



The impact of adaptation measures proposed in the Climate Change Act, 22 of 2024 on the electricity sector in South Africa

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Abstract

On 23 July 2024, South African President Cyril Ramaphosa signed the Climate Change Bill (B9-2022), which is now known as the Climate Change Act 22 of 2024. This legislative proposal constitutes a complex piece of legislation with the potential to exert a significant influence across a wide array of sectors in South Africa, including the electricity sector.

The purpose of the Climate Change Act 22 of 2024 is to facilitate a comprehensive response to climate change and support the transition toward a sustainable, low-carbon economy in South Africa. The Act aligned with section 24 of the Constitution, as it introduced measures to mitigate greenhouse gas emissions that contributed to climate change and adaptation measures to manage the impacts of climate change.

The key focus area of this research was to analyse South Africa's electricity sector, in line with the adaptation measures set out in the Act, which aimed to enhance energy security and promote cleaner, competitive energy sources. The research investigated the impact on the electricity sector of the adaptation measures outlined in the Act.

The study considered the global legislative frameworks for climate action, exploring the evolution of adaptation priorities from the United Nations Framework Convention on Climate Change (UNFCCC) to the Paris Agreement and Glasgow Climate Pact. These international themes served as a framework to evaluate South Africa's alignment with international goals and objectives.

An analysis of South Africa's legislative and policy frameworks was undertaken, including the National Development Plan 2030, the National Climate Change Response Policy, and the Climate Change Act. This also comprised a comparative analysis of Denmark's adaptation measures, offering lessons for South Africa. Denmark's leading role in renewable energy integration, grid modernisation, and policy implementation provided valuable insights into addressing the unique challenges faced by South Africa's electricity sector. The analysis highlighted the importance of investing in technological innovation, stakeholder collaboration, and institutional capacity-building.

The research concluded by emphasising the importance of coordinated policy implementation, innovative financing mechanisms, and cross-sectoral collaboration in

achieving a resilient, low-carbon electricity sector. By aligning national strategies with international objectives and incorporating lessons from global leaders in renewable energy, such as Denmark, South Africa can enhance its adaptation efforts and ensure sustainable energy security.

Key Words

Climate Change Bill, Climate Change Act, electricity sector, adaptation measures, United Nations Framework Convention on Climate Change, Denmark's Strategy for Adaptation to a Changing Climate

Acknowledgments and dedications

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List of Abbreviations

AC	Adaptation Committee
CBIT	Capacity-building Initiative for Transparency
COP	Conference of the Parties
DFFE	Department of Forestry, Fisheries and Environment
Eskom	State-owned electricity utility in South Africa
EU	European Union
GCF	Green Climate Fund
GCP	Glasgow Climate Pact
IPCC	Intergovernmental Panel on Climate Change
LDCF	Least Developed Countries Fund
LDCs	Least Developed Countries
LEG	Least Developed Countries Expert Group
NAPAs	National Adaptation Programmes of Action
NAPs	National Adaptation Plans
NAS	National Adaptation Strategy
NASP	National Adaptation Strategy and Plan
NCCRP	National Climate Change Response White Paper
NCOP	National Council of Provinces
NDCs	Nationally Determined Contributions
NDP	National Development Plan
NEMA	National Environmental Management Act
OECD	Organisation for Economic Cooperation and Development
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SA	South Africa
SCCF	Special Climate Change Fund
SDGs	Sustainable Development Goals
SETs	Sectoral Emission Targets
SIDS	Small Island Developing States
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1 Introduction and background

1.1. Introduction

Section 24 of the Constitution of the Republic of South Africa¹ ("the Constitution") recognises the fundamental right of all citizens to an environment that is not detrimental to their health and well-being.² This provision mandates the state to protect the environment and to promote an ecologically sustainable development.³

The Climate Change Bill (B9-2022), referred to as "the Bill", was officially presented to Parliament on 18 February 2022 by the Department of Forestry, Fisheries, and the Environment (DFFE). On 24 October 2023, the National Assembly passed the Bill.⁴ The National Council of Provinces (NCOP) approved the Climate Change Bill on 29 April 2024, and it was submitted to President Cyril Ramaphosa for final signature and gazetting into law.⁵

On 23 July 2024, President Cyril Ramaphosa signed the Climate Change Bill into law, formally establishing it as the Climate Change Act No. 22 of 2024.⁶ The Climate Change Act was promulgated into law on 17 March 2025. Although the Act has come into effect, the commencement of certain provisions relating to the carbon budgets, municipal and provincial responses, the National Adaptation Strategy, and finance mechanisms has been deferred. This delay is due to the development and finalisation of the regulations necessary to enable the implementation of these provisions.⁷ The Climate Change Act represents a complex and transformative piece of legislation with the potential to have an impact on numerous sectors across South Africa, including the

¹ Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996). Available at: <https://www.parliament.gov.za/bill/2300773> (Accessed: 12 March 2024).

² Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996). Available at: <https://www.parliament.gov.za/bill/2300773> (Accessed: 12 March 2024).

³ Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996). Available at: <https://www.parliament.gov.za/bill/2300773> (Accessed: 12 March 2024).

⁴ Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996). Available at: <https://www.parliament.gov.za/bill/2300773> (Accessed: 12 March 2024).

⁵ Climate Change Act 22 of 2024. Available at: <https://www.gov.za/documents/acts/climate-change-act-22-2024-english-tshivenda-23-jul-2024> (Accessed: 22 March 2025).

⁶ Department of Forestry, Fisheries and the Environment (DFFE) *NCop Climate Change Bill*. Available at: https://www.dffe.gov.za/mediareleases/ncop_climatechangebill (Accessed: 22 March 2025).

⁷ Department of Forestry, Fisheries and the Environment (DFFE) *Minister George announces proclamation and implementation of the Climate Change Act, 22 of 2025* (Accessed 25 March 2025) www.dffe.gov.za

electricity sector. The purpose of the Act was to facilitate a comprehensive response to climate change and support the transition toward a sustainable, low-carbon economy in South Africa.⁸ The Act is in line with section 24 of the Constitution, as it introduces measures to mitigate greenhouse gas emissions that contribute to climate change and adaptation measures to manage the impacts of climate change.

The Act does not specifically address the electricity sector. The transition toward renewable energy sources can be expedited by adequate carbon pricing, technological advancements, and increased competition in the sector.⁹ The cost of renewables has already become competitive when compared to coal-based energy.¹⁰ The Act further emphasises South Africa's commitment to international climate change efforts in terms of the proposed adaptation measures.

The Climate Change Act has the potential to transform and reshape South Africa's electricity sector by addressing the complex challenges brought about by climate change.¹¹ One of its primary objectives is to restrict greenhouse gas emissions, a consequence of South Africa's extensive reliance on fossil fuels.¹² To achieve this, the Act introduces a series of measures aimed at navigating the electricity sector toward renewable energy sources and the implementation of carbon reduction targets, both of which are instrumental in aligning with the global climate objectives.¹³

⁸ Department of Forestry, Fisheries and the Environment (DFFE) Minister George announces proclamation and implementation of the Climate Change Act, 22 of 2025 (Accessed 25 March 2025) www.dffe.gov.za

⁹ <https://www.irena.org/News/pressreleases/2022/Jul/Renewable-Power-Remains-Cost-Competitive-amid-Fossil-Fuel-Crisis>

¹⁰ <https://www.irena.org/News/pressreleases/2022/Jul/Renewable-Power-Remains-Cost-Competitive-amid-Fossil-Fuel-Crisis>

¹¹ Cairncross and Strydom "Energy" Fuggle and Rabie Environmental Management in South Africa/Chapter 10 Energy.

