWh	147,37MWh
Actual CO2 emissions avoided per R1mn note holding	51,15 tons	127,43 tons	71,96 tons	140,00 tons

Figure 14 - Nedbank Annual Green Bond Impact Report, 2023 (Nedbank Limited, 2023)

With reference to section 4.3.2, Nedbank has disclosed the following method used for the calculation of avoided carbon emissions:

$$Avoided\ CO_2\ \ savings\ (tons\ CO_2) = Annual\ Electricity\ Generation\ [MWh] x\ 0.95$$

$Where$:

$0.95 = Eskom\ emmission\ factor\ in\ tons\ per\ MWh$

Reviewing Nedbank's Annual Green Bond Impact Reports in the context of the required disclosures stipulated by the Harmonised Framework for Impact Reporting and the summary template illustrated in **Appendix 5,** it can be concluded that the level and quality of disclosure are consistent with the requirements of the GBP. The data on avoided carbon emissions can be reliably utilized to assess the carbon reduction outcomes of green bond-funded projects. **Table 6** summarizes the total CO_2 emissions avoided, measured in tons, for each project from 2020 to 2023. The electricity generated by each project fluctuates yearly based on the availability of solar and wind resources. Consequently, the total CO_2 emissions avoided also varies from year to year. The average annual CO_2 emissions avoided from the project's inception to December 2023 has also been indicated on the table.

Note: The tabulated values are based on the total green bond contribution for each project, converted from the values reported per R1 million note holding in **Figures 12** to **14**.

Table 6 - Summary of Actual CO_2 emissions avoided per annum (tons)

	Actual CO_2 emissions avoided (tons)				
Project	**2020**	**2021**	**2022**	**2023**	**Average**
Matla A Bokone Solar	44831	34130	49236	34093	40573
Konkoonsies II	5165	15386	41163	59722	30359
Zeerust		33191	40634	41166	38330
Golden Valley			52998	133663	93330

Figure 15 below presents a bar chart derived from the data in **Table 6** illustrating the avoided carbon emissions for each project from 2020 to 2023. Plotting data in a chart form is significant as it allows for the observation of relationships between different variables. The bar diagram in **Figure 15** demonstrates a general yearly increase in avoided carbon emissions across three projects, except for the Matla A Bokone Solar project, which deviates from this trend in 2023. This observation is significant as it indicates that the annual fluctuations in solar and wind resource availability do not negatively impact the overall carbon emissions avoided by renewable energy projects, including those funded by green bonds in South Africa. The researcher acknowledges that the phased commissioning of projects could potentially influence the observed data. This was however not mentioned in the Nedbank reports and was therefore not considered a key factor for evaluation.

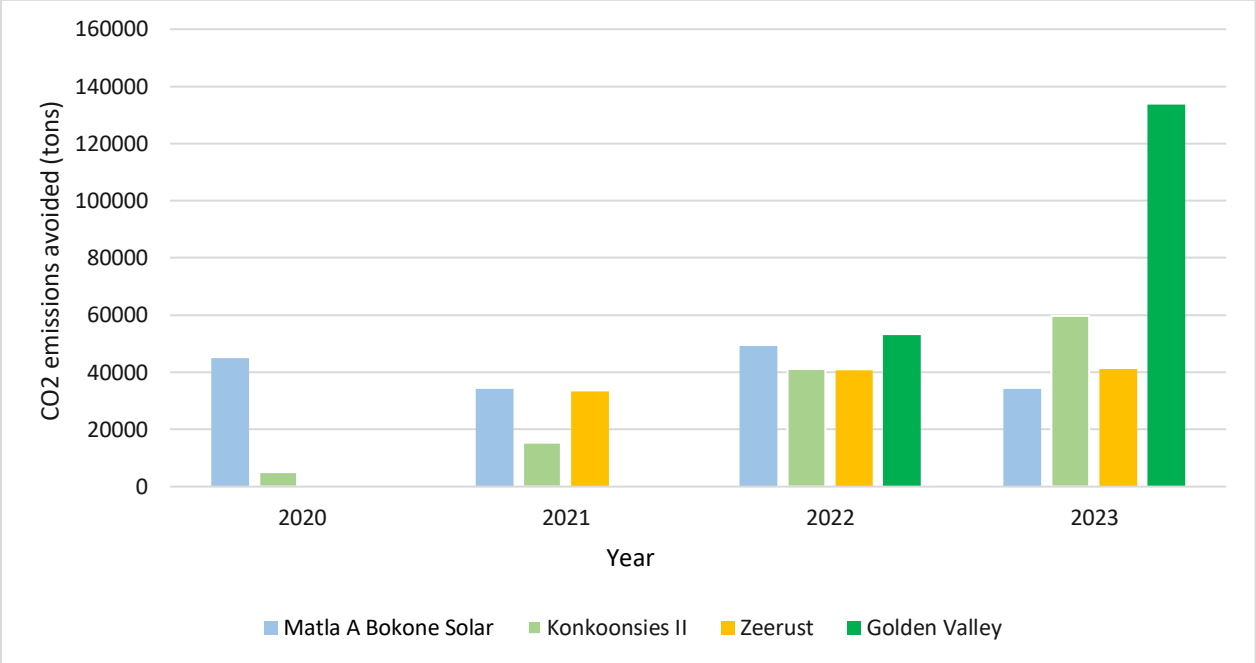


Figure 15 - CO_2 emissions avoided by project (2020-2023)

4.3.5 Significance of Avoided Carbon Emissions in South Africa's Carbon Reduction Strategy

Reducing carbon emissions from the energy sector is crucial for South Africa's strategy to transition to a low-carbon future. The Climate Bonds Initiative (2021, 11) mentions that "the electricity sector is where the largest amount of emissions can be mitigated at the least cost". Similarly, electricity generation has historically accounted for about 42% of all GHG emissions further highlighting the need to diversify the countries energy mix (Eskom, undated). This section will leverage the data on CO_2 emissions avoided, as detailed in **Figure 14**, to assess how green bond-funded projects can contribute to reducing South Africa's CO_2 emissions.

The following steps were taken:

1. Used **Appendix 7**, which provides historical electricity generation data for each of Eskom's power plants, to identify the plant with the highest electricity generation (MWh/year) in 2023 (the most recent year).

   Plant name – Matimba Power Station
   Electricity generation – 23 257 630 MWh/year

2. Applied Eskom's emission factor of 0.95 to calculate the annual CO_2 emissions generated by the identified plant in 2023.

   Annual CO_2 emissions generated – 22 094 750 tons

3. Referenced Nedbank's Annual Green Bond Impact Report to identify the project with the highest actual CO_2 emissions avoided per R1 million note holding in 2023.

   Project – Golden Valley Wind Farm
   Actual CO_2 emissions avoided per R1mn note holding – 140 tons

4. Used the value of actual CO_2 emissions avoided per R1 million note holding to estimate the amount of CO_2 that could be avoided if green bond funding were increased to a desired level.

Table *7* illustrates the relationship between various levels of green bond funding, ranging from R50 million to R650 billion, and the corresponding CO_2 emissions that would be avoided.

Table 7 - CO_2 avoided at different levels of green bond funding in tons/annum

Green bond investment (R 1Bn)	CO_2 avoided tons/annum
0,05	7000
0,1	14000
0,25	35000
0,5	70000
0,75	105000
1	140000
5	700000
25	3500000
50	7000000
75	10500000
100	14000000
125	17500000
130	18200000
260	36400000
390	54600000
520	72800000
650	91000000

To accurately assess the funding implications, it's essential to contextualize the funding amounts within South Africa's climate finance needs. According to the Presidential Climate Commission's 2023 report on the South African Climate Finance Landscape and **Appendix 2**, the country's climate finance must increase by three to five times the current annual average of R131 billion (PCC, 2023). Therefore, the CO_2 emissions that would be avoided at R130 billion, as well as at 2, 3, 4, and 5 times this amount, have been calculated and are presented in **Table 7**. For this study, it is assumed that all financing will be directed exclusively toward renewable energy projects. However, the current climate finance of R130 billion is actually allocated across a broader spectrum of sustainability-driven initiatives.

5. The data in **Table *7*** was presented in a chart to clearly illustrate the relationship between the two variables, enabling insightful analysis. The total CO_2 emissions calculated in step 2 were also indicated on the chart for comparison, see **Figure 16**.

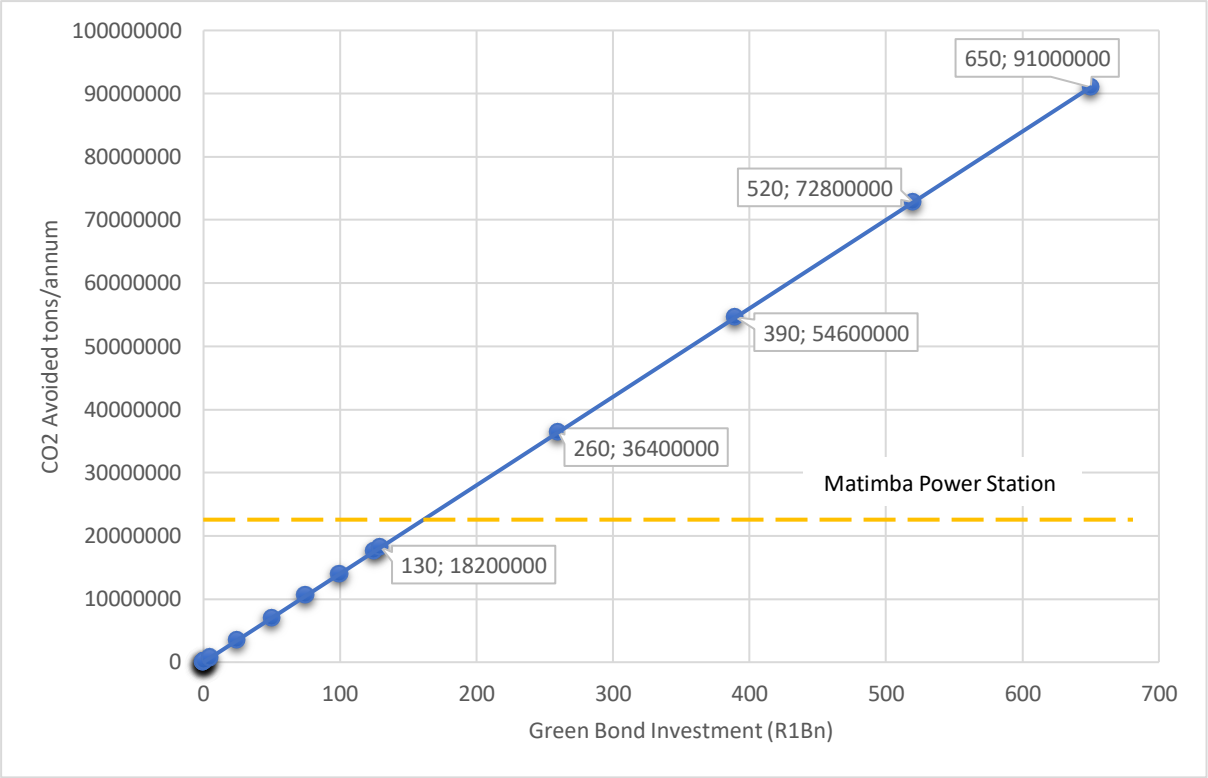


Figure 16 - Chart of CO_2 avoided at different levels of green bond-funding in tons/annum

The following observations can be made from the chart:

1. There is a directly proportional relationship between the amount of green bond funding provided each year and the CO_2 emissions avoided. In other words, an increase in green bond funding leads to a corresponding increase in avoided carbon emissions.

2. The current climate finance of R131 billion does not result in sufficient CO_2 emissions avoided to offset the total carbon emissions produced by the largest electricity-generating power plant in 2023. Indicating deficiency of climate funding at this level.

3. Approximately R160 billion worth of climate finance would be required for a renewable energy project with the same efficiency level as Golden Valley Wind Farm to offset the Matimba power plant in 2023.

4. With funding two to five times the current amount allocated to renewable energy, several projects could offset multiple power plants. Given this funding is needed

annually, South Africa could realistically decommission its power plants, transition to renewable energy, and significantly reduce its current carbon footprint by 2050.

5. The above observation assumes that not all climate finance would be directed towards renewable energy projects, underscoring that achieving the desired reduction in carbon emissions would take much longer. This is a realistic expectation given the current distribution of climate financing.

In summary, current climate finance is insufficient to offset major power plant emissions, highlighting the need for increased overall funding. For example, increasing green bond funding or other forms of climate finance two to five times the current level could enable South Africa to transition to renewable energy and significantly reduce its carbon footprint by 2050.

4.3.6 Key Findings – Sub Question 2

The evaluation of Nedbank's renewable energy bonds confirms compliance with the disclosure requirements outlined by the Harmonised Framework for Impact Reporting. The green bond disclosures are readily accessible to the public, supporting the claim of increased transparency. Navigating directly through Nedbank's website to find the Green Bond Annual Impact Reports however proved to be more challenging.

In terms of the quality of disclosures, Nedbank's Annual Green Bond Impact Reports meet the standards set by the GBP. The provided data on avoided carbon emissions is reliable and can be used to assess the carbon reduction outcomes of green bond-funded projects in South Africa.

Despite this, the findings indicate that current levels of climate finance, including green bond funding, are insufficient to significantly offset emissions from major power plants. To facilitate South Africa's transition to renewable energy and achieve substantial carbon reductions by 2050, green bond funding and other forms of climate finance must increase by at least two to five times the current levels.