[http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates\\$fn=default.htm](http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates$fn=default.htm)

¹² Cairncross and Strydom "Energy" Fuggle and Rabie Environmental Management in South Africa/Chapter 10 Energy.

[http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates\\$fn=default.htm](http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates$fn=default.htm)

¹³ Cairncross and Strydom "Energy" Fuggle and Rabie Environmental Management in South Africa/Chapter 10 Energy.

[http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates\\$fn=default.htm](http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates$fn=default.htm)

The key focus area of this research was to analyse SA's electricity sector, in line with the adaptation measures set out in the Act, which aim to enhance energy security and promote cleaner, competitive energy sources.

Furthermore, the Climate Change Act has the potential to positively influence the electricity sector by adapting to the effects of climate change and building a more resilient economy and society. However, it is important to note that the Act could also have some negative repercussions.

1.2. Motivation

This study was motivated by the recognition that in South Africa, the Act represents a pivotal and complex piece of legislation that has the potential to significantly affect the country's electricity sector. The Act's primary objective is to combat climate change by reducing greenhouse gas emissions and promoting the transition to renewable energy sources, aligning both national and international environmental and sustainability goals.¹⁴

An analysis of the Climate Change Act reveals its relevance to the electricity sector. It introduces various critical elements, including adaptation strategies, provincial and municipal responses to climate change, national greenhouse gas emissions trajectory, sectoral emissions targets, and the phasing down and phasing out of synthetic greenhouse gas emissions.¹⁵

To help South Africa achieve its climate change adaptation goals, it is important to learn from a comparative analysis of Denmark's approach to climate change adaptation.¹⁶ Denmark has made notable progress in transitioning toward a sustainable green society and has established itself as a leader in climate change and adaptation efforts.

¹⁴ Cairncross and Strydom 'Energy', in Fuggle, and Rabie, *Environmental management in South Africa*. Available at: [http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates\\$fn=default.htm](http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates$fn=default.htm).

¹⁵ Climate Change Bill 2019.

¹⁶ Danish Strategy for Adaptation to a Changing Climate, Danish Government, March 2008, <https://www4.unfccc.int/sites/NAPC/Documents/Adaptation%20Strategies%20and%20Plans/Denmark/Danish%20Strategy%20for%20Adaptation%20to%20a%20changing%20Climate.pdf>

Denmark's approach is based on the establishment of an efficient and renewable energy sector, which serves as the foundation for transitioning toward a sustainable green society.¹⁷ By investing in renewable energy sources, such as wind and solar power, Denmark has been able to reduce its greenhouse gas emissions and increase its energy efficiency.¹⁸ The country's policies incentivise energy efficiency and the adoption of renewable energy sources.

Denmark's comprehensive approach to climate change adaptation incorporates sustainability principles into various aspects of its economy and society.¹⁹ The country has implemented circular economy principles that promote the efficient use of resources, waste reduction, and recycling.²⁰

South Africa and Denmark have significant differences in their socio-economic development. However, Denmark is a valuable model for South Africa to follow regarding the electricity sector's adaptation to climate change. Denmark is an international leader in the fight against climate change and has set ambitious targets, such as shifting the entire energy system to renewable energy by 2035 and phasing out oil, gas, and coal entirely by 2050.²¹

In addition, Denmark and South Africa have been cooperating since 2011 on the transition to a green energy.²² The partnership focuses on capacity-building for South African partners and sharing Danish experiences with regulatory frameworks for integrating renewable energy.²³ Denmark has identified vulnerabilities in various

¹⁷ Denmark's Integrated National Energy and Climate Plan under the Regulation of the European Parliament and of the Council on the Governance of the Energy Union, Danish Ministry of Climate, Energy and Utilities, December 2019, <https://ens.dk/en/our-responsibilities/energy-climate-politics/eu-energy-union-denmarks-national-energy-and-climate>

¹⁸ Denmark's Integrated National Energy and Climate Plan under the Regulation of the European Parliament and of the Council on the Governance of the Energy Union, Danish Ministry of Climate, Energy and Utilities, December 2019, <https://ens.dk/en/our-responsibilities/energy-climate-politics/eu-energy-union-denmarks-national-energy-and-climate>

¹⁹ Danish Strategy for Adaptation to a Changing Climate, Danish Government, March 2008, <https://www4.unfccc.int/sites/NAPC/Documents/Adaptation%20Strategies%20and%20Plans/Denmark/Danish%20Strategy%20for%20Adaptation%20to%20a%20changing%20Climate.pdf>

²⁰ Danish Strategy for Adaptation to a Changing Climate, Danish Government, March 2008, <https://www4.unfccc.int/sites/NAPC/Documents/Adaptation%20Strategies%20and%20Plans/Denmark/Danish%20Strategy%20for%20Adaptation%20to%20a%20changing%20Climate.pdf>

²¹ <https://ens.dk/en/our-responsibilities/global-cooperation/country-cooperation/south-africa>

²² <https://ens.dk/en/our-responsibilities/global-cooperation/country-cooperation/south-africa>

²³ <https://ens.dk/en/our-responsibilities/global-cooperation/country-cooperation/south-africa>

sectors, including energy, in its Strategy for Adaptation to a Changing Climate.²⁴ For the energy sector, Denmark proposed actions such as enhancing energy sector adaptation and resilience, and developing policies for integrating renewable energy effectively.²⁵

Denmark's proactive approach, successful renewable energy integration, and commitment to climate resilience make it an excellent case study for South Africa's electricity sector adaptation.²⁶ By studying Denmark's approach to climate change adaptation, South Africa can gain valuable insights into effective strategies for addressing climate challenges. This can assist the South African government and the private sector to develop the appropriate policies and practices that can facilitate the transition toward a sustainable, green society. Through leveraging these insights, South Africa can make significant progress toward achieving its climate change adaptation goals and contribute to the global efforts to alleviate the impacts of climate change.

The potential impact of the Climate Change Act extends to various sectors, including energy, agriculture, water, human health, infrastructure, manufacturing, transportation, and tourism.²⁷ While it offers opportunities for job creation and economic growth in the renewable energy and energy efficiency sectors, it also poses challenges, such as potential job losses in coal mining.²⁸ It is, therefore, important to plan carefully and collaborate with stakeholders to maximise the positive effects and mitigate negative consequences. Key stakeholders, including government, academia, the private sector, civil society as well as labour unions, are critical in implementing the Act. Their active consultation and involvement are necessary to ensure a fair and just transition to a low-carbon electricity sector that benefits all parties.

²⁴ <https://sydafrika.um.dk/en/relations/climate-and-energy-cooperation>

²⁵ <https://www.iea.org/reports/denmark-climate-resilience-policy-indicator>

²⁶ <https://sydafrika.um.dk/en/relations/climate-and-energy-cooperation>

²⁷ Cairncross E, Strydom HA "*Energy*" Fuggle and Rabie Environmental Management in South Africa/Chapter 10 Energy.