4.4 Summary of Key Findings and Conclusion.

This chapter addressed sub-questions 1 and 2, exploring the role of Nedbank's Renewable Energy Bonds in promoting private sector participation in South Africa's renewable energy sector and assessing the effectiveness of green bond-funded projects in reducing carbon emissions.

For sub-question 1, the findings highlighted Nedbank's pioneering role as the first private sector entity to issue a Renewable Energy Bond in South Africa, significantly influencing the broader market by setting a high standard and differentiating itself by obtaining certification with the CBI. This inspired other private sector players, especially local banks, to invest in renewable energy development, with South Africa's energy crisis further driving investor interest in the local renewable energy sector. We also observed that while investor attitudes often prioritize financial returns over environmental concerns, there is a growing trend of investors increasingly seeking opportunities in sustainable initiatives. High issuance costs and other barriers were also identified as factors limiting broader participation. Despite these challenges, optimism about green bond issuances remains strong in both local and global markets.

For sub-question 2, the evaluation of Nedbank's green bonds confirmed compliance with the Harmonised Framework for Impact Reporting, supporting claims of transparency. The quality of disclosures aligns with the GBP, providing reliable data on carbon emission reductions. However, current levels of climate finance, including green bond funding, were found to be insufficient for achieving significant carbon reductions, particularly in offsetting emissions from major power plants. The findings suggest that to meet South Africa's 2050 carbon reduction targets, climate finance, including green bond funding, must increase substantially.

This chapter demonstrates that while Nedbank's Renewable Energy Bonds have played a critical role in fostering private sector participation in South Africa's renewable energy landscape, significant barriers remain, particularly in terms of balancing financial returns with environmental objectives and overcoming the high costs of bond issuance. While the positive outlook for green bonds is encouraging, substantial increases in climate finance are necessary to meet the country's carbon reduction goals.

5 LOCAL COMMUNITY OUTCOMES AND STAKEHOLDER PERCEPTIONS OF GREEN BONDS AS A FUNDING MECHANISM FOR RENEWABLE ENERGY DEVELOPMENT

5.1 Introduction

This chapter addresses sub-questions 3 and 4 of the study. It begins with Section 5.2, which examines the impact of green bond-funded projects on local communities and their outcomes. The primary data source for this study are semi-structured interviews, supplemented by secondary data to contextualize and substantiate the findings. The case study focuses on the Golden Valley Wind Farm, one of the projects funded by Nedbank's Renewable Energy Bond.

Section 5.3 explores sub-question 4, which aims to determine stakeholder perceptions regarding the role of green bonds in supporting renewable energy and the low-carbon transition in South Africa. This section identifies the strengths and limitations of green bonds as a funding instrument for renewable energy development and explores the intricate relationships between the economy and environmental preservation. Finally, Section 5.4 concludes the chapter.

5.2 Impact of Green Bond-Funded Projects on Local Communities and Their Outcomes

Reporting on social outcomes is not a "Core Indicator" under The GBP for projects funded by green bonds (The Green Bond Principles, 2024). This may explain its omission from Nedbank's Annual Green Bond Impact Reports reviewed in section 4.3.4. Nonetheless, the literature review and resulting conceptual framework emphasize that the social dimension of sustainable development is equally vital alongside the environmental and economic dimensions. This is particularly relevant when evaluating green bonds and their effectiveness in facilitating a low-carbon energy transition in an emerging economy like South Africa. Similarly, coal mining currently employs over 90,000 people across South Africa. Therefore, the job and social implications of a successful transition cannot be considered in isolation from the impact this would have on local communities (Climate Bonds Initiative, 2021). Recognizing this under "Other Sustainability Indicators," the GBP provide social-related indicators for green bond-funded projects, see **Figure 17**.

As shown in **Figure 17**, the framework presents an extensive list of "Other Sustainability Indicators," which is too broad for comprehensive coverage within this study. To narrow the scope, the research will focus on the social and community aspects, specifically

evaluating how green bonds can promote the three outcomes listed below. This will be based on a case study of the 120 MW Golden Valley Wind Farm facility, where Nedbank's renewable energy bond created a funding opportunity for the private sector to participate in such projects.

1. To what extent did the Golden Valley Wind Farm expand the investment landscape to previously disadvantaged communities?

2. To what extent did the Golden Valley Wind Farm encourage positive change and development within local communities?

3. To what extent did the Golden Valley Wind Farm provide training and upskilling opportunities to local communities?

5.2.1 Data Overview

This section of the report addresses sub-question 3 of the study, with the corresponding data presented in **Table 8**. The primary data source for this sub-question consisted of semi-structured interviews with two community members and employees of the Golden Valley Wind Farm, referred to as COM-1 and COM-2. COM-1, born and raised in Bedford, currently works as a site manager at the wind farm. Similarly, COM-2, also a Bedford resident, serves as the coordinator of operations and maintenance at the same facility. By interviewing these two deeply entrenched community members, the study gained valuable and rich insights into the wind farm's impact on the community and its residents. Secondary data was used to contextualize the findings and enhance the quality of the analysis.

Table 8 - Data overview for sub-question 3

Research sub-questions and overall research question	Secondary data collected	Primary data collected
Sub-question 3 What have been the outcomes in the communities surrounding the 120 MW Golden Valley Wind Farm facility in which Nedbank's renewable energy bond created a funding opportunity for the private sector to participate in such projects?	**Key Themes** • Green Bond Principles, Renewable Energy Indicators • Golden Vally wind farm, data and key information • Social upliftment in Eastern Cape, Cookhouse and surrounding communities **Data Sources** • The Green Bond Principles, Handbook, Harmonised Framework for Impact Reporting. 2024. • Bte Renewables, Unlocking Potential. Digital Brochure. • EOH, Golden Valley Wind Energy Project. Environmental Impact Assessment. 2016. • Power Technology, The Golden Valley Wind Power Project South Africa, 2021.	**Key Themes** • Investment prospects and economic opportunities prior to construction of wind farm facility • Changes in surrounding communities post establishment of wind farm facility • Employment & upskilling opportunities generated by wind farm facility • Enhancing local community inclusion & empowerment. **Data Sources** • COM-1 (Community member and Site Manager at Golden Valley Wind Farm) • COM-2 (Community member and Coordinator of Operations and Maintenance at Golden Valley Wind Farm)
Overview on data analysis process	Through comparative data analysis, key themes from secondary sources and interview data were corroborated and correlated, leading to the identification of sub-findings related to the various elements of the sub-question.	

Number	Indicators (Renewable Energy)	Number	Indicators (Renewable Energy)
	Core Indicators		**Other Sustainability Indicators (Continued)**
1	Annual GHG emissions reduced/avoided in tonnes of CO_2 equivalent/a	15	Number of permanent full-time jobs created (in FTE) by the projects
2	Annual renewable energy generation in MWh/GWh (electrcicity) and GJ/TJ (other energy)	16	Number of workers affected by the transition supported to reskill and/or relocate
3	Additional capacity of renewable energy plant(s) constructed or rehabilitated in MW	17	Increased human health/productivity valorised amount (currency (mn)/year)
		18	Contribution of the issuer to the transmission/distribution costs to consumer bills
	Other Indicators (Examples)	19	Key sensitive animal/plant species affected by the project (Number of species/specimens)
4	Additional capacity of renewable energy plant(s) to be served by transmission systems (MW)	20	Key biodiversity areas affected by the project (m2)
5	Decrease in the carbon intesnity factor (tCO_2e/MWh)	21	Area of land remediated/rehabilitated (m2/ hectares)
6	Annual Absolute (Gross) GHG emissions from the project in tonnes of CO_2 equivalent/a/b	22	Remediation actions to preserve biodiversity (e.g. installation of nesting platforms for overhead lines)
		23	Water consumption (m^3)
	Other Sustainability Indicators	24	Variation of the carbon intensity factor of the transmission system in tonnes of CO2 equivalent per MWh
7	Number of households served with clean energy	25	Investment valorised amount (currency (mn)) dedicated to reskilling/upskilling previously high-emitting facility workers beyond depolluting or dismantlement minimum legal requirements
8	Number of households served with energy efficiency solutions such as smart meters	26	Investment valorised amount (currency (mn)) dedicated to repurposing of the previously high-emitting facilities beyond depolluting or dismantlement minimum legal requirements
9	Reduction in air pollutants (SO2, NOx, PM, VOCs, SF6) from fossil fuels (in tonnes/annually)	27	% of jobs conserved in the decommission phase of high-emitting or polluting facility(ies)/activity(ies)
10	Energy efficiency components produced or procured (m2, m^3, tonnes or %)		
11	Amount of energy recovered from non-recyclable waste (MWh/GWh or GJ/TJ)		
12	% of embodied energy (and carbon) reduced over lifecycle (“cradle to grave”) vs local benchmark		
13	On-farm energy audit		
14	Volume of sustainably sourced goods produced or procured (m^3, tonnes)		

Figure 17 - Renewable Energy Indicators, Harmonised Framework for Impact Reporting (The Green Bond Principles , 2024)

5.2.2 The Golden Valley Wind Farm Facility

The Golden Valley Wind Farm is a 120MW onshore wind power project located in the Eastern Cape, South Africa (BTE Renewables, undated). The wind farm, located near the towns of Cookhouse, Somerset East, Bedford, and Adelaide, began commercial operations in 2021 having started construction in 2018 (See **Figure 18**) (ibid). The project was developed by Engie (previously called BTE Renewables) and was awarded Preferred Bidder status under the REIPPPP Bid Window 4. It currently generates and supplies 477 GWh of electricity annually to Eskom under a 20-year PPA (Power Technology, 2021). Engie, like many other developers, has committed to investing in socio-economic development initiatives that benefit the local communities where projects are situated (BTE Renewables, undated). These initiatives are expected to continue throughout the 20-year life span of the project. The abstract below, taken from EOH (2016, 8), an Environmental Impact Assessment Report for the project, aims to provide the "social upliftment" motivation for the project. It highlights the reality of many South African communities that would greatly benefit from such a project being implemented in their areas.

"***Social upliftment****: The Eastern Cape, and particularly the Cookhouse area, has large tracts of land which are very dry and the farmers do their best to earn a living from the land. The towns are small and socio-economic development activities are limited at best. The need to improve the quality of life for all, but especially the poor, is critical in South Africa. With the expected wind resources in the Cookhouse area, the proposed project will contribute directly to the upliftment of the individuals and the societies in which they live. Amstilite (RF) Proprietary Limited intends to identify community involvement, and projects will be implemented to the fundamental improvement in Cookhouse and the surrounding areas."*

To gain a firsthand understanding of the socio-economic conditions in the communities surrounding the Golden Valley Wind Farm, semi-structured interviews were conducted with two local community members, COM-1 and COM-2, who are also employees at the wind farm. These interviews assessed the region's socio-economic status before the wind farm and evaluated its impact on development, job creation, and empowerment. Engaging directly with affected individuals provided a comprehensive view of the wind farm's influence on local communities.





Figure 18 - Golden Valley Wind Farm. Note: Somerset East was officially renamed to KwaNojoli in March 2023 (Source: Adapted from Google Earth)

5.2.3 Investment Prospects and Economic Opportunities Prior to the Golden Valley Wind Farm

Prior to the construction of the Golden Valley Wind Farm, the economic landscape of the surrounding communities was characterized by limited investment prospects and scarce job opportunities. Both COM-1 and COM-2 highlighted that the region, comprising small towns such as Bedford, Somerset East, Cookhouse, and Adelaide, was heavily dependent on government support and private farming activities.

COM-1 noted that most economic activities relied on government grants and municipal investments, primarily channeled through departments like Public Works (DPW) or initiatives funded by the Department of Energy. The area lacked significant private sector investment, with employment opportunities primarily originating from these government-led initiatives. The few available jobs were typically short-term and project-based, offering little in the way of long-term employment security. Outside of government-funded projects, the local economy relied heavily on privately owned farms, where community members would find work tending livestock or performing other farm-related tasks. Apart from farm work, employment could occasionally be found in small businesses like privately owned petrol stations, but overall, economic prospects were bleak.

COM-2 echoed these sentiments, noting that prior to the introduction of wind farms, there were almost no substantial economic opportunities in the region. The few projects that did exist, such as the construction of ablution facilities or RDP houses, were temporary and did not provide stable employment. COM-2 described the pre-wind farm era as one lacking job security, with most residents relying on infrequent, short-lived projects for income. The area's isolation from larger economic centers further compounded these challenges, as residents had to travel to cities like Port Elizabeth or East London for shopping or other services, reflecting the lack of commercial development in their immediate surroundings.

5.2.4 Observable Changes in Surrounding Communities Post-Establishment of the Wind Farm Facility

The establishment of the Golden Valley Wind Farm has led to a variety of observable changes within the surrounding communities, as highlighted by COM-1 and COM-2 during interviews. Both participants, deeply rooted in these communities, provided detailed accounts of how the wind farm has influenced local life, economy, and infrastructure since its inception.

COM-1 recalled the significant impact the wind farm had on the town of Bedford, particularly during the construction phase. The influx of workers was noticeable, with many people seen wearing reflective vests, a visual representation of the extensive employment opportunities created by the project. The increased activity brought about a boom in local business, especially in the transport sector, as taxis were frequently used to transport workers to and from the wind farm, which is situated about 20 to 30 minutes away from town.