[http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates\\$fn=default.htm](http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates$fn=default.htm)

²⁸ Cairncross E, Strydom HA "*Energy*" Fuggle and Rabie Environmental Management in South Africa/Chapter 10 Energy.

[http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates\\$fn=default.htm](http://jutastatjutacoza.nwulib.nwu.ac.za/nxt/gateway.dll/emsa/96?f=templates$fn=default.htm)

1.3. Objective

The objective of this research was to analyse how the adaptation measures in the Climate Change Act will affect South Africa's electricity sector. This encompassed several key facets, including:

- a) Identification of crucial elements relevant to the electricity sector.
- b) An assessment of the potential ramifications across various sectors, emphasising electricity.
- c) Recognition of essential stakeholders and their significance within the electricity sector.
- d) Evaluation of the Climate Change Act's alignment with national and international environmental and sustainability goals.
- e) The formulation of recommendations to guide the legislation's implementation.

This dissertation commenced with the introduction and background to the research. Chapter 2 provides the background to the international development of the legislative framework for climate action, with a review and analysis of the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, and the Glasgow Pact, with specific reference to adaptation. Chapter 3 examines the development of South Africa's national legislative framework in response to climate change. Chapter 4 presents the analysis of Denmark's adaptation measures to climate change and its impact on the electricity sector in comparison to South Africa. Chapter 5 provides insights and recommendations on strengthening South Africa's adaptation strategies in the electricity sector.

1.4. Research methodology

To achieve the objectives of this dissertation, the analysis was based on legal theory research. The primary information sources comprised the existing literature but not limited to the Climate Change Act, the United Nations Framework Convention on Climate Change, the Paris Agreement, and the Glasgow Climate Pact. Furthermore, the research also included the analysis of various other domestic and international legal frameworks and policies relating to the adaptation measures pertinent to the electricity sector.

Chapter 2 A historical overview of the global legislative framework for climate action: foundations for adaptation and resilience

2.1. Introduction

The complex concept of climate change and adaptation measures emerged in the 1990s.²⁹ Even though the concepts lacked a universally accepted definition, the topic gained political prominence in the early 21st century. Several strategies were developed at various levels (regional, national, and local), but their implementation often lagged behind policy commitments.³⁰

The term "climate change adaptation" lacked a universally accepted definition.³¹ The Intergovernmental Panel on Climate Change (IPCC) defines adaptation in its 5th Assessment Report as

the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.³²

In 1992, the concept of climate change adaptation became widely recognised in science and policymaking.³³ It was introduced as part of the United Nations Framework Convention for Climate Change (UNFCCC) to address climate system changes, but the emphasis was on climate mitigation.³⁴

A critical review of adaptation in practices such as land-use planning highlighted the importance of integrating local stakeholders and adopting measures that are socially, culturally, and economically viable.³⁵ As a result, adaptation evolved as a recognised

²⁹ Climate change adaptation (Oxford Research Encyclopaedia of Climate Science 2025), available at <https://www.ipcc.ch/assessment-report/ar5/> (accessed 24 March 2025)

³⁰ Climate change adaptation (Oxford Research Encyclopaedia of Climate Science 2025), available at <https://www.ipcc.ch/assessment-report/ar5/> (accessed 24 March 2025).

³¹ climate change adaptation | Oxford Research Encyclopaedia of Climate Science.

³² <https://www.ipcc.ch/assessment-report/ar5/>

³³ Climate change adaptation (Oxford Research Encyclopaedia of Climate Science 2025), available at <https://www.ipcc.ch/assessment-report/ar5/> (accessed 24 March 2025)

³⁴ Climate change adaptation | Oxford Research Encyclopaedia of Climate Science.

³⁵ Climate change adaptation | Oxford Research Encyclopaedia of Climate Science.

goal in terms of Article 7 of the Paris Agreement, which emphasises national adaptation plans, stakeholder inclusivity, and systemic planning.

By 2021, in terms of the Glasgow Climate Pact, adaptation developed to resilience-building and integrating long-term, forward-looking strategies.³⁶ The Pact highlights the need for both mitigation and adaptation, aligning with the concept of loss and damage.

This chapter explores the global frameworks that govern climate adaptation, including the UNFCCC, the Paris Agreement, and the Glasgow Climate Pact. The objective was to focus on adaptation measures within the context of international climate action mandates. The aim was to illustrate how the international development of adaptation and climate resilience has shaped South Africa's national policies and legislative responses, specifically through the Climate Change Act No. 22 of 2024.

The chapter will also provide an analysis of the influence that these international mandates for adaptation have had on South Africa's legislative approaches and sector-specific strategies, and specifically on the electricity sector.

2.2. United Nations Framework Convention on Climate Change (UNFCCC)

Climate change adaptation evolved from a secondary concern to a central objective of climate action, especially for developing countries that are disproportionately and negatively affected by climate variability.³⁷ Under the UNFCCC, climate change adaptation aims to enhance the resilience of ecosystems, communities and economies to the adverse effects of climate change. It emphasises the need for proactive measures to be taken to reduce vulnerability and strengthen adaptive capacity.

The key milestones under the UNFCCC include:

³⁶ 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee, https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

³⁷ 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee, https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

- a) In 2001, the Marrakech Accords adopted at the Conference of the Parties (COP) 7, established the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF) to support adaptation projects in vulnerable developing countries.³⁸
- b) The Bali Action Plan in 2007 recognised adaptation as one of the four pillars of long-term cooperative action and called for enhanced action on adaptation.³⁹
- c) In 2010, the Cancun Adaptation Framework aimed to enhance action on adaptation through measures such as the formulation of national adaptation plans (NAPs), strengthening institutions, and enhancing support for developing countries.⁴⁰ Furthermore, the Adaptation Committee (AC) was established to support the consistent implementation of strengthened adaptation measures.⁴¹
- d) The Paris Agreement placed adaptation on a par with mitigation, with Article 7 dedicated entirely to adaptation. It established a global goal on adaptation and called for the integration of adaptation into national policies and planning.⁴²
- e) The Glasgow Climate Pact reinforced the importance of adaptation by calling for the doubling of adaptation finance by 2025 compared to the 2019 levels. It launched the Glasgow–Sharm el-Sheikh work programme to advance the global goal on adaptation, aiming to enhance knowledge-sharing and monitoring frameworks. The pact emphasises the inclusion of vulnerable communities and

³⁸ 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee,
https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

³⁹ 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee,
https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

⁴⁰ 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee,
https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

⁴¹ <https://unfccc.int/Adaptation-Committee>

⁴² 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee,
https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

regions, underlining the necessity of transparent and inclusive adaptation planning.⁴³

2.3. Key adaptation measures under the UNFCCC

The UNFCCC highlights the establishment and operation of a financial mechanism to provide resources for climate change adaptation. This mechanism includes several key components, such as financial resources on a grant or concessional basis, including for technology transfer.⁴⁴

The UNFCCC includes a provision that focuses on protecting the climate system and giving priority to vulnerable developing countries. Parties are expected to protect the climate system for both current and future generations, based on principles of fairness and differentiated responsibilities.⁴⁵ Developed countries are expected to lead in combating climate change. The specific needs and special circumstances of developing countries, especially those vulnerable to climate change and facing disproportionate burdens, should be fully considered. Parties should take precautionary measures to foresee, prevent, or minimise the causes of climate change and its adverse effects. The absence of complete scientific certainty should not deter these measures, which should be cost-effective and consider different socio-economic contexts, covering all sources and sectors.⁴⁶

Furthermore, the UNFCCC adaptation measures incorporate climate change considerations into relevant social, economic, and environmental policies and actions.

⁴³ 25 Years of Adaptation under the UNFCCC, A Report by the Adaptation Committee, https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf

⁴⁴ United Nations Framework Convention on Climate Change (opened for signature 9 May 1992, entered into force 21 March 1994) <https://unfccc.int/resource/docs/convkp/conveng.pdf> (accessed 25 March 2025).

⁴⁵ United Nations Framework Convention on Climate Change (opened for signature 9 May 1992, entered into force 21 March 1994) <https://unfccc.int/resource/docs/convkp/conveng.pdf>

⁴⁶ United Nations Framework Convention on Climate Change (opened for signature 9 May 1992, entered into force 21 March 1994) <https://unfccc.int/resource/docs/convkp/conveng.pdf>

It also advances the use of impact assessments to minimise adverse effects on the economy, public health, and environmental quality.⁴⁷

The UNFCCC promotes the exchange of information and cooperation between parties relating to scientific, technological, technical, socio-economic research, systematic observation, and the development of data archives related to the climate system to improve the understanding and reduce uncertainties about climate change and its impacts including the economic and social consequences of response strategies.⁴⁸

Thus, the UNFCCC emphasises the importance of addressing climate vulnerabilities, while it prioritises fairness and equity. Key adaptation principles include supporting vulnerable developing countries, especially those disproportionately affected by climate change, such as small island states and drought-prone regions, integrating adaptation considerations into social, economic, and environmental policies, ensuring resilience across all sectors, and promoting financial support and technology transfer to enable countries to implement effective adaptation measures.⁴⁹ These measures aim to address climate change through comprehensive international cooperation, financial support, technology transfer, and consideration of specific vulnerabilities and development priorities across different country categories.

Climate adaptation is critical to the electricity sector, due to its exposure to risks that include extreme weather, water scarcity, and infrastructure vulnerabilities.⁵⁰ The Paris Agreement and the Glasgow Climate Pact reflect a change towards adaptation strategies, which focus on resilience-building, financial support, and technology-driven solutions to withstand the impact of climate change.

⁴⁷ United Nations Framework Convention on Climate Change (opened for signature 9 May 1992, entered into force 21 March 1994) <https://unfccc.int/resource/docs/convkp/conveng.pdf>

⁴⁸ United Nations Framework Convention on Climate Change
<https://unfccc.int/resource/docs/convkp/conveng.pdf>

⁴⁹ United Nations Framework Convention on Climate Change -
<https://unfccc.int/resource/docs/convkp/conveng.pdf>

⁵⁰ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

These adaptation strategies are particularly relevant to South Africa, where coal-fired power plants dominate electricity generation and intensify climate vulnerability.⁵¹ The Climate Change Act aligns with these international objectives, as it provides a framework for integrating adaptation into energy policies and infrastructure planning.

2.4. Paris Agreement

The Paris Agreement, a legally binding agreement, was adopted in December 2015 at the UN Climate Change Conference (COP21) and entered into force in 2016. The Agreement is regarded as an important milestone as its primary objective is to confine global warming to levels well below 2 degrees Celsius above pre-industrial levels, with an ambitious aim of limiting the temperature rise to 1.5 degrees Celsius.⁵² Operationally, the Paris Agreement is based on a structure of nationally determined contributions (NDCs), in which each participating nation outlines its climate action plan and targets.⁵³

The Paris Agreement is a comprehensive and flexible framework that allows countries to establish and amend their own climate objectives as the contributions are subject to periodic reviews and improvement.⁵⁴ Furthermore, it emphasises transparency and accountability through a detailed monitoring and reporting mechanism.

The Agreement provides several mechanisms to support the implementation of the various adaptation measures.⁵⁵ It states that developed countries must provide the financial resources to assist developing countries with both mitigation and adaptation.⁵⁶ These countries should also lead in mobilising climate finance and report biennially on their financial contributions. The financial mechanism of the convention serves this agreement, aiming for efficient resource access.

⁵¹ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

⁵² The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁵³ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁵⁴ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁵⁵ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁵⁶ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

Achieving an effective global response to climate change requires support and sustainable development through technological advancement and financial resources for collaborative research and development.⁵⁷ The Paris Agreement promotes the development and transfer of technologies that enhance adaptation efforts, alongside capacity-building initiatives to help developing countries plan and implement the adaptation strategies effectively.⁵⁸

COP is an annual summit that serves as the meeting of the parties to the Paris Agreement. The summit assesses the implementation of the Agreement through a process called the "global stocktake".⁵⁹ The assessment evaluates the parties' progress towards the Agreement's long-term goals, considering mitigation, adaptation, means of implementation, support, equity, and the best available science.⁶⁰

The first global stocktake took place in 2023 and will take place every five years thereafter.⁶¹ The Adaptation Committee (AC) under the UNFCCC supports the implementation of adaptation measures by providing technical guidance, facilitating knowledge exchange, and promoting best practices. The results of the global stocktake guide the parties in updating and improving their actions and support, consequently, leading to the improvement of international cooperation for climate action.⁶²

The Paris Agreement establishes a global goal on adaptation and encourages national adaptation plans to enhance resilience and reduce vulnerability.

2.4.1. Challenges in implementation

The implementation of adaptation measures remains a challenge even though there are various financial mechanisms in place.⁶³ Furthermore, while the NAP process promotes the integration of adaptation measures into national development planning, achieving this in practice remains difficult due to limited institutional capacities,

⁵⁷ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁵⁸ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁵⁹ <https://sdgs.un.org/frameworks/parisagreement>

⁶⁰ <https://sdgs.un.org/frameworks/parisagreement>

⁶¹ The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁶² The Paris Agreement - https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

⁶³ <https://sdgs.un.org/frameworks/parisagreement>

inadequate governance, and a lack of access to relevant data and technologies.⁶⁴ It is essential that by strengthening these focus areas and making sure that climate resilience is incorporated into sectoral policies and investments for the successful implementation of adaptation measures.

It is also important that adaptation measures are fair, equitable and inclusive for addressing the needs of marginalised and vulnerable communities.⁶⁵ It is important to build relationships with local stakeholders and incorporate their traditional knowledge into the adaptation process.⁶⁶ There must also be effective monitoring and reporting frameworks in place which are needed to track progress and ensure that adaptation measures provide the required outcomes.

The Paris Agreement sets out the framework for enhancing resilience and reducing vulnerability due to climate changes. It is an important building block needed to address the challenges related to funding, implementation, monitoring and integration by strengthening international cooperation, ensuring adequate financial support, and building institutional competencies needed for the effective implementation of adaptation measures.