This economic boost extended beyond just employment. COM-1 mentions how a local hotel, called The Duke, has seen substantial development, driven by the need to accommodate engineers and inspectors visiting the wind farm. As more wind farms were established in the area, the demand for accommodation, rentals, and even housing increased, with some employees deciding to settle in Bedford, Cookhouse, or Somerset. This led to a surge in property purchases and rentals, not just by individuals but also by companies holding long-term contracts with the wind farms. The growth in population and economic activity encouraged further development, including the opening of new businesses such as the areas first SPAR supermarket, which was established to cater to the increased demand (see **Figure 19**).

However, COM-1 also noted that this rapid growth brought some challenges. The influx of people and money into a small town like Bedford led to a rise in typical socio-economic issues, including increased alcohol consumption and crime. With more disposable income and limited entertainment options, many residents turned to alcohol, which in turn contributed to an uptick in burglaries and muggings, particularly targeting newcomers unfamiliar with the area.

On the positive side, the local government and municipality responded to these changes by improving infrastructure. The R63 road (See **Figure 19**), a vital route for transporting wind farm components from Port Elizabeth, was resurfaced, significantly enhancing its condition. Additionally, there have been efforts to upgrade the town's electrical infrastructure, including better street lighting, which has helped to address some of the safety concerns that arose with the community’s development.

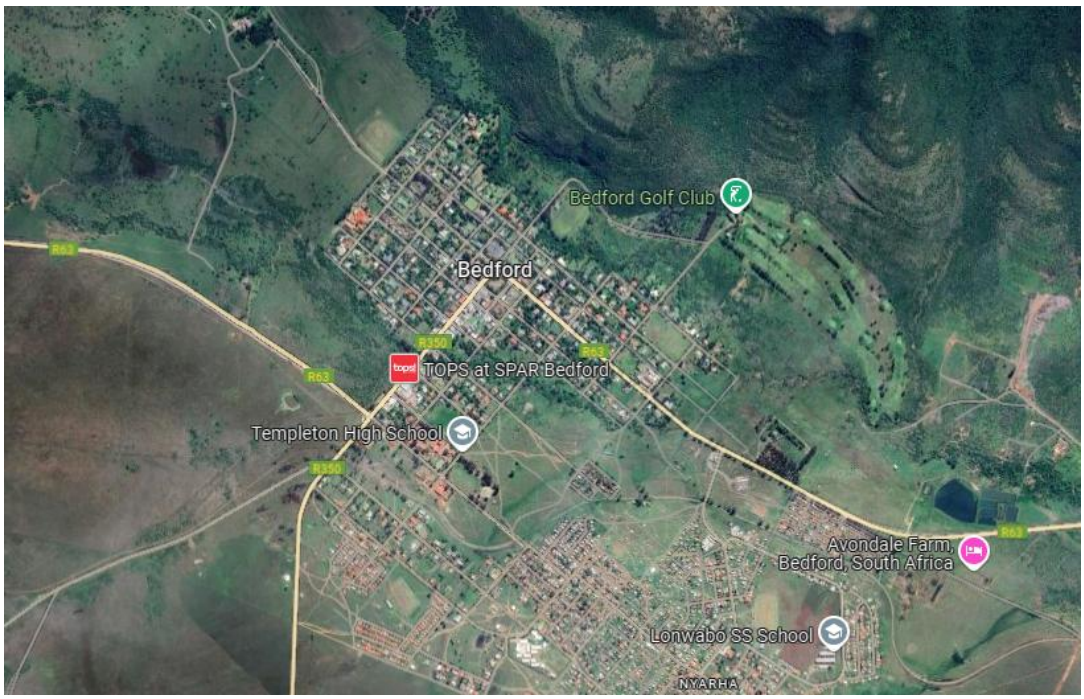


Figure 19 - Image showing SPAR development and R63 Road through the town of Bedford (Image adapted from Google Maps)

COM-2 echoed many of these observations and highlighted further positive changes within the community. The most notable change, according to COM-2, has been in the realm of education and overall lifestyle improvements. Prior to the wind farms, educational opportunities were limited, with many students relying on bursaries like the Funza Lushaka government scheme, which primarily supported degrees in teaching or social work. However, the wind farms have shifted the focus towards broader educational opportunities, leading to an increase in the number of graduates and an overall rise in the level of education within the community. This has, in turn, led to a behavioral shift, with some community members making positive changes in their lives while others have struggled with the temptations brought by increased financial means.

The economic impact of the wind farms is also evident in the rise of local entrepreneurship. COM-2 pointed out that many community members, who previously did not own cars or run businesses, have now started their own ventures, thanks to the opportunities created by the wind farms. These new businesses have not only improved the quality of life for their owners but have also created additional employment opportunities within the community, further boosting the local economy.

5.2.5 Employment and Upskilling Opportunities Generated by the Golden Valley Wind Farm Facility

COM-1 described how the construction phase of the wind farm created substantial employment opportunities for local community members. During this period, hundreds of individuals were employed by various companies engaged in the construction activities. This surge in employment significantly benefited the local workforce, with many people from the surrounding communities being hired. However, as the project transitioned into the operational phase, the need for labour decreased, leading to a reduction in the number of employees required on-site. COM-1 noted that the operational phase requires a smaller, more specialized workforce, primarily focused on the maintenance of the facility. The Operations and Maintenance (O&M) contractor, Gold Wind, a Chinese company, manages this phase with a team that includes both Chinese and South African technicians. Four local South African technicians have been appointed to learn from the Chinese experts, with the intention that these locals will be able to sustain the necessary maintenance work even if the contract with Gold Wind is not renewed after five years.

Employment during the construction phase was deliberately focused on recruiting from the local area. COM-2 confirmed that most of the employees on-site were from local communities, in line with a policy that prioritized local recruitment before considering candidates from outside the community. This approach ensured that the economic benefits of the project were felt primarily within the local population.

As the project moved into the operational phase, employment opportunities, while fewer, remained accessible to local community members. COM-1 highlighted the ongoing employment within the biodiversity monitoring program, which currently employs 17 local individuals responsible for wildlife monitoring. These positions are accessible due to relatively low entry requirements, such as a grade 12 certificate and a driver's license, making them attainable for local community members. COM-1 also mentioned that the program's supervisor is a local woman with a degree in environmental studies, illustrating the project's commitment to supporting local talent in leadership roles. Additionally, other operational roles, including health and safety, waste management, and substation management, are filled by local community members. This aligns with the project’s hiring policy, which prioritizes candidates living within a 50-kilometer radius of the wind farm.

A significant outcome of the Golden Valley Wind Farm project has been the upskilling of local employees. COM-2, who began as a Community Liaison Officer (CLO) during the construction phase and now serves as a coordinator for operations and maintenance, shared that many employees have advanced their careers through the training and

educational support provided by the company. The company has actively supported employees in upgrading their academic qualifications, particularly in areas related to their job functions. This support has included both voluntary training requests and mandatory departmental training, ensuring that employees are able to execute their roles within the company.

5.2.6 Enhancing Local Community Inclusion and Empowerment in Projects Like the Golden Valley Wind Farm: Recommendations and Reflections.

According to COM-1, there's an opportunity for wind farms to do more for local communities. While acknowledging the benefits of employment and indirect economic opportunities, such as local business growth, COM-1 pointed out that the long-term beneficiaries of the wind farm's operations appear to be the farmers who lease their land to the project. These farmers receive a portion of the production profits, creating a financial benefit that is not directly felt by the wider community.

A key recommendation from COM-1 was the need for greater education and awareness about the variety of job opportunities available within the wind farm industry. Many community members, according to COM-1, are unaware of roles beyond the technical positions, such as those in environmental management, health and safety, administration, and human resources. This lack of knowledge limits the community's ability to fully benefit from the opportunities presented by the wind farm. COM-1 suggested initiatives like career days in schools and community outreach programs to educate locals about these opportunities and to bridge the digital divide by providing free Wi-Fi access, which would help people access information and resources more easily.

COM-1 also highlighted the importance of making real, long-term investments in the community, rather than simply fulfilling compliance requirements. While the wind farm has created jobs and engaged locals in various capacities, COM-1 believes there is a need for more meaningful engagement, particularly with the youth, through technology and education-focused initiatives. Despite this, COM-1 highlighted his own journey as evidence of the positive impact the wind farm is having on local communities. He explained how he was initially unemployed before securing a position as a supervisor at the wind farm and has since been promoted to site manager. This progression underscores the wind farm's commitment to investing in local talent. COM-1 mentioned how he hopes similar opportunities will be extended to others in the community

COM-2 shared the sentiment that there is always room for improvement in community support. With the wind farm only in year 3 of a 20-year commitment, COM-2 believes its

ability to support the community will improve each year. COM-2 emphasized the importance of aligning projects with the community's needs and encouraging the community to take ownership of these initiatives. This approach would ensure that the community can sustain the benefits of these projects even after the wind farm's involvement comes to an end.

COM-2 mentioned how a community trust has recently been established as a key mechanism for fostering inclusion. The trust comprises both community and independent trustees, with the community trustees serving as the voice of the community to the wind farm operators. This structure is intended to ensure that the community's interests are represented and that they have a say in decisions impacting their lives. While this trust demonstrates the wind farm's effort to create a lasting and inclusive impact, COM-2 noted that ongoing efforts are needed to strengthen this relationship and foster a sense of ownership within the community

5.2.7 Key Findings – Sub Question 3

The interviews with COM-1 and COM-2 confirmed the lack of stable economic opportunities in the communities surrounding the Golden Valley Wind Farm, emphasizing their dependence on government support and minimal private investment. This aligns with the motivation for social upliftment outlined in the EOH (2016) environmental impact report, which highlights the potential for projects like these to stimulate investment and economic development in underserved areas of South Africa. Through engagement with two community members, we observed how the Golden Valley Wind Farm has positively impacted employment, business development, infrastructure, and education, illustrating the significant socio-economic transformation such large-scale projects can bring to small towns. Additionally, the project facilitated essential training and upskilling opportunities, with both interviewees progressing from entry-level positions to more permanent, rewarding roles within the wind farm. Despite these substantial gains in a relatively short period, there is still room for improvement in fostering greater community engagement and ensuring long-lasting benefits as more wind farms are established in South Africa.

The next section will build on these insights by investigating stakeholder perceptions regarding the role of green bonds in supporting renewable energy and facilitating South Africa's low-carbon transition. It will examine the strengths and limitations of green bonds as a finance mechanism for renewable energy development and explore the complex interplay between economic growth and environmental sustainability.

5.3 Stakeholder Perceptions on the Role of Green Bonds in Supporting Renewable Energy and Low-Carbon Transition in South Africa

Considering South Africa's relatively low issuance of green bonds compared to international markets, this section aims to explore stakeholder perceptions of the strengths and limitations of green bonds as a financial tool to support the country's critical transition to a low-carbon economy. By exploring this topic, the section aims to uncover the factors contributing to the stagnation of the green bond market, examine the complex relationship between the economy and environmental preservation, and identify structural issues hindering market growth. It will also assess the government's role in fostering an enabling environment for South Africa's low-carbon energy transition.

South Africa's aspiration to lead the global South as the first coal-dependent economy to transition to a low-carbon economy relies heavily on its ability to retire its aging coal-fired power stations and establish the energy capacity needed to satisfy its increasing demand (Climate Bonds Initiative, 2021). In alignment with this goal, Eskom has developed a 50-year plan to decommission all its coal power stations and achieve carbon neutrality by 2050, see **Appendix 8** (ibid). This recognises that the energy sector is the largest contributor to GHG emissions where the largest contribution can be made to South Africa's climate change efforts. In addition to a credible transition strategy, access to a substantial pool of capital is essential to finance the country's energy transition, this is where green bonds can play a significant role in providing the necessary funding.

5.3.1 Data Overview

This section of the report addresses sub-question 4 of the study, with the corresponding data presented in **Table 9**. The findings for this sub-question were gathered through semi-structured interviews with key professionals in South Africa's green bond and energy sectors. GEN-1, from Growthpoint Properties, represents the only property company in South Africa to have issued a green bond and listed on the JSE. GEN-2 and GEN-3, both from the Industrial Development Corporation (IDC), contributed valuable insights to the study from their positions as senior dealmaker and business development manager in the energy sector.

Table 9 - Data overview for sub-question 4

Research sub-questions and overall research question	Primary data collected
Sub-question 4 How do stakeholders perceive the effectiveness or limitations of green bonds as a funding mechanism for renewable energy development and emissions reduction in South Africa?	**Key Themes** • Effectiveness of green bonds in supporting sustainable development in South Africa • Strengths and limitations of green bonds as funding instruments for renewable energy projects in South Africa. • Barriers to entry in the South African green bond market. • Key factors behind the stagnation of South Africa's green bond market in comparison to global growth. • Role of government in supporting private sector engagement in the green bond and renewable energy sectors **Data Sources** • GEN-1 (Head of Asset Management, Growthpoint Properties) • GEN-2 (Senior Dealmaker, Energy, IDC). • GEN-3 (Business Development Manager, Energy, IDC)
Overview on data analysis process	Through comparative data analysis, key themes from the interview data were corroborated and correlated, leading to the identification of sub-findings related to the various elements of the sub-question.

5.3.2 Evaluating the Effectiveness of Green Bonds in Supporting Sustainable Development in South Africa

Perspectives shared by GEN-2 and GEN-3 provide key insights into how green bonds play a role in promoting sustainable development, particularly within South Africa's renewable energy and broader decarbonization efforts. GEN-2 highlighted the critical role that green finance and green bonds have played in driving the success of the REIPPPP.