2.5. *Glasgow Climate Pact*

The Glasgow Climate Pact was established at the 26th Conference of the Parties (COP26) in 2021.⁶⁷ It builds on the foundations of the UNFCCC and the Paris Agreement, reflecting the global consensus on accelerating climate action leading up to 2030.⁶⁸

The Pact highlights the need to cut greenhouse gas emissions, gradually reduce coal dependency, and increase financial assistance to developing nations for both mitigation and adaptation efforts.⁶⁹ It also urges countries to adopt more ambitious Nationally Determined Contributions (NDCs), scale up climate funding, and prioritise support for

⁶⁴ <https://sdgs.un.org/frameworks/parisagreement>

⁶⁵ Building Climate-Resilient Infrastructure for a Sustainable Future - Infrastructurist.

⁶⁶ Building Climate-Resilient Infrastructure for a Sustainable Future - Infrastructurist.

⁶⁷ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁶⁸ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁶⁹ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

vulnerable communities most affected by climate change.⁷⁰ Central to the Pact is the recognition that achieving the objectives of the Paris Agreement depends on coordinated global action aimed at building a resilient and sustainable future.

2.5.1. Key adaptation provisions in the Glasgow Climate Pact

The Glasgow Climate Pact highlights the urgent necessity of strengthening adaptation measures in light of the escalating effects of climate change. It urges all nations to advance their adaptation strategies, with particular attention given to safeguarding the most at-risk populations.⁷¹

According to the Intergovernmental Panel on Climate Change (IPCC), the Sixth Assessment Report warns that as global temperatures rise, extreme weather events and their harmful consequences are expected to become increasingly frequent and severe.⁷²

The IPCC's report states that it is crucial to urgently increase action and support, including finance, capacity-building, and technology transfer, to improve adaptive capacity, strengthen resilience, and reduce vulnerability to climate change. These efforts should be based on the best available science and should consider the needs of developing countries.⁷³

The adaptation communications and national adaptation plans that are submitted improve the understanding and implementation of adaptation actions and priorities. This ensures that parties can integrate adaptation into local, national, and regional planning.⁷⁴

The importance of the global goal on adaptation for the effective implementation of the Paris Agreement is acknowledged. This includes the launch of the two-year Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation.⁷⁵

⁷⁰ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁷¹ <https://www.ipcc.ch/assessment-report/ar6/>

⁷² <https://www.ipcc.ch/assessment-report/ar6/>

⁷³ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁷⁴ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁷⁵ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

In terms of climate finance for adaptation in developing countries, there is concern that the current level of available funding for climate adaptation is inadequate to address the worsening climate change impacts in the developing countries. Therefore, developed countries are urged to significantly increase their provision of climate finance, technology transfer, and capacity-building for adaptation to meet the developing countries' needs. This includes supporting the formulation and implementation of national adaptation plans and communications.

The adequacy and reliable predictability of adaptation finance are crucial. The Adaptation Fund is highlighted for its dedicated support, and developed countries are encouraged to consider multi-year pledges. Commitments by many developed countries to increase climate finance for adaptation are encouraged. As a result, contributions to the Adaptation Fund and the Least Developed Countries Fund have shown significant progress.⁷⁶

Developed countries were encouraged to at least double their collective climate finance for adaptation to developing countries, aiming for a balance between mitigation and adaptation.⁷⁷ Multilateral development banks, other financial institutions, and the private sector are urged to enhance finance mobilisation to achieve climate adaptation plans. Parties are encouraged to explore innovative approaches and instruments for mobilising private finance for adaptation.⁷⁸

Even though the Pact focuses on adaptation, it also recognises the importance of addressing loss and damage associated with the impacts of climate change.⁷⁹ The Pact promotes equitable transitions that support sustainable development, poverty alleviation, and job creation. It also emphasises the need for financial assistance to minimize greenhouse gas emissions, increase technology transfer as well as provide capacity building to developing nations to support adaptation plans and initiatives.⁸⁰

⁷⁶ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁷⁷ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁷⁸ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁷⁹ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁸⁰ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

The Pact highlights the importance of transparency in adaptation actions by encouraging countries to improve the quality and quantity of their adaptation communications by providing clearer information on adaptation priorities and strategies.

2.5.2. Implementation mechanisms

The commitment by developed countries to double adaptation finance by 2025 is a critical mechanism for enhancing support.⁸¹ The Pact also includes provisions for exploring funding arrangements specifically for loss and damage, which is closely related to adaptation efforts.

The Pact promotes the involvement of high-level advocates in supporting the active participation of non-party stakeholders.⁸² It also celebrates the completion of the Paris Agreement work programme, which includes decisions on common timeframes for nationally determined contributions, an enhanced transparency framework, the operation of public registries, cooperative approaches, rules for the Article 6 mechanism, and non-market approaches.⁸³

The Glasgow Pact requires parties to be ready for timely reporting under the improved transparency framework and recognises the necessity for more support for developing countries.⁸⁴ It acknowledges the Global Environment Facility's encouragement to increase financial resources for climate-related purposes, recognises ongoing support for developing countries' institutional and technical capacity, and urges continued facilitation of access to the capacity-building initiative for transparency.⁸⁵

The Pact identifies the importance of making financial support and assistance available to developing countries for reduced greenhouse gas emission pathways.⁸⁶ It also helps

⁸¹ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁸² Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁸³ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁸⁴ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁸⁵ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁸⁶ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

to address the concerns of parties most affected by response measures by promoting just transitions that help with sustainable development, poverty eradication, and job creation.

Furthermore, the Pact acknowledged the need for capacity building and technology transfer to enhance adaptation efforts.⁸⁷ Programs such as the Technology Mechanism and the Capacity-building Initiative for Transparency (CBIT) support countries in developing and implementing effective adaptation plans.⁸⁸

2.5.3. Analysis of adaptation measures under the Glasgow Climate Pact

In comparison to previous COP outcomes, the Pact places a strong emphasis on adaptation. It commits to doubling adaptation funding and establishes a global work programme focused on the global goal for adaptation, reflecting a heightened focus on resilience building.

Despite the challenges to mobilise and make adaptation funding available, it is a step in the right direction to ensure that the most vulnerable countries and communities obtain financial support to enable them to enhance their climate adaptation strategies.

By exploring innovative funding mechanisms, including private sector engagement and blended finance, could enhance resource mobilisation for climate adaptation.

The reaffirmation of NAPs emphasises their significance in integrating adaptation into national development plans. The successful implementation of NAPs necessitates strong institutional frameworks, stakeholder engagement, and ongoing monitoring and evaluation.⁸⁹ The global stocktake process will evaluate collective progress on adaptation, aiding in the identification of areas for improvement and informing future actions. Adaptation efforts must be integrated across various sectors, including

⁸⁷ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁸⁸ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

⁸⁹ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

agriculture, water resources, infrastructure, and health, to address the multifaceted impacts of climate change.⁹⁰

The Glasgow Pact recognises the need to prioritise the most vulnerable communities in adaptation efforts.⁹¹ Thus, it is essential to ensure that adaptation measures are inclusive and equitable for their effectiveness.

It is critical to improve transparency and support for the monitoring and tracking of adaptation actions and initiative to maintain accountability.⁹² Detailed and transparent reporting on adaptation will ensure a better understanding and coordination global adaptation efforts.

The Pact is a significant step for addressing climate adaptation on a global scale by highlighting the need for increased adaptation efforts, doubling funding, and setting up a dedicated work programme on adaptation goals.⁹³ However, to meet these objectives means overcoming challenges in funding, implementation, and integration. This can be achieved by strengthening international cooperation, securing adequate financial resources, and building institutional capacity.

2.6. Themes and the evolution of adaptation in the global framework for climate action

The UNFCCC, the Paris Agreement, and the Glasgow Climate Pact set out the key adaptation themes that guide global and national efforts. These themes are the building blocks in the development of South Africa's adaptation strategies which will be discussed in chapter 3. The discussion will also include an analysis of the themes including the potential challenges on South Africa's electricity sector.

⁹⁰ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁹¹ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁹² Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁹³ The Glasgow Pact- https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

The international frameworks emphasise the importance of building a climate-resilient infrastructure to withstand the impacts of extreme weather events and long-term climate changes.⁹⁴ Article 7 of the Paris Agreement calls for enhancing adaptive capacity and reducing vulnerability, while the Glasgow Climate Pact highlights protecting critical infrastructure against climate risks.⁹⁵

The Paris Agreement and Glasgow Climate Pact emphasises the importance of incorporating renewable energy as a fundamental strategy for adaptation aimed at reducing greenhouse gas emissions and diversifying energy systems.⁹⁶ The Paris Agreement emphasises the necessity of transitioning to clean energy to strengthen resilience, whereas the Glasgow Climate Pact advocates for financing renewable energy initiatives and facilitating technology transfer.⁹⁷

The UNFCCC highlights the importance of addressing the socio-economic aspects of adaptation, especially for vulnerable communities.⁹⁸ The Paris Agreement emphasises the principle of equity, while the Glasgow Climate Pact highlights the need to prioritise those who are most affected by the impacts of climate change.⁹⁹

The UNFCCC framework acknowledges the interconnectedness of climate adaptation across sectors, especially relating to energy and water.¹⁰⁰ Addressing the water-energy nexus is vital for countries facing water scarcity and climate-induced droughts, as emphasised in the Paris Agreement's adaptation goal.¹⁰¹

⁹⁴ Building Climate-Resilient Infrastructure for a Sustainable Future - Infrastructurist.

⁹⁵ Cohen R, Eames PC, Hammond GP, Newborough M, and Norton B, 2022. 'Briefing: The 2021 Glasgow Climate Pact – steps on the transition pathway towards a low carbon world', published online 19 April [DOI: 10.1680/jener.22.00011].

⁹⁶ *Climate and Disaster Resilient Infrastructure: Building Resilience to Future Uncertainties and Shock* – United Nations Regional Collaborative Platform, 2021 - ESCAP-2021-PB-Climate-and-disaster-resilient-infrastructure.pdf

⁹⁷ *Climate and Disaster Resilient Infrastructure: Building Resilience to Future Uncertainties and Shock* – United Nations Regional Collaborative Platform, 2021 - ESCAP-2021-PB-Climate-and-disaster-resilient-infrastructure.pdf

⁹⁸ *Climate and Disaster Resilient Infrastructure: Building Resilience to Future Uncertainties and Shock* – United Nations Regional Collaborative Platform, 2021 - ESCAP-2021-PB-Climate-and-disaster-resilient-infrastructure.pdf

⁹⁹ *Climate and Disaster Resilient Infrastructure: Building Resilience to Future Uncertainties and Shock* – United Nations Regional Collaborative Platform, 2021 - ESCAP-2021-PB-Climate-and-disaster-resilient-infrastructure.pdf

¹⁰⁰ <https://unfccc.int/resource/docs/convkp/conveng.pdf>

¹⁰¹ <https://unfccc.int/resource/docs/convkp/conveng.pdf>

The UNFCCC and Glasgow Climate Pact emphasise the critical need for reliable, predictable and sufficient adaptation finance, as well as the transfer of climate-resilient technologies to developing nations. The Green Climate Fund (GCF), established under the UNFCCC, along with the commitments made in the Glasgow Climate Pact to double adaptation finance by 2025, are essential mechanisms that support national adaptation strategies.¹⁰²

The role of adaptation has evolved from a marginal to a central focus over time. This development indicates that early adaptation initiatives were primarily reactive and insufficiently resourced.¹⁰³ As time has progressed, adaptation has been recognised as an essential element of climate policy. However, the focus has also shifted to vulnerable populations, particularly in least developed countries (LDCs) and small island developing states (SIDS). This underscores the necessity for equity and justice in adaptation funding and planning.¹⁰⁴

Adaptation has been incorporated into national and sectoral development plans to promote sustainability.¹⁰⁵ Strategies have moved from addressing immediate needs through the National Adaptation Programmes of Action (NAPAs) to focusing on long-term planning with NAPs and building systemic resilience.¹⁰⁶ Financial mechanisms, such as the GCF and the Adaptation Fund, have provided essential resources, while technical support has been offered by organisations such as the Adaptation Committee and the Least Developed Countries Expert Group (LEG).¹⁰⁷

Present adaptation efforts prioritize building resilience through integrated, participatory, and gender-responsive methods.¹⁰⁸ There is also an urgent need to scale

¹⁰² 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019

¹⁰³ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019.

¹⁰⁴ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019.

¹⁰⁵ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019

¹⁰⁶ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019.

¹⁰⁷ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019.

¹⁰⁸ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019

up funding to close the adaptation finance gap and enhance monitoring and evaluation to ensure both effectiveness and accountability. It also aims to advance knowledge-sharing and capacity-building efforts to meet the diverse adaptation needs on a global scale.¹⁰⁹ Thus, adaptation has evolved from a localised, reactive measure to a coordinated, global effort aimed at protecting communities and ecosystems from increasing climate risks.

2.7. Conclusion

The adaptation themes set out in the UNFCCC, Paris Agreement, and Glasgow Climate Pact, including resilient infrastructure, renewable energy integration, socio-economic adaptation, the water-energy nexus, and financial mechanisms, provide a comprehensive framework to appraise South Africa's initiatives within the electricity sector. By concentrating on these adaptation themes, these frameworks offer a roadmap for South Africa to enhance its adaptation strategies. Hence, the electricity sector can drive the transition to renewable energy, build infrastructure resilience, and address climate vulnerabilities by aligning with international goals, thereby ensuring sustainable development in the face of climate change.

¹⁰⁹ 25 Years of Adaptation under the UNFCCC, UNFCCC. Adaptation Committee (AC) - 17 December 2019.

Chapter 3 Timeline of South Africa's national legislative framework in response to global frameworks relating to climate change

3.1. Introduction

As a country that is highly vulnerable to climate variability and extreme weather events, SA has recognised the need for comprehensive legislation that addresses climate adaptation. The discussion and the adaptation themes identified in the UNFCCC, the Paris Agreement and the Glasgow Climate Pact provide the backdrop for understanding how international mandates have influenced SA's legislative process.

This chapter examines how the adaptation strategies in the global climate change frameworks are implemented in SA's context. The focus is on the development of adaptation measures in South Africa's various national environmental legislation and frameworks, analysing their potential impact, identifying key stakeholders involved in the implementation, and assessing the ramifications for the electricity sector.