According to GEN-2, the renewable energy sector is a highly competitive environment where green bonds can play an essential role in lowering the cost of capital. Green bonds provide access to cheaper finance, enabling renewable energy projects to be developed at lower tariffs, thus increasing the likelihood of winning bids in the procurement process. GEN-2's view underscores how green bonds directly contribute to scaling renewable energy projects in South Africa, noting that without the availability of this affordable green finance, the REIPPPP would not have achieved the scale it has, nor would the country have seen such substantial reductions in electricity tariffs.

GEN-3 supported these sentiments from a broader decarbonization perspective, noting that green finance plays an essential role in enabling industries to transition towards net-zero emissions. Both GEN-2 and GEN-3 mentioned that much of this funding comes from international DFIs, offering concessionary loans at lower interest rates, which incentivize companies to embark on sustainability projects that might otherwise be cost-prohibitive. GEN-3 acknowledged that while local funding is available, it is often not as competitive as the financing provided through international green bonds.

5.3.3 Strengths and Limitations of Green Bonds as Funding Instruments for Renewable Energy Projects in South Africa

Emphasizing the pivotal role of green bonds, GEN-2 highlights their contribution to the expansion of renewable energy in South Africa. According to GEN-2, green bonds have been instrumental in de-risking the sector and attracting additional investment. However, GEN-2 also points out the limitations associated with these bonds. One key challenge is the prescriptive nature of green bonds, which often excludes entities like the IDC due to their involvement in industries perceived as environmentally detrimental, such as mining. GEN-2 argues that this limitation is short-sighted, as it prevents organizations capable of driving inclusive growth from fully participating in the green bond market. This direct quote from GEN-2 underscores their concern.

"If inclusivity isn't there, if communities, black, women-owned businesses, and local companies aren't included to the extent they can be—then, even if you bring in green bonds, the industry itself will not be sustainable."

GEN-2 mentions that as the renewable energy sector continues to grow in South Africa, it is crucial to ensure the involvement of communities and local entities, particularly black- and women-owned businesses. He argues that the IDC is ideally positioned to facilitate this inclusivity. GEN-2 draws a parallel with the mining industry, noting that its

unsustainability stems from the lack of economic integration of surrounding communities into the benefits of the mines. While private banks like Nedbank and RMB will still raise green bonds, GEN-2 argues that without the participation of entities like the IDC, capable of ensuring broad inclusivity, green bonds alone may not achieve sustainable renewable energy development in South Africa.

In contrast, GEN-3 highlights how green finance contributes to the viability and attractiveness of renewable energy projects by providing a more holistic approach to funding. GEN-3 notes that the initial high returns observed in early rounds of the REIPPPP have decreased as the market has become more competitive. They mention that without the innovation in funding structures provided by green finance, the low returns from renewable energy projects might not have been sufficient to meet the hurdle rates required by some lenders. GEN-3 explains that relying solely on local funding would render renewable energy projects unfeasible. However, when green aspects such as climate change benefits are incorporated, the returns for shareholders and investors begin to align, making the investments more attractive and viable, which is where the strength of green bonds lies. They emphasize that, given the current environmental landscape, evaluating transactions or projects now involves more than just financial or commercial considerations. It's essential to assess the sustainability impact and how the project aligns with the SDGs, as investors increasingly demand this comprehensive approach. In the South African context, demonstrating alignment with the country's NDCs is as crucial as meeting financial requirements. This shift makes green finance a more holistic form of funding for renewable energy projects.

5.3.4 Barriers to Entry in the South African Green Bond Market

According to GEN-3, one of the main obstacles to issuing green bonds is the stringent reporting requirements. These requirements, particularly in relation to tracking and reporting on environmental performance, can be onerous for companies, especially in an economy like South Africa's. Many companies, even those with strong balance sheets, face difficulties in meeting the rigorous standards required to issue green bonds. GEN-3 explained that sectors like mining, which could potentially issue green bonds, often avoid them due to the reluctance of certain investors and international DFIs to associating with industries seen as environmentally damaging. This echoes the point made by GEN-2 in section 5.3.3. According to GEN-3, the structure of South Africa's economy limits the participation of many key players in the green bond market.

This reluctance is particularly problematic when companies in traditionally “dirty” industries, such as coal mining, attempt to decarbonize. For instance, GEN-3 described how a coal mining company might want to reduce its reliance on Eskom by building a solar PV plant. However, despite the company’s efforts to become more sustainable, international DFIs may still be unwilling to provide funding because of their opposition to supporting any business associated with coal. This creates a conflict where companies trying to reduce their carbon footprint are unable to access green finance due to their existing involvement in industries with high environmental impact.

GEN-1 supported this sentiment from the property perspective, stating that the current green bond market does not provide sufficient incentives for companies to pursue green finance over traditional funding options. In their view, the absence of a significant cost differential between green bonds and vanilla finance makes it difficult for companies to justify choosing green bonds, particularly for mature assets. GEN-1 acknowledged that while green bonds may offer some reputational benefits or "kudos," these are not substantial enough to outweigh the lack of financial incentives. According to GEN-1, the lack of financial benefits and the burdensome reporting requirements can serve as a disincentive.

Participants emphasized that the barriers to green bond issuance in South Africa are not only financial but also linked to broader perceptions and structural issues. The reluctance of international investors to engage with companies tied to industries like mining, coupled with the high compliance costs of issuing green bonds, makes it difficult for companies to access the green bond market. As GEN-3 noted, the challenge lies in finding a balance between decarbonizing the economy and navigating the restrictive conditions imposed by green finance stakeholders, which often result in a longer and more complex path toward sustainability.

5.3.5 Key Factors Behind the Stagnation of South Africa’s Green Bond Market in Comparison to Global Growth.

GEN-2 highlighted the inherent limitations within South Africa’s industrialized economy, particularly the energy-intensive nature of key sectors like mining. They emphasized that while renewable energy could play a role in powering parts of the economy, it cannot fully substitute fossil fuels in heavy industries due to cost and reliability concerns. They stated, “*In South Africa, you can’t fully power the industry with renewables, so there’s a limit to the impact of green bonds. Whereas in other countries, where green bonds continue to proliferate, their industries may not be as energy intensive*.” This observation sheds light on the structural challenge that the South African green bond market faces in

comparison to more service-oriented or less energy-intensive economies, where green bonds have experienced exponential growth. According to GEN-2, the high energy demands of industries such as mining make it difficult for green bonds to gain significant traction since these sectors cannot fully transition to renewable energy without risking higher costs and reduced reliability.

GEN-3 echoed this sentiment, noting that South Africa's reliance on coal makes it challenging to attract green bond investments. International investors tend to avoid any association with “dirty” fuels, making it difficult for even transitional green projects to gain funding. GEN-3 highlighted that while there is a strong push for decarbonization, the country's current economic struggles, compounded by ongoing issues like load shedding, complicate the transition to renewable energy. They emphasized the importance of balancing climate goals with the immediate survival of industries reliant on fossil fuels, questioning, “What comes first, climate or just survival?”. According to GEN-3, the rigid position of international investors on fossil fuel involvement poses a significant barrier to expanding the green bond market in South Africa, where industries are still heavily coal-dependent.

GEN-1 supported this view, adding that banks in South Africa are also generally risk-averse, preferring to lend to established players with strong balance sheets rather than new entrants or smaller firms. He pointed out that this creates an additional barrier for smaller companies looking to issue green bonds, as the cost of compliance and administration is high. They explained that issuing a bond involves significant upfront costs, including the setup fees. Additionally, a bond typically requires a credit rating from agencies like Fitch or Moody’s, which adds further expenses. As a result, only large companies with substantial financial resources can afford to navigate this process. This further discourages potential issuers, particularly when traditional financing offers fewer obstacles and similar rates.

5.3.6 Role of Government in Supporting Private Sector Engagement in the Green Bond and Renewable Energy Sectors

GEN-2 views the government's current efforts positively, acknowledging that the REIPPPP is a robust framework that supports the green energy sector. According to GEN-2, the government has made significant strides in regulatory reforms, such as eliminating generation licenses and enhancing grid access. Despite these advances, GEN-2 notes that the government faces practical challenges, particularly in balancing the transition to renewable energy with the need to maintain a stable energy supply. As GEN-2 puts it, "*I*

think there's a realization from the government that you can't shut down coal, and you can't discontinue nuclear. If you did, you might as well kiss industry goodbye - I don't know what you'd eat after that." This statement underscores the complexity of the energy transition and the government's role in managing both economic and environmental priorities.

GEN-3 emphasizes the critical need for policy certainty as a cornerstone for attracting private sector investment in green bonds. They argue that the stability of regulatory frameworks is essential for the success of long-term infrastructure projects, which can span several decades. GEN-3 points out that frequent changes in policy, especially with each new administration, can undermine the viability of projects, as they may impact financial returns and project feasibility. They state, "*If you look at how our government is structured, there will be one or more than two administrations within the life of the project. It can't be that the policy changes to the extent that it jeopardizes the viability of a project over the life of, say, a loan*." GEN-3's emphasis on policy certainty highlights the need for a predictable regulatory environment that supports long-term investments, mitigates risks, and ensures that projects remain viable throughout their duration. This stability is crucial not only for the success of individual projects but also for fostering overall confidence in the green bond market.

GEN-1 provides a practical suggestion for enhancing private sector involvement in green bonds. They propose that while the government might not issue green bonds directly, it could play a supportive role by underwriting default risks. This could involve reducing costs associated with green bonds and offering a safety net for defaults, thus making the bonds more attractive to investors. GEN-1's suggestion aims to lower the financial risks for issuers and encourage greater private sector participation by providing a level of government-backed security.

5.3.7 Key Findings – Sub Question 4

The evaluation of green bonds in South Africa, as drawn from interviews with GEN-1, GEN-2, and GEN-3, highlights both the significant contributions and the limitations of this financial instrument in supporting sustainable development. Green bonds have played a crucial role in advancing renewable energy projects by providing cheaper capital and facilitating initiatives such as the REIPPPP which has been recognised as a world-renowned policy instrument for renewable energy generation (Eberhard and Kaberger, 2016). However, their impact is constrained by restrictive eligibility criteria, high compliance costs, and a need for greater inclusivity. Structural challenges, including the

energy-intensive nature of South Africa's economy and the reluctance of international investors to support industries tied to fossil fuels, further impede market growth. Additionally, while the government's efforts in regulatory reforms and policy advancements are acknowledged, practical challenges remain in balancing economic and environmental priorities and ensuring policy stability. Enhancing private sector participation could be supported by government measures such as underwriting default risks and providing a more predictable regulatory environment. Addressing these barriers and fostering a more inclusive and supportive framework are essential for the green bond market to effectively contribute to South Africa's sustainability goals.

5.4 Summary of Key Findings and Conclusion.

This chapter addressed sub-questions 3 and 4, providing a detailed exploration of the local impacts of green bond-funded projects, as perceived by two individuals employed at the Golden Valley Wind Farm, alongside industry stakeholder perceptions regarding the role of green bonds in supporting renewable energy and South Africa's low-carbon transition.

In response to sub-question 3, the case study of the Golden Valley Wind Farm provided compelling evidence of the socio-economic benefits for the surrounding community. Interviews with community members, COM-1 and COM-2, revealed improvements in employment, infrastructure, and education, as well as the creation of new business opportunities. Both interviewees emphasized the role of training and upskilling programs, which helped them progress into more stable and rewarding roles within the wind farm. However, challenges remain in ensuring the long-term sustainability of these benefits, particularly in the face of limited private sector investment and the community's ongoing dependence on government support. While the project has positively impacted the area, further efforts are needed to deepen community engagement and expand economic opportunities.

Sub-question 4 explored the perceptions of key stakeholders in the green bond and energy sectors. Interviews with professionals from Growthpoint Properties and the IDC revealed that green bonds play a crucial role in financing renewable energy projects by reducing the cost of capital and supporting initiatives such as South Africa's REIPPPP. However, their potential is hindered by restrictive eligibility criteria, high compliance costs, and structural barriers, such as South Africa's reliance on fossil fuels and the energy-intensive nature of its economy. Despite these challenges, stakeholders acknowledged the government's efforts to advance regulatory reforms but emphasized the need for a more inclusive and supportive framework to enhance market growth. Greater private sector

involvement, underpinned by policy stability and risk mitigation measures, will be crucial to expanding the impact of green bonds.

In conclusion, the chapter highlights the substantial socio-economic contributions of green bond-funded projects, while also identifying key areas for improvement. To fully realize the potential of green bonds in driving South Africa's renewable energy transition, it will be essential to address structural barriers, enhance stakeholder collaboration, and ensure that the benefits are equitably distributed within local communities.

6 ANALYSIS AND DISCUSSION

6.1 Introduction

This chapter provides a comprehensive analysis and discussion of the findings from the fieldwork conducted in Chapters 4 and 5. Key themes covered include the role of green bonds in promoting transparency and accountability, Nedbank's Renewable Energy Bonds and their influence on private sector participation, the effectiveness of green bonds in advancing sustainable development, and the carbon reduction outcomes of projects funded by green bonds. The chapter also examines the challenges of balancing profit with environmental preservation and explores the socio-economic impacts of renewable energy projects. Finally, it explores the barriers limiting participation in the green bond market and presents strategic solutions to overcome them.

6.2 The Role of Green Bonds in Promoting Transparency, Accountability, and Ethical Investment in South Africa's Climate Finance Landscape

Interviews with PVT-1 and PVT-2 reveal that green bonds are part of a broader group of green finance instruments, categorized as "use of proceeds" bonds. We were made aware that green bonds are required to comply with the guidelines set by the GBP which specify eligible projects and outline the necessary disclosures and compliance standards. As a result, transparency and accountability are identified as critical features of green bonds. These characteristics are essential for ensuring that green bonds drive genuine change with measurable climate outcomes. We further identify the alignment of green bonds with global ESG objectives, as well as the critical need for increased green finance to support the goals established at the Paris Agreement. This is consistent with the views of Hafner et al. (2020), who argued that traditional funding sources, such as infrastructure finance and government expenditure, are insufficient to meet the ambitious targets established at the Paris Agreement. The literature demonstrated how global trends and external pressures can drive nations to take significant action on climate change. For instance, China, as one of the largest carbon emitters, has responded to such pressures by setting the "double carbon" objective, aiming to peak carbon emissions by 2030 and achieve carbon neutrality by 2060 (Wenqi et al., 2021). Similarly, the ability of green bonds to speak to global ESG objectives is highly significant as it provides a supportive framework for South Africa to work towards achieving its NDCs which are key to meeting the countries commitments to the Paris Agreement (PCC, 2023).

Furthermore, as highlighted in the literature, green bonds can help counter the growing trend of greenwashing, where corporations mislead consumers about the true environmental impact of their activities, which can undermine environmental performance

within the private sector (Zhang et al., 2022). Green bonds could thus encourage meaningful private sector participation in South Africa's climate change and renewable energy initiatives, minimizing the risk of greenwashing or unethical practices. High-profile scandals, such as those involving Steinhoff and Tongaat, as reported by Daily Investor (2022), have revealed how vulnerable private and listed companies in South Africa are to "widespread corruption" and unethical behaviour, despite appearing to have robust governance structures in place. This is consistent with the findings of Wang and Shen (2024), who demonstrated that green bonds effectively reduced corporate greenwashing practices among listed companies in China. In conclusion, green bonds have the potential to mobilize private sector funding for renewable energy while supporting ESG objectives by ensuring contributions are ethical, transparent, and impactful in driving sustainable development.

6.3 Nedbank's Renewable Energy Bonds and Their Influence on Private Sector Participation in South Africa

The data offers a comprehensive analysis of the role and impact of Nedbank's Renewable Energy Bonds in promoting private sector engagement in renewable energy development. According to PVT-1, Nedbank was a pioneer as the first private sector entity in South Africa to issue a Renewable Energy Bond, positioning the bank as a trailblazer in the local market. PVT-2, however, provided a contrasting perspective, pointing out that while issuing green bonds to finance renewable energy projects is common globally and not a unique differentiator, Nedbank's accreditation with the CBI sets them apart. This certification, held by only 5% of issued bonds worldwide, elevated the green bond's significance and established a benchmark that encouraged other private sector players, particularly banks, to follow suit. **Table 2** provides evidence of the growing engagement within the local banking sector, with banks contributing 49% of total green bond issuances. PVT-1 also indicated that banks such as ABSA, Standard Bank, and FirstRand have significantly closed the gap and may have caught up to Nedbank in terms of overall green bond issuances. This firm commitment to environmental preservation is not unique to the local banking sector but mirrors trends set by international giants such as HSBC, BNP Paribas, and Deutsche Bank, all of which have integrated environmentally sustainable products into their corporate policies (Frimpong et al., 2022). This underscores the potential positive impact of global pressures, such as those exerted by the World Bank, as discussed in Section 2.6 of the literature. More importantly, the argument made by de Jongh and Mollmann (2014, 639) that "To remain competitive and profitable, companies will have to incorporate climate change and environmental awareness into their business strategies". Similarly, the rise in green bond issuances following Nedbank's 2019 issuance

supports Liang and Yang's (2024) argument that increased ESG disclosure can act as a catalyst, encouraging other private sector players within the same industry to adopt similar ESG practices. The observed growth in green bond issuances is complex and likely driven by a range of factors, varying across different issuers based on their specific corporate goals or ESG objectives. However, evidence suggests that Nedbank's Renewable Energy Bonds acted as a catalyst, inspiring other local stakeholders to participate more actively in the green bond market.

6.4 Evaluating the Effectiveness of Green Bonds in Supporting Sustainable Development

Assessing the effectiveness of green bonds in advancing sustainable development, particularly in renewable energy, is a core focus of this study. Analysis of the data reveals the crucial role that green finance has played in the success of the REIPPPP, which has facilitated the delivery of numerous renewable energy projects in South Africa. GEN-2 explained how green bonds contributed to lowering the cost of capital and providing access to more affordable financing, which not only facilitated the delivery of renewable energy projects but also helped reduce electricity tariffs. A reduction in tariffs points to increasing efficiency. While several factors, such as advancements in technology may have contributed to this, literature by Naeem et al. (2021) and Mensi et al. (2021) concluded that green bond issuances play a significant role in enhancing EE and overall environmental protection. GEN-3's statement that green finance is essential in helping industries transition to net-zero further reinforces this argument. Similarly, GEN-3 emphasized how the comprehensive nature of green finance enhances the viability of renewable energy projects that might not have been feasible otherwise. This holistic approach highlights green finance's dual emphasis on achieving financial returns while prioritizing ESG factors that appeal to investors.

However, we also identified a significant limitation of green bonds, as their prescriptive nature often excludes entities well positioned to drive inclusive growth from participating in the market. In the South African context, where inequality ranks among the highest in the world and the lingering effects of apartheid result in profound exclusion within the economy, ensuring inclusive growth is essential for achieving sustainable development (Huchzermyer, 2014). GEN-2 emphasized that without the active involvement of local communities, particularly black and women-owned businesses, the renewable energy sector could become unsustainable, undermining the positive impact that green bonds aim to achieve. We can draw similarities from the mining industry which has been largely unsustainable due to its failure to fully integrate surrounding communities into its

operations and benefits. The most significant consequence of this failure was the Marikana massacre, where 34 miners were killed by the South African Police Service (SAPS) in August 2012 (Marinovich, 2012). In conclusion, while green bonds effectively promote sustainable development and renewable energy, their restrictive nature in South Africa limits inclusive growth by sidelining key stakeholders.

6.5 Evaluating the Carbon Reduction Outcomes of Green Bond-Funded Projects.

Similarly, an analysis was conducted to evaluate the carbon reduction outcomes of green bond funded projects. The analysis required verifying claims of increased transparency in environmental performance disclosures, ensuring alignment with the requirements of the GBP, and evaluating the significance of carbon reduction outcomes associated with green bond funded projects. While no existing research was found that could provide a comprehensive methodology to answer this question, we are informed by KPMG (undated) that evaluating the impact of projects funded through green bond proceeds continues to be a significant challenge in the market. Similarly, the Green Bond Principles (2024) acknowledges the absence of a universally accepted standard for calculating environmental performance indicators. It instead allows issuers the discretion to use their own methodologies, provided these are disclosed. This provides both justification and credibility to the methodology used in this research.

The following conclusions could therefore be drawn, first, green bond disclosures are publicly accessible, reinforcing claims of increased transparency. Nedbank's Annual Green Bond Impact Reports align with the standards of the GBP meaning the data on avoided carbon emissions can effectively be used to measure the carbon reduction outcomes of green bond-funded projects. The findings however reveal that current levels of climate finance, including green bond funding, remain insufficient to significantly offset emissions from major power plants. While much of the literature, including studies by Khan et al. (2022) and Zhou et al. (2023), concluded that green finance significantly reduces carbon dioxide emissions, these findings were based on larger datasets, such as multiple provinces, or longer test periods, spanning from 2007 to 2020. By contrast, we found that individual projects funded by green bonds do not produce enough avoided carbon emissions to meaningfully impact South Africa's efforts to reduce GHG emissions. Significantly more green bond funding is required to make a meaningful contribution to reducing GHG emissions. As one of the top 12 GHG emitters globally, South Africa faces a unique challenge, offsetting the emissions from a single Eskom power station will require numerous renewable energy projects (Neumann, 2023). This makes the task of

offsetting carbon emissions even more challenging and underscores PVT-2's argument that significantly more green finance will be needed to meet our climate change targets.

6.6 Balancing Profit and Environmental Preservation: Challenges and Emerging Trends in Private Sector Engagement with Green Finance

The challenge of balancing profit with environmental preservation continues to be a contentious issue among private sector players engaged in sustainable practices. The literature review, along with secondary and primary data gathered from interviews, indicates that profit remains a key driving factor in the decision-making processes of private companies involved in sustainable practices, such as renewable energy development. According to de Jongh and Mollmann (2014), the effectiveness of corporate action is hampered by the prevailing attitudes that environmental issues can be regarded as secondary to core business operations. Regrettably, PVT-1 reinforced this viewpoint, stating that investors and trustees are primarily focused on returns rather than on resolving energy issues. This aligns with the researcher's initial hypothesis and supports Baker's (2015) assertion that bank representatives seek projects that are financially viable and capable of generating the necessary rate of return to secure funding for renewable energy initiatives. While it is important to understand the challenges associated with providing green finance such as project finance structures, developing strategies to foster greater voluntary engagement from the private sector beyond merely meeting minimum requirements can significantly enhance the growth of green projects in South Africa. Analysis of stakeholder perceptions offer reasons for optimism, suggesting that a shift in attitudes is imminent. They highlight how changing demographics and heightened societal awareness are driving more investors to demand responsible investment practices. This trend is likely to compel an increasing number of private sector players to engage in sustainable business behaviour.

6.7 The Socio-Economic Impact of Renewable Energy Projects: Challenges and Opportunities

Engagement with COM-1 and COM-2 revealed the lack of stable, long-term employment or economic opportunities in the towns of Cookhouse, Somerset East, Bedford and Adelaide. These towns form the communities surrounding the Golden Valley Wind Farm, where a funding opportunity was established through Nedbank's Renewable Energy Bonds. More significantly, we also established that outside of government grants and limited municipal investments, there were no prospects for development or private investment in the region. This aligns with the findings of the 2016 EOH report, which highlighted the critical need to improve the quality of life in the region prior to the

establishment of the wind farm. We can therefor draw that the availability of wind resources, along with green bonds, has expanded the investment landscape to areas that might not have otherwise seen development. Green bonds played a crucial role in attracting private sector investment and reducing the cost of capital, making the Golden Valley Wind Farm project viable in a competitive market.

Furthering the discussion, we identified significant social upliftment and development in the region as a result of the wind farm's establishment. This included job creation, a surge in local businesses, population growth, infrastructure development, expanded educational opportunities, and a rise in local entrepreneurship. This is highly significant and supports the study's conceptual framework, which asserts that the effectiveness of green bonds in promoting renewable energy development cannot be viewed in isolation from the social dimension, one of the three pillars of sustainable development. Drawing on the literature, a reinforcing argument is made by Dyllick and Hockerts (2002) that long term business sustainability is a product of a combined focus on the three dimensions of sustainability, which is the environmental, social and economic. This further supports GEN-2's argument that failing to ensure the meaningful inclusion of local communities in the development framework of green bonds will ultimately undermine long-term sustainable development efforts. Although the GBP does offer guidance as depicted in **Figure 17** for "Other Sustainability Indicators", social indicators are not considered core indicators for green bond issuers. Consequently, these were not disclosed in Nedbank's Annual Green Bond Impact Reports. While the GBP provides an international framework for green bond issuers, ensuring consistency and transparency, it can be argued that the framework has a Global North focus, where social considerations are less critical compared to countries in the Global South.

There's an urgent and undeniable need to ensure that the most vulnerable are considered in the climate change discussion. As noted by Adenle et al. (2017), climate change is expected to exacerbate already severe levels of poverty, food insecurity, and public health challenges in developing countries. This is particularly evident in South Africa, where 90,000 people are employed in the mining sector, meaning a just transition must address the potential loss of income for thousands of breadwinners across the country (Climate Bonds Initiative, 2021). We also noted dissatisfaction from COM-1, who indicated that the farmers privately owning the land where the wind farms are located will be the long-term beneficiaries of the operations. The farmers receive a share of the production profits from the wind farm, a benefit not directly felt by the wider community, despite wind being a resource that is not owned by anyone. This touches on the sensitive topic of land,

underscoring how historical injustices under the apartheid regime continue to shape livelihoods and perpetuate inequality and social injustices, 30 years into democracy. Inequality in South Africa is among the highest in the world, with 10% of the population owning over 80% of the wealth and means of production, including farmland (Aljazeera, 2022). There is sufficient evidence to suggest that renewable energy resources, such as wind and solar, have the potential to drive development similar to the gold rush that led to the establishment of Johannesburg, particularly in towns with suitable locations. However, there is currently no mechanism to ensure that these projects do not contribute to sustaining economic injustices. Additionally, the GBP does not adequately engage in this critical conversation, which is crucial in the South African context.

6.8 Overcoming Barriers to Participation in South Africa's Green Bond Market: Stakeholder Perspectives and Strategic Solutions

Analysis of the data also informs us that persistent challenges, including the high costs of issuing green bonds and stringent reporting requirements have discouraged broader participation in the market. We find that the restrictive conditions set by green finance stakeholders limit the participation of industries, like mining, which have the potential to significantly increase green bond issuances. As discussed in the literature, the South African economy is heavily dependent on mining, mineral extraction and agriculture, all of which are highly energy-intensive (NCCAS, 2019). The inability of green bonds to engage these industries and overcome the "dirty industry" stigma severely restricts their growth potential. Stakeholders indicate that these challenges, along with the lack of a substantial cost advantage, have led companies to prefer traditional 'vanilla' bonds over green bonds. A major critique of green bond literature, including that of the Climate Bonds Initiative (2021), is the failure to involve "dirty industries." Green bonds must move beyond selective engagement to foster an inclusive environment that supports any stakeholder demonstrating positive social and environmental contributions, regardless of their past practices. After all, a transition implies change; industries wouldn't need to transition if they were already 'clean.