3.2. National Development Plan (NDP) 2030

South Africa's National Development Plan (NDP) 2030 serves as an all-encompassing strategy aimed at eradicating poverty, reducing inequality, and promoting sustainable development.¹¹⁰ Recognising the complex threats posed by climate change, the NDP incorporates climate change adaptation as a critical component of its vision.¹¹¹ This chapter will evaluate the NDP 2030's approach to climate change adaptation by

¹¹⁰ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹¹ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

examining its strategies and the effectiveness in enhancing the country's resilience to climate impacts.

3.2.1. Key climate change adaptation measures in the NDP 2030

By 2030, South Africa aims to have adapted its energy sector to address climate change through a range of strategic measures.¹¹² These include reducing pollution and mitigating the impacts of climate change, while advancing the energy transition by decreasing the country's dependence on coal in favour of cleaner alternatives, such as natural gas, renewable energy sources such as wind and solar, and imported hydroelectric power.¹¹³

In addition, South Africa plans to modernise its transport sector by expanding public transport networks and increasing the adoption of hybrid and electric vehicles.¹¹⁴ Improving energy efficiency across the economy is also a key priority, with efforts focused on lowering energy intensity and encouraging the use of energy-saving technologies. These initiatives aim to create a diverse and competitive energy market that supports sustainable growth and fosters innovative energy solutions.¹¹⁵

The initiatives will potentially be supported with policies, governance frameworks, and competitive markets to ensure the consistent distribution of efficient energy services, social equity and economic growth. South Africa relies heavily on coal, which accounts for over 70% of the country's primary energy production, more than 90% of electricity, and a third of liquid fuels, making it a significant emitter of carbon dioxide.¹¹⁶

In addressing climate change and enhancing the energy sector's sustainability, it is clear that SA is trying to decrease its reliance on coal to reduce carbon emissions and

¹¹² National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹³ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹⁴ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹⁵ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹⁶ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

mitigate climate risks. These strategies also aim to improve energy security by tackling power outages and ensuring dependable distribution of electricity and liquid fuels.

The NDP aims to enhance energy efficiency by reducing the country's high energy intensity, which currently exceeds the Organisation for Economic Cooperation and Development (OECD) average.¹¹⁷ The plan aims to enhance market competition and regulation in the electricity sector by improving the regulation of prices, supply, and the quality of energy products. It will focus on optimising fuel prices to ensure that paraffin, liquefied petroleum gas, and alternative household fuels are more affordable, thereby reducing reliance on expensive and unhealthy fuels.¹¹⁸ Another aspect is addressing rail capacity constraints, while the country must still rely on coal to improve coal delivery to power stations and expand coal exports.¹¹⁹ These initiatives aim to create a more sustainable, efficient, and competitive energy sector, while trying to address the challenges posed by climate change.

South Africa's transition to a low-carbon economy is a detailed approach that incorporates sustainable development goals with climate resilience objectives.¹²⁰ It is essential that there is coordinated planning and investment for the transition. This is to ensure infrastructure and services are designed to address climate change by providing clean water, adequate sanitation, and affordable, safe energy, thereby strengthening communities' resilience.¹²¹

Adaptation strategies will be incorporated into national development plans, with importance placed on disaster preparedness, sustainable technological solutions, and ecosystem conservation.¹²² South Africa aims to enhance consumer awareness, green product innovation, recycling infrastructure, and waste-to-energy projects to support

¹¹⁷ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹⁸ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹¹⁹ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁰ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²¹ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²² National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

a zero-waste society.¹²³ Renewable energy growth will be driven by government support, decreasing technology costs, and effective carbon pricing mechanisms, all of which contribute to job creation through niche product development, regional partnerships, and increased domestic manufacturing of renewable technologies.¹²⁴

The reduction of carbon emissions will be achieved by managing investments in renewables and developing equitable carbon trading systems that will fulfil international obligations, while maintaining global competitiveness.¹²⁵ This transition is underpinned by strong policy and regulatory frameworks that prioritise environmental and social considerations in development decisions, land management, and ecosystem restoration. Furthermore, agricultural sustainability will be advanced through investments in climate-resilient technologies and targeted support for small-scale and rural farmers, ensuring both livelihood protection and the growth of commercial agriculture.¹²⁶

Careful decision-making will be necessary to effectively balance the decline of traditional sectors, such as coal-fired electricity, with the growth of industries in the green economy.¹²⁷ Emerging small, medium, and micro enterprises in waste management will help reduce and address unemployment, poverty, and income inequality.¹²⁸

SA's primary approach to climate change adaptation relies on building economic and societal resilience through a range of targeted strategies.¹²⁹ It is therefore crucial to strengthen resilience by reducing poverty and inequality, creating employment

¹²³ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁴ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁵ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁶ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁷ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁸ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹²⁹ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

opportunities, improving education and skills development, improve healthcare services, and preserve ecosystem integrity.¹³⁰

An integrated policy and governance implementation process that incorporates climate adaptation into national development strategies will be required to ensure effectiveness.¹³¹ This will also ensure that sectoral plans will be guided by climate forecasts. Furthermore, investment in scientific research and adaptive planning will be important to make informed decisions as well as to develop flexible strategies that accommodate various future scenarios.

It is important that adaptation efforts are modified to key sectors such as water, agriculture, forestry, health, biodiversity, and human settlements.¹³² This also means that there must be improvements to disaster risk management and communication systems. The recommended actions include establishing a national climate research facility, advancing agricultural research focused on food security, continuing water impact studies, and incorporating climate risks into disaster management plans.¹³³

It is a priority to protect vulnerable populations from the effects of climate change. This includes implementing measures to mitigate health risks and ensure fair, inclusive transitions to low-carbon economies.¹³⁴ In support of sustainable development, SA aims to grow green economy sectors, encourage local manufacturing of green technologies, and apply carbon pricing within a carbon budgeting framework. Regional and international partnerships will reinforce these initiatives as SA engages with other nations through collaborative forums to advance climate resilience and environmental sustainability.¹³⁵ Through these adaptation measures, the country aspires to develop a

¹³⁰ National Development Plan: Vision for 2030 -

https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹³¹ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹³² National Development Plan: Vision for 2030 -

https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹³³ National Development Plan: Vision for 2030 -

https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹³⁴ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹³⁵ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

society capable of withstanding future climate impacts while advancing sustainable development and social justice.

3.2.2. Implementation mechanisms

The NDP establishes and appoints inter-ministerial committees and task forces that are responsible for coordinating the implementation of adaptation measures. This is to ensure consistency across different sectors and levels of government. Local governments are identified as essential in ensuring implementation of these measures. The plan supports capacity-building for municipalities to integrate climate adaptation into local planning.¹³⁶

The NDP further advocates for investments from both public and private sectors in climate-resilient infrastructure and projects.¹³⁷ This involves leveraging international climate finance and pioneering innovative funding mechanisms.¹³⁸ A focus is placed on creating insurance schemes and financial tools to manage climate-related risks, safeguarding communities and businesses.

The NDP promotes capacity-building initiatives aimed at equipping the various stakeholders, such as government officials and local communities, with the necessary skills to implement adaptation strategies effectively.¹³⁹ Furthermore, it is important to note that investing in climate research and improving data collection and distribution is important for making informed decisions and effective adaptation planning.