Our analysis reveals that a major limitation of green bonds in South Africa's market is the energy-intensive nature of the economy. While renewable energy can power some sectors, it cannot fully replace fossil fuels in heavy industries due to cost and reliability concerns. This issue is further complicated by ongoing challenges like load shedding, underscoring the need to balance climate goals with the immediate needs of industry. This conversation tie-ins with PVT-2's argument that a crucial yet often overlooked link between green bonds and a country's economy is the need for a substantial pool of eligible green assets

(See **Appendix 3**). Without these assets, the potential for green bond issuances remains limited. This is crucial, as we noted that Europe's abundance of green assets has significantly driven the growth of green bonds in their market. Addressing South Africa's energy-intensive economy and expanding the pool of eligible green assets are key to unlocking the potential of green bonds.

A well-known quote by Bob Hope states that "A bank is a place that will lend you money if you can prove that you don't need it" (Grewal, 2023). This is particularly evident in the local market, where green bond stakeholders, especially banks, have adopted overly risk-averse practices that primarily favour companies with strong balance sheets. Additionally, the high upfront costs of issuing green bonds have restricted access to large companies that can afford to navigate the process. This has further sidelined many potential participants and created a sense of exclusivity which is counterproductive for promoting climate action. This discussion aligns with the literature on climate finance in Africa, where Neumann (2023) argues that the failure of wealthy nations to fulfil their climate finance commitments has thrown the continent's climate finance landscape into disarray. Just as it is counterproductive for wealthy nations to be the sole drivers of climate change initiatives, it is equally harmful for only a few large companies to dominate access to green bonds. Excluding smaller players, who could make meaningful contributions, undermines the inclusivity needed for broad-based climate action. This further underscores the need to demystify green bonds and find solutions to increase broader participation, while also engaging stakeholders to address their concerns and open the market to smaller players.

While participants have noted that green bonds have performed reasonably well in a challenging sustainable finance environment, we identify several structural, institutional, and policy initiatives that could enhance the local green bond market and attract more players to the renewable energy sector. Drawing from the literature, we informed by Magale (2021) that insufficient institutional backing and widespread lack of awareness are some of the challenges facing the Kenyan green bond market that he describes as "sluggish". This argument was recognised by PVT-1 who informed us of several strategies being implemented by the JSE to boost private sector participation in the green bond market. This includes educational programs aimed at enhancing the understanding of green bonds among both issuers and investors. To address the high costs associated with green bond issuance, we learned about upcoming financial and technical assistance programs designed to support issuers in the sustainability sector. The importance of adequate institutional support is highlighted in the literature by the Climate Bonds

Initiative (2022) which informed us of how the Nigerian Green Bond Market Development Programme facilitated the generation of US$ 41.7 million through the upskilling of over five hundred practitioners. We also identified opportunities for the government to play a role in creating an enabling environment that could boost the volume of green bond issuances. We noted similarities between PVT-1 and GEN-1, both suggesting that government incentives, such as tax breaks for green bond issuers and underwriting default risks, could make green bonds more attractive by providing a safety net for issuers. Focusing on policy, GEN-3 emphasized the critical need for policy certainty and a stable regulatory framework as essential for attracting increased private investment and fostering overall confidence in the market. Given the long-term nature of renewable energy projects and the potential for multiple administrations over a project's lifespan, a predictable and stable policy environment is essential for attracting more participants to this market. GEN-2, however, offered a more positive view of the government's role, asserting that they do not see it as an obstacle to the growth of the renewable energy market. They highlighted the success of the REIPPPP and recent regulatory reforms, such as the elimination of generation licenses and improved grid access, as indicators of progress. This perspective is reinforced by Mogale (2021), who cited South Africa's Pension Funds Act Regulation 28 as an example of how policy support can enhance sustainable investing. This regulation mandates the integration of ESG factors into the investment portfolios of pension funds. Additionally, the launch of South Africa's Carbon Market by the JSE in 2023 provides further evidence of the government's proactive support for sustainable development efforts (Business Tech, 2023). This market enables local participants to buy and sell carbon credits, which are generated by initiatives that reduce emissions, such as renewable energy projects. Local companies unable to reduce their carbon emissions can offset these emissions through credits for tax purposes, as permitted by the government (ibid). This reflects the government's commitment to being an influential player in the sustainable development conversation and its willingness to embrace innovation. Despite this, we still recognise a need for further structural and policy reforms to broaden participation in South Africa's green bond market. Government incentives, policy stability, and educational programs are essential for attracting more players and driving market growth.

6.9 Conclusion

This chapter has explored the diverse role of green bonds in South Africa's climate finance landscape, particularly focusing on their potential to promote transparency and accountability while aligning with global ESG objectives. It examined Nedbank's pioneering issuance of its 2019 Renewable Energy Bonds, which has effectively

stimulated private sector engagement and encouraged other financial institutions to become active participants in the green bond market. This engagement is crucial for mobilizing resources to meet the urgent funding needs of renewable energy projects in line with the targets established by the Paris Agreement.

The analysis of green bonds' effectiveness in supporting sustainable development revealed notable achievements alongside significant limitations. While these instruments have facilitated cost reductions and enabled renewable energy projects, gaps remain in carbon reduction outcomes, especially given South Africa’s status as a leading GHG emitter. The chapter also highlighted the socio-economic impacts of renewable energy initiatives, underscoring the necessity of integrating social considerations and engaging local communities. Furthermore, barriers to participation in the green bond market were identified, emphasizing the complexities that affect broader involvement. Overall, the findings illustrate the essential yet intricate role that green bonds play in advancing sustainable development in South Africa.

7 CONSOLIDATION OF SUB-FINDINGS AND CONCLUSION

7.1 Overview

The study aimed to evaluate the outcomes of green bonds in supporting renewable energy development and facilitating the transition to a low-carbon energy system. Focusing on Nedbank's 2019 Renewable Energy Bonds, it analysed their strengths and limitations as a financial instrument for supporting renewable energy initiatives and reducing carbon emissions in South Africa. To address the primary research question, the study formulated four sub-questions that guided data collection and informed the development of key findings. This chapter presents the study's sub-findings, focusing on the role of renewable energy bonds in fostering private sector participation, their impact on carbon reduction, and the socio-economic outcomes in communities surrounding funded projects. Additionally, it incorporates stakeholder insights on the effectiveness and limitations of green bonds within South Africa's renewable energy sector. The chapter concludes with a consolidation of findings and offers recommendations to address the structural, regulatory, and socio-economic challenges identified in the research.

7.2 Encouraging Private Sector Participation: Innovation and Impact of Nedbank's Renewable Energy Bonds

In consolidating the findings, the study revealed that Nedbank's Renewable Energy Bonds were pivotal in promoting private sector participation in renewable energy development in South Africa, though their impact was linked to a broader set of contributing factors. While Nedbank's leadership in issuing renewable energy bonds was important, global pressures and sustainability commitments also played a significant role in driving private sector engagement. For instance, the study found that South Africa's obligations under the Paris Agreement, particularly the need to meet its NDCs, were critical external motivators. These global commitments exerted pressure on private companies to align with international ESG standards, and green bonds provided a structured way for institutions to demonstrate their commitment to climate goals. Additionally, the load shedding experienced in South Africa during this period intensified the focus on the country's renewable energy resources, reinforcing the urgent need for sustainable solutions.

The study also shows that while Nedbank's Renewable Energy Bonds set an important precedent, other factors such as the increasing demand for ethical investments and the global movement toward sustainable finance were key in mobilizing private sector capital. Green bonds, by design, require adherence to guidelines that ensure funds are used transparently and ethically, a feature that resonates strongly in a market where trust in

corporate governance has been shaken by scandals. This ethical framework likely made green bonds more attractive to private sector participants, independently of Nedbank's direct influence.

Despite positive outcomes, challenges remain in fully realizing the potential of green bonds to drive private sector participation. High issuance costs and the need for financial returns are key barriers, as many private sector players prioritize profitability. While green bonds offer environmental and ethical incentives, their financial appeal must be strengthened to boost participation.

7.3 Nedbank's Renewable Energy Bonds: Implications for Carbon Reduction

Analysis of Nedbank's Renewable Energy Bonds offered valuable insights into their role in promoting carbon reductions within South Africa's renewable energy landscape. While existing research lacks a comprehensive methodology for evaluating carbon reductions, guidance from secondary sources, such as the GBP, provided credibility to the methodology adopted in this study. The study found that Nedbank's Annual Green Bond Impact Reports align with GBP recommendations, presenting data on avoided carbon emissions that can be reliably used to assess the carbon reduction outcomes of green bond-funded projects. Notably, the projects funded demonstrated measurable reductions in carbon emissions, underscoring their contribution to South Africa's renewable energy objectives. Additionally, the study indicated that annual fluctuations in solar and wind resource availability do not adversely affect the overall carbon emissions avoided.

However, the study also found that the current levels of climate finance, including green bond funding, are insufficient to make a meaningful impact on carbon reduction efforts. While studies in the literature have suggested that green finance can significantly reduce carbon dioxide emissions, these conclusions were typically drawn from larger datasets and longer time frames. In contrast, the study showed that individual projects funded by green bonds typically fail to generate enough avoided carbon emissions to meaningfully impact South Africa's GHG reduction targets. The study showed that to meaningfully offset emissions from carbon-intensive operations, the volume of green bond issuance must be significantly increased, highlighting the urgent need for greater funding in renewable energy projects.

7.4 Community Outcomes Arising from the Golden Valley Wind Energy Facility Funded by Nedbank's Renewable Energy Bonds

The study's findings indicate that the establishment of the Golden Valley Wind Farm has catalysed transformative changes within the socio-economic landscape of surrounding communities. The introduction of the wind farm expanded the investment landscape in a region that had previously seen limited private sector interest. The successful mobilization of Nedbank's Renewable Energy Bonds was pivotal in attracting investment and reducing capital costs, making the project financially viable. The Golden Vally project demonstrates how renewable energy initiatives can drive economic development by linking environmental sustainability with local empowerment.

In addition, the wind farm has played a key role in fostering social upliftment, driving job creation, spurring new businesses, and expanding educational opportunities. These changes have not only improved living standards but also stimulated local entrepreneurship, reflecting a shift toward greater community involvement in economic activities. These advancements, while promoting economic vitality, have also led to emerging challenges such as increased alcohol consumption and crime, requiring continued community engagement and support.

The study makes a key finding regarding the unequal distribution of benefits, with long-term financial gains from the wind farm primarily benefiting farmers leasing their land, while broader community members see little direct profit-sharing. This raises critical questions about equity and inclusion, particularly given South Africa's history of injustices and ongoing socio-economic disparities. The study reinforces the argument that meaningful local community involvement is crucial in green bond development frameworks to avoid perpetuating economic injustices.

7.5 Stakeholder Perspectives on Green Bonds and Their Effectiveness and Limitations in South Africa's Renewable Energy Sector

Stakeholder perspectives provide valuable insights into the effectiveness and limitations of green bonds as funding mechanisms for renewable energy development in South Africa. While green bonds provide affordable capital and support initiatives like the REIPPPP, their impact is hindered by persistent challenges. A key finding of the study is the stigma surrounding "dirty industries," which limits broader market engagement. Stakeholders noted that restrictive eligibility criteria and high compliance costs associated with green bonds have driven many companies toward traditional bond options, limiting growth potential in the market. This reveals a critical gap in the green bond framework:

the need for inclusivity. The study emphasizes the importance of fostering a supportive environment that recognizes industries with positive environmental and social impacts, regardless of their historical practices. The transition to a sustainable economy requires inclusive participation from all sectors, not just those typically classified as “clean.”

The analysis also revealed that the energy-intensive nature of South Africa's economy complicates the viability of green bonds. While renewable energy can serve some sectors, it cannot fully replace fossil fuels in heavy industries due to economic and reliability concerns. The study further indicated that the availability of eligible green assets is crucial for green bond issuance, with South Africa needing to expand its pool of such assets to unlock market potential. Additionally, the cautious approach of financial institutions, favouring larger, risk-averse companies, limits opportunities for smaller enterprises that could drive significant climate action. Despite barriers, the study found that green bonds have performed well, but structural, institutional, and policy changes could further strengthen the local market. Key measures include educational programs to raise awareness and reducing issuance costs through financial and technical assistance. The study emphasized the government's crucial role in creating an enabling environment for green bond issuance. Stakeholders suggested incentives like tax breaks and underwriting default risks to boost attractiveness, alongside a stable regulatory framework to attract private investment.

7.6 Consolidation of Findings and Conclusion

This study aimed to assess the outcomes of green bond-funded projects on renewable energy development and the transition to a low-carbon energy system in South Africa, focusing particularly on Nedbank’s Renewable Energy Bonds as a case study. To address this research question, four key sub-questions were explored, resulting in several significant findings. While the primary focus was on Nedbank’s green bond issuance, the insights from this study contribute to a broader understanding of green bond outcomes across South Africa.

The findings confirm that Nedbank’s Renewable Energy Bonds played a pivotal role in encouraging private sector participation in renewable energy development, helping to create a market for sustainable investments. As a leader in the market, Nedbank set a precedent for transparency and alignment with global ESG standards, encouraging other financial institutions to follow suit. However, Nedbank’s success must be understood in the context of global pressures, like the Paris Agreement, and local factors such as South

Africa’s ongoing energy shortages, all of which have shaped private sector engagement in renewable energy.

The study demonstrated that projects funded by Nedbank’s Renewable Energy Bonds have made measurable contributions to reducing carbon emissions, aligning with global green bond principles. However, while significant, this contribution remains limited in scope, underscoring the urgent need for increased financial investment to help South Africa meet its carbon reduction targets. The exclusion of key sectors, driven by the stigmatization of "dirty industries," further hampers the potential for large-scale carbon reductions, raising critical questions about the inclusivity of the green bond framework. The contradiction between the objectives and execution within the green bond market is concerning. While the goal is to promote sustainable initiatives and reduce emissions, green bonds have struggled to engage high-emission industries. Given the importance of these industries to both the economy and the low-carbon transition, their exclusion restricts the potential for achieving meaningful emissions reductions.

The study also raises a critical question about whether the green transition can realistically occur within the framework of capitalism, especially in South Africa’s carbon-dependent economy. The findings suggest that transitioning away from fossil fuels will likely require the involvement and capital of industries currently regarded as "dirty”. Without acknowledging their role in funding and advancing renewable energy initiatives, South Africa's green transition could face major challenges. The study suggests that the green bond market should be tailored to the local context, incorporating industries traditionally seen as part of the problem into the solution. This approach could help reduce stigma around certain sectors and create a more inclusive and effective green bond market.

The issue of inclusivity goes beyond industries to encompass communities and demographics. Unlike more developed regions like Europe, where green bonds have proliferated, South Africa’s socio-economic context requires that green bonds also address community outcomes. This study found that projects like the Golden Valley Wind Farm, have significantly impacted marginalized areas by creating jobs, fostering entrepreneurship, and improving education. However, the unequal distribution of financial benefits, particularly regarding land ownership and profit-sharing, underscores persistent inequalities. For green bonds to be sustainable in South Africa, socio-economic outcomes must be prioritized alongside environmental goals, especially in historically marginalized communities.

Stakeholder feedback further highlighted the challenges facing green bonds in South Africa's renewable energy sector. High issuance costs, compliance burdens, and exclusionary practices that favour established companies over smaller, emerging players limit the diversity of participants in the market. These barriers prevent a broader range of industries and companies from engaging with green bonds and contributing to the country's climate goals. Stakeholders also pointed to the need for structural reforms, such as government incentives and regulatory changes, to lower the cost of issuance and broaden participation in the green bond market.

In conclusion, the study finds that while green bonds have demonstrated significant potential to advance South Africa's renewable energy development and carbon reduction goals, the green bond market, as currently structured, faces significant limitations. These include high issuance costs, exclusivity barriers, and an insufficient focus on socio-economic outcomes in a country with profound inequalities. For green bonds to be a sustainable solution in South Africa, they must be tailored to local conditions, prioritizing inclusivity, community development, and structural reforms that encourage broader private sector participation across industries. Ultimately, green bonds offer a promising avenue for transitioning to a low-carbon economy, but their success will depend on their ability to align environmental goals with socio-economic imperatives in a just and equitable manner.

7.7 Recommendations

In light of the findings and conclusions, this study presents key recommendations to improve the effectiveness of green bonds in driving renewable energy development and supporting a just transition to a low-carbon energy system within South Africa. These recommendations address the structural, regulatory, and socio-economic challenges identified throughout the research.

It is recommended that future research explore strategies to address the perception of exclusivity in the green bond market, with an emphasis on fostering education and awareness to engage industries often labelled as "dirty." In South Africa, where fossil fuel operations are economically significant, dismantling this stigma is crucial for meeting emissions reduction targets outlined in the country's NDCs. Moreover, integrating these industries is essential for advancing an inclusive and sustainable transition to a low-carbon economy. There is also a need to investigate how strategic support can help carbon-intensive industries navigate the requirements of the GBP. Such support should focus on

ensuring these requirements are viewed as achievable, facilitating their transition to more sustainable practices.

Similarly, there is a need for further research on how green bond frameworks in South Africa can incorporate the country's socio-economic context. This includes exploring ways for green bond-funded projects to prioritize socio-economic outcomes alongside carbon reductions, ensuring long-term sustainability. Research should also address strategies to promote equitable distribution of benefits in marginalized communities, mitigating the risk of perpetuating historical inequalities. A "one size fits all" approach tailored to established markets, like Europe, may overlook South Africa's unique needs. Adapting frameworks to the local context while preserving the integrity of the GBP is essential for an inclusive and equitable transition.

Lastly, there is a need for further research on how the government can play a role in creating an enabling environment for increased green bond issuances. This includes exploring policy certainty through stable, long-term regulatory frameworks that support green bonds and sustainable development. Additionally, research should focus on regulatory reforms such as tax incentives, higher green portfolio allocations for pension funds, and support for innovative projects like sustainable freight rail and waste-to-energy, to boost private sector participation and expand the green bond market.

In conclusion, the success of green bonds in South Africa depends on their ability to balance environmental, social, and economic outcomes in a just and equitable manner. By addressing the barriers of exclusivity, promoting policy certainty and incorporating socio-economic indicators, green bonds can play a transformative role in South Africa's transition to a low-carbon economy. With adequate support from both the public and private sectors, the green bond market has the potential to unlock substantial opportunities for sustainable development, benefiting both present and future generations.

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Appendix 1 – Research ethics approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | SCHOOL OF ARCHITECTURE PLANNING

6 August 2024

Mchunu,Sifiso Mpilonhle

2786148

TO WHOM IT MAY CONCERN

RESEARCH ETHICS APPROVAL

Assessing the outcomes of green bond-funded projects on renewable energy development and transition to a low-carbon energy system within South Africa – A case study of Nedbank's Renewable Energy Bonds

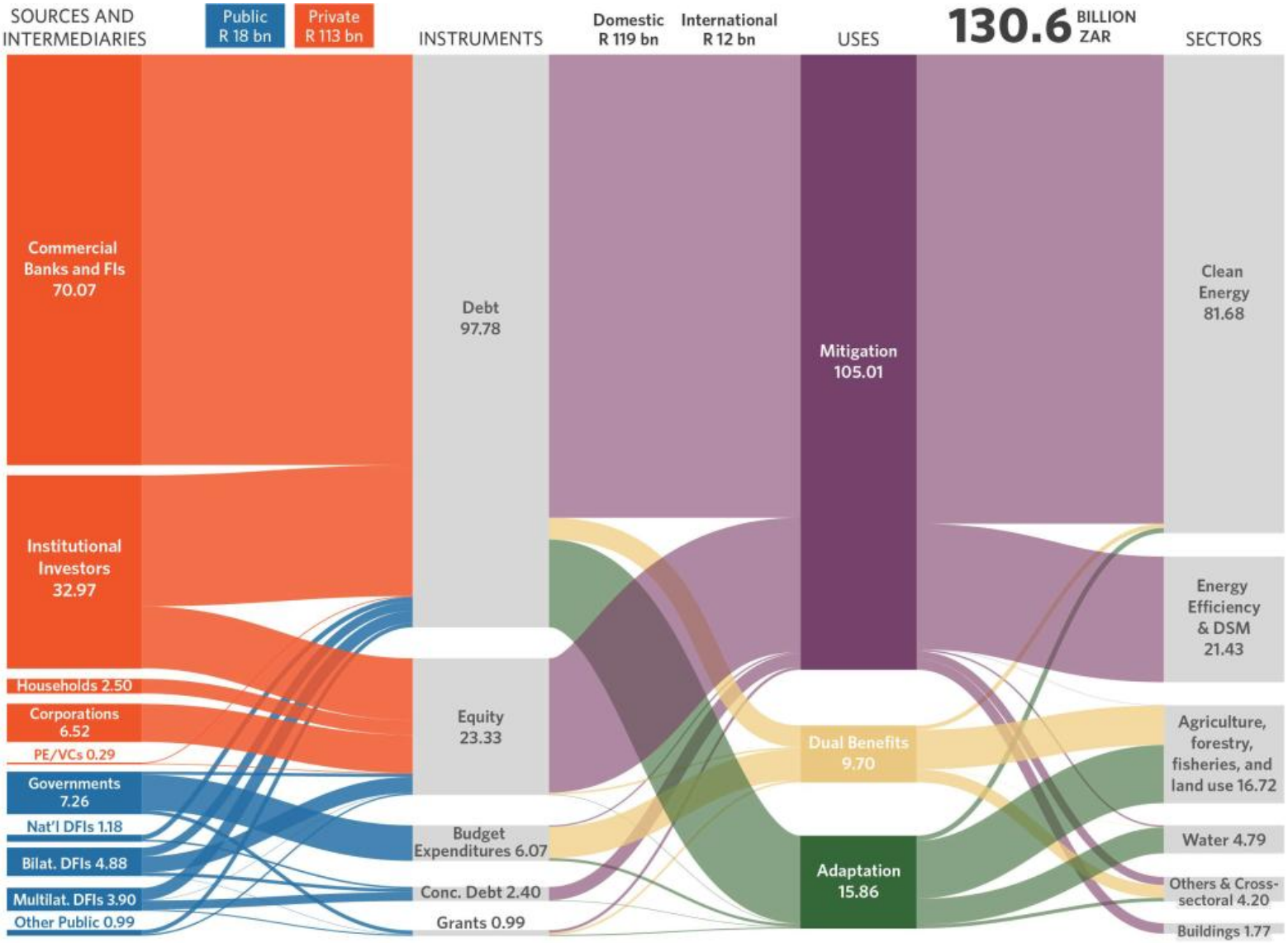
This letter serves to confirm that the Ethics application for the above titled study has been approved. The researcher has been granted clearance to proceed with the research study or project.

Protocol/clearance number is: **SOAP048/05/2024**

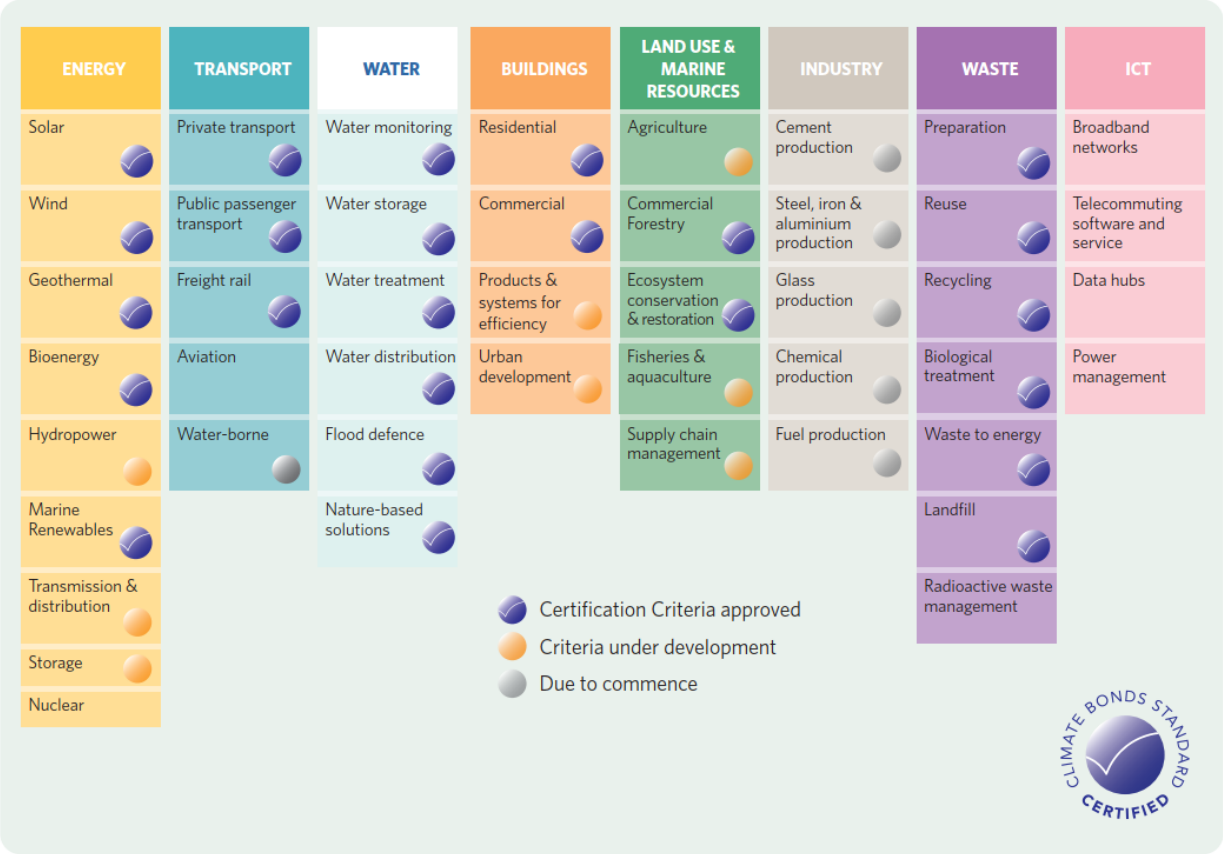
Yours sincerely

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Appendix 2 – Climate finance landscape in South Africa 2023 (R billion) (PCC, 2023)



Appendix 3 – Eligible projects under the Climate Bonds taxonomy (FSD Africa, 2020).



Appendix 4 – Comparison of issuance processes for regular bonds and green bonds (Climate bonds Initiative, 2021)

Pre-Issuance • Get rated • Get market intelligence on currency, tenor, size • Decide on underwriters • Register with local regulator • Issue prospectus • Comfort letter / due diligence • Outreach through road shows and sales	**Pre-Issuance** • Define a Green Bond Framework: 1. Preparation 2. Define how project meets green bond eligibility criteria (Use of Proceeds) 3. Put in place project selection process and select eligible projects (Selection of Projects and Assets) 4. Set up accounts and process to earmark and allocate proceeds – ring-fence the proceeds (Management of Proceeds) 5. Establish Reporting processes 6. Get pre-issuance external review (External Review) • Check for support mechanisms
Issuance: Launch the bond into the market • Build the book of investors who are interested in the bond	**Issuance: Launch the bond into the market** • Include the green attributes in marketing materials and investor documents
Post-Issuance • Price and allocate bond to support secondary market performance • Communication to the capital market • Monitor secondary market	**Post-Issuance** • Allocate proceeds to the projects • Monitor the projects and track allocation over time • Publish impact Report • Post issuance Audit if necessary

Appendix 5 – Summary template for project-level reporting (World Bank , 2015)

Option 1 (impacts of different project components reported separately)

Energy Efficiency (EE)	Signed Amount a/	Share of Total Project Financing b/	Eligibility for green bonds	EE component	Allocated Amount c/	Project lifetime d/	#1) Annual energy savings (electricity / other)		#2) Annual GHG emissions reduced/avoided e/	Other Indicators
Project name f/	*currency*	*%*	*% of signed amount*	*% of signed amount*	*currency*	*in years*	*MWh/ GWh*	*GJ/TJ*	*in tonnes of CO_2 equivalent*	
e.g. Project 1	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX people benefited; XXX t CO2 eq. Absolute annual project emissions.

Renewable Energy (RE)	Signed Amount a/	Share of Total Project Financing b/	Eligibility for green bonds	RE Component	Allocated Amount c/	Project lifetime d/	#3) Annual generation (electricity / other)		#4) a) Renewable energy capacity added	#4) b) Renewable energy capacity rehabilitated	#2) Annual GHG emissions reduced/avoided e/	Other Indicators
Project name f/	*currency*	*%*	*% of signed amount*	*% of signed amount*	*currency*	*in years*	*MW/ GWh*	*GJ/TJ*	*MW*	*MW*	*in tonnes of CO_2 equivalent*	
e.g. Project 2	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX t CO_2 eq. Absolute annual project emissions.

Option 2 (impacts of different project components not reported separately)

Energy Efficiency (EE) *and* Renewable Energy (RE) g/	Signed Amount a/	Share of Total Project Financing b/	Eligibility for green bonds	Allocated Amount c/	Project lifetime d/	#1) Annual energy savings (electricity / other)		#3) Annual generation (electricity / other)		#4) a) Renewable energy capacity added	#4) b) Renewable energy capacity rehabilitated	#2) Annual GHG emissions reduced/ avoided e/	Other Indicators
Project name f/	*currency*	*%*	*% of signed amount*	*currency*	*in years*	*MWh/ GWh*	*GJ/TJ*	*MWh/ GWh*	*GJ/TJ*	*MW*	*MW*	*in tonnes of CO_2 equivalent*	
e.g. Project 3	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX people benefited; XX t CO_2 eq. Absolute annual project emissions.

Notes:

a/ Signed amount represents the amount legally committed by the issuer for the project or component that is eligible for green bond financing.

b/ This is the share of the total project cost that is financed by the issuer. Issuers may also report the total project cost. When aggregating impact metrics, only the pro-rated share should be included in the total.

c/ This represents the amount of green bond proceeds that has been allocated to disbursements to the project.

d/ Based on either the expected economic life or financial life of the project. Issuer should disclose the reporting basis used.

e/ The methodology and assumptions used should be disclosed when emission reductions/avoidances are reported.

f/ Confidentiality considerations may restrict the project level detail that can be disclosed, but issuers should aim to report the list of projects and either project level or aggregate level committed and allocated amounts and core indicator amounts.

g/ Where projects include both an energy efficiency and renewable energy component, issuers may combine both components into a single table. The proposed core indicators would be included where applicable and where data is available. Issuers may also include the share of project financing attributable to renewable energy and energy efficiency respectively.

Appendix 6 – Summary template for portfolio-level reporting (World Bank , 2015)

Option 1 (impacts of different portfolio components reported separately)

Energy Efficiency (EE)	Signed Amount a/	Share of Total Portfolio Financing b/	Eligibility for green bonds	EE component	Allocated Amount c/	Average portfolio lifetime d/	#1) Annual energy savings (electricity / other), possibly per unit of financing		#2) Annual GHG emissions reduced/avoided (possibly per unit of financing) e/	Other Indicators per unit (possibly per unit of financing)
Portfolio name	*currency*	*%*	*%*	*%*	*currency*	*years*	*MWh /GWh*	*GJ/TJ*	*in tonnes of CO_2 equivalent*	
e.g. Portfolio 1	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX people benefited; XX t CO2 eq. Absolute annual project emissions.

Renewable Energy (RE)	Signed Amount a/	Share of Total Portfolio Financing b/	Eligibility for green bonds	RE Component	Allocated Amount c/	Average portfolio lifetime d/	#3) Annual generation (electricity/other), possibly per unit of financing		#4) a) Renewable energy capacity added (possibly per unit of financing)	#4) b) Renewable energy capacity rehabilitated (possibly per unit of financing)	#2) Annual GHG emissions reduced/avoided (possibly per unit of financing) e/	Other Indicators (possibly per unit of financing)
Portfolio name	*currency*	*%*	*%*	*%*	*currency*	*years*	*MWh/ GWh*	*GJ/TJ*	*MW*	*MW*	*in tonnes of CO_2 equivalent*	
e.g. Portfolio 2	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX t CO_2 eq. Absolute annual portfolio emissions

Option 2 (impacts of different portfolio components not reported separately)

Energy Efficiency (EE) *and* Renewable Energy (RE) g/	Signed Amount a/	Share of Total Portfolio Financing b/	Eligibility for green bonds	Allocated Amount c/	Average portfolio lifetime d/	#1) Annual energy savings (energy/other), possibly per unit of financing		#3) Annual generation (electricity /other), possibly per unit of financing		#4) a) Renewable energy capacity added (possibly per unit of financing)	#4) b) Renewable energy capacity rehabilitated (possibly per unit of financing)	#2) Annual GHG emissions reduced/avoided (possibly per unit of financing) e/	Other Indicators (possibly per unit of financing)
Portfolio name	*currency*	*%*	*%*	*currency*	*years*	*MWh/ GWh*	*GJ/TJ*	*MWh/ GWh*	*GJ/TJ*	*MW*	*MW*	*in tonnes of CO_2 equivalent*	
e.g. Portfolio 3	XX	XX	xx	XX		XX	XX	XX	XX	XX	XX	XX	XX people benefited; XX t CO_2 eq. Absolute annual portfolio emissions

Notes:

a/ Signed amount represents the amount legally committed by the issuer for the portfolio or portfolio components eligible for green bond financing.

b/ This is the share of the total portfolio cost that is financed by the issuer. Issuers may also report the total portfolio cost. When impact metrics are available, only the pro-rated share should be included in the total.

c/ This represents the amount of green bond proceeds that has been allocated for disbursements to the portfolio.

d/ Based on either the expected economic life or financial life of the portfolio. Issuer should disclose the reporting basis used.

e/ The methodology and assumptions used should be disclosed when emission reductions/avoidances are reported.

g/ Where portfolios include both an energy efficiency and renewable energy component, issuers may combine both components into a single table. The proposed core indicators would be included where applicable and data is available. Issuers may also include the share of portfolios financing attributable to renewable energy and energy efficiency respectively.

Appendix 7 – Eskom historical data on electricity generation per power station (Eskom, 2023)

Plant names	Installed capacity (MW) - IR23	Commissioning date	Reinstallation date	UoM	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Arnot	2100	1971/09/21	1971/09/21	MWh/year	12 194 878	12 229 098	11 950 797	10 840 753	9 893 812	10 099 018	10 483 060	10 305 115	9 929 077	10 713 440	10 148 766	9 085 064	7 530 158
Duvha	2875	1980/08/18	1980/08/18	MWh/year	20 267 508	17 556 459	17 413 964	17 925 378	13 191 464	14 060 101	16 359 000	13 001 015	11 120 844	10 649 157	11 230 400	9 822 489	9 555 266
Hendrina	1098	1970/05/12	1970/05/12	MWh/year	11 938 206	11 412 357	9 489 357	8 861 776	10 079 833	8 172 225	8 919 238	7 667 408	7 355 513	4 785 111	4 873 506	4 738 179	2 136 620
Kendal	3840	1988/10/01	1988/10/01	MWh/year	25 648 258	27 309 297	26 198 513	27 012 212	24 459 162	25 301 535	23 183 480	25 445 952	21 049 970	17 186 573	15 106 544	15 139 746	15 750 630
Kriel	2640	1976/05/06	1976/05/06	MWh/year	18 204 910	15 289 169	16 570 689	14 443 442	14 803 828	15 940 417	14 837 902	12 183 630	13 067 561	13 951 805	11 328 488	12 597 519	10 727 877
Kusile	2880	2017/08/30	2017/08/30	MWh/year									3 921 196	7 487 938	8 553 383	7 992 189	9 119 476
Lethabo	3558	1985/12/22	1985/12/22	MWh/year	25 500 366	24 274 937	22 480 206	23 092 551	23 742 350	20 996 410	22 271 522	18 202 800	21 565 771	18 888 210	21 832 979	22 890 481	21 367 191
Majuba	3807	1996/04/01	1996/04/01	MWh/year	24 632 585	25 325 348	24 781 734	23 801 048	22 423 750	21 187 846	20 900 760	24 413 271	24 154 240	22 088 772	21 857 835	19 823 301	15 540 628
Matimba	3690	1987/12/04	1987/12/04	MWh/year	28 163 040	27 899 475	26 714 123	25 895 187	26 851 628	24 554 035	25 610 275	26 369 000	26 677 698	26 704 094	23 533 126	23 180 336	23 257 630
Matla	3450	1979/09/29	1979/09/29	MWh/year	21 504 422	20 650 022	21 939 690	18 376 342	20 221 135	20 811 348	20 032 197	19 408 403	18 938 849	19 887 819	18 560 297	18 412 664	15 170 449
Medupi	3600	2015/08/22	2015/08/22	MWh/year							2 428 262	4 420 084	15 518 851	19 978 963	19 753 895	22 637 675	23 246 212
Tutuka	3510	1985/06/01	1985/06/01	MWh/year	19 067 501	20 504 886	19 306 569	18 103 698	20 594 572	18 383 009	16 028 708	16 730 961	15 169 501	12 129 632	10 554 111	8 524 715	7 564 337
Koeberg	1854	1984/07/21	1984/07/21	MWh/year													
Acacia	171	1976/05/13	1976/05/13	MWh/year	992	1 163	9 958	56 443	64 570	55 960	151	76	1 712	438	1 467	873	1 069
Ankerlig	1327	2007/03/01	2007/03/01	MWh/year	130 241	391 049	1 225 994	2 358 259	2 350 792	2 503 859	20 939	62 963	788 527	808 699	703 887	953 788	1 332 491
Gourikwa	740	2007/07/01	2007/07/01	MWh/year	62 233	314 651	657 374	1 133 246	1 226 384	1 307 888	8 153	54 496	409 512	518 521	749 724	870 396	1 681 217
Port Rex	171	1976/09/30	1976/09/30	MWh/year	5 507	2 162	10 830	73 166	67 421	68 699	41	63	1 787	436	1 457	937	3 010
Colley Wobbles/Mbashe	42	1985/01/01	1985/01/01	MWh/year													
First Falls	6	1979/02/01	1979/02/01	MWh/year													
Gariep	360	1971/09/08	1971/09/08	MWh/year													
Ncora	2	1983/03/01	1983/03/01	MWh/year													
Second Falls	11	1979/04/01	1979/04/01	MWh/year													
Van Der Kloof	240	1977/01/01	1977/01/01	MWh/year													
Sere	100	2015/03/31	2015/03/31	MWh/year													
Drakensberg	1000	1981/06/17	1981/06/17	MWh/year													
Ingula	1324	2016/06/30	2016/06/30	MWh/year													
Palmiet	400	1988/04/18	1988/04/18	MWh/year													
Camden	1481	1967/08/01	2005/03/01	MWh/year	7 490 836	7 267 648	8 379 789	8 727 143	8 336 111	7 947 972	7 763 734	6 777 927	6 972 647	5 846 748	2 518 438	6 670 341	7 378 745
Grootvlei	570	1969/06/01	2008/04/30	MWh/year	3 546 952	6 094 910	5 491 180	7 345 967	6 144 207	5 273 434	4 545 234	3 295 218	2 703 531	2 477 795	2 992 859	2 445 162	2 416 293
Komati	990	1961/11/06	2009/03/31	MWh/year	2 060 141	2 398 132	4 104 105	5 059 255	4 066 079	4 241 812	4 123 522	2 209 493	2 064 923	1 581 225	708 862	608 728	369 330

Appendix 8 – 50-year plan to decommission Eskom's coal fired power station (Climate bonds Initiative, 2021)