The NDP incorporated indicators into its policy framework to track and assess the progress of adaptation measures. This allows for the continuous learning and

¹³⁶ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹³⁷ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹³⁸ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹³⁹ National Development Plan: Vision for 2030 -
https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

development of adaptation strategies to make sure they remain effective and relevant.¹⁴⁰

3.2.3. Analysis of climate change adaptation measures in the NDP 2030

The NDP 2030 provides a comprehensive and integrated approach to climate adaptation, by aligning with various sectoral and developmental objectives.¹⁴¹ However, there are practical challenges with its implementation and coordination. As an example, ensuring that adaptation measures prioritise vulnerable populations is critical. The NDP's aim on social safety nets and community-based adaptation is aligned with this goal, but the practical implementation must ensure these initiatives reach those most in need.

Mobilising sufficient financial resources for adaptation remains difficult.¹⁴² Although the NDP highlights investment importance, there is a need to strengthen actual funding levels and mechanisms to guarantee consistent support. It is clear that the focus on innovative financing methods, such as insurance and involving the private sector, is a positive development in the NDP.

The NDP's emphasis on enhancing the capability of local governments to implement adaptation measures is also crucial across various sectors.¹⁴³ While the NDP's framework for inter-ministerial collaboration is a promising initiative, the challenge is whether this can be practically implemented.

Developing monitoring and evaluation systems is indispensable for tracking advancement and ensuring accountability.¹⁴⁴ Although the NDP includes performance indicators, effective implementation and oversight are essential. Adaptation is an

¹⁴⁰ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹⁴¹ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹⁴² The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹⁴³ National Development Plan: Vision for 2030 - https://www.gov.za/sites/default/files/gcis_document/201409/devplan2.pdf

¹⁴⁴ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

iterative process demanding ongoing learning and adjustment.¹⁴⁵ Mechanisms that promote feedback and knowledge exchange are necessary to refine strategies and improve outcomes continually.

The NDP's objective is to boost SA's ability to deal with climate change by integrating adaptation into national and local planning, by promoting sustainable practices, and emphasising resilience.¹⁴⁶ In this regard, South Africa has an extensive climate change adaptation framework encompassing various sectors and developmental aims.¹⁴⁷ However, challenges related to funding, institutional capacity, governance and coordination must be addressed to fully realise the potential of these adaptation measures.

3.3. South Africa's Sustainable Development Goals (SDGs) in terms of climate change adaptation measures

South Africa is highly susceptible to climate change effects, which presents significant risks to its economy, ecosystems, and communities. In response to these risks and challenges, South Africa has pledged to uphold the Sustainable Development Goals (SDGs) established by the United Nations.¹⁴⁸

SDGs are a global framework for addressing the various aspects of sustainable development, including climate change adaptation.¹⁴⁹ This section will analyse how South Africa is working toward achieving these goals by implementing measures to adapt to climate change. The review assesses the compatibility, implementation, and effectiveness of these measures in enhancing resilience and sustainability.

¹⁴⁵ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹⁴⁶ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹⁴⁷ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹⁴⁸ <https://southafrica.un.org/en/sdgs>

¹⁴⁹ <https://southafrica.un.org/en/sdgs>

3.3.1. Key SDGs related to climate change adaptation

Several SDGs are directly or indirectly related to climate change adaptation, with SDG 7 focusing on affordable and clean energy, while SDG 13 focuses on climate action and the ability to take urgent action to combat climate change and its impacts.¹⁵⁰

3.3.2. Adaptation measures in South Africa's SDG Framework

The purpose of SDG 7 is to ensure that everyone has access to affordable, reliable, sustainable energy. SA tries to address its energy challenges by promoting the use of renewable energy sources by making it more widely accessible¹⁵¹. This involves signing more Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) projects, removing licensing requirements for embedded generation, and removing bottlenecks from regulatory processes for electricity generation.¹⁵² Tax incentives should be introduced to encourage investments in renewable energy and increase energy generation. It is also important to involve academia, the private and public sectors, in raising awareness and promoting the milestones of SDG 7.¹⁵³

The objective of SDG 13 is to address climate change and build resilience to climate change, especially for those who are most vulnerable, by monitoring climate trends, such as increased warming rates, variable rainfall, and extreme weather events. This is necessary to reduce the adverse impacts of climate change experienced by vulnerable communities.¹⁵⁴ These measures aim to reduce communities' vulnerability to climate impacts and support sustainable development in response to changing climate conditions.

¹⁵⁰ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵¹ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵² Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵³ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵⁴ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

SA's national and provincial adaptation strategies align with SDG 13 in terms of which the purpose is to address climate change through the development and integration of adaptation into legislation, policies and strategies to reduce future climate-related risks.¹⁵⁵ Furthermore, the integration of adaptation into sectoral plans reflects a holistic approach to sustainable development towards a low carbon society. However, the practical implementation of the policies is strained by financial limitations, insufficient institutional capacity, and stakeholder coordination challenges.¹⁵⁶

South Africa has developed mechanisms for tracking progress on SDG implementation, including adaptation measures to ensure coherence between national development goals and global commitments.¹⁵⁷ Projects that engage local communities in adaptation planning and implementation ensure that measures are context-specific and effective. This supports SDG 10 (Reduced Inequalities) by including marginalised groups in adaptation efforts.

3.3.3. Analysis of climate change adaptation measures in South Africa's SDG framework

South Africa has a comprehensive national environmental policy framework that aligns its adaptation efforts with the global SDGs.¹⁵⁸ The integration of adaptation into sectoral plans and strategies provides a detailed approach to sustainable development. However, challenges arise with the practical implementation due to limited financial resources, lack of institutional capacity and poor stakeholder coordination despite having the necessary policies in place.¹⁵⁹

¹⁵⁵ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

¹⁵⁶ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵⁷ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵⁸ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁵⁹ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

South Africa has made notable attempts to obtain climate finance, including through international partnerships.¹⁶⁰ However, funding remains insufficient in relation to adaptation demands, particularly for vulnerable groups. Progress in developing innovative financial tools such as climate risk insurance is promising, with the potential for broader application.¹⁶¹ The development of innovative financial instruments, such as climate risk insurance, demonstrates progress in resource mobilisation. Increasing access to these instruments could provide broader protection against climate risks.¹⁶²

Improving local government's ability to implement adaptation measures is also crucial.¹⁶³ By empowering municipalities through decentralised approaches can improve the effectiveness and sustainability of adaptation efforts. It should be considered that it is essential to improve coordination between national and local governments, as well as between different sectors, for better integrated adaptation planning.

Collaborative frameworks can improve the consistency and impact of adaptation measures.¹⁶⁴ In order to achieve and maintain SDGs, adaptation measures must prioritise vulnerable populations by engaging and empowering communities to enhance resilience and reduce inequalities.

The development of effective monitoring and evaluation mechanisms is vital for tracking progress and maintaining accountability.¹⁶⁵ These systems need to provide clear indicators and metrics for assessing the effectiveness of adaptation measures.

South Africa is strongly committed to the SDGs, utilising them as a framework for climate change adaptation.¹⁶⁶ Efforts to raise financial resources, enhance institutional

¹⁶⁰ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

¹⁶¹ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹⁶² The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>.

¹⁶³ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁶⁴ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁶⁵ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

¹⁶⁶ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

capacity, and involve local communities are comprehensive. It is therefore crucial to continually address the funding, implementation, and coordination challenges.

3.4. *National Climate Change Response Policy White Paper (NCCRP)*

SA's National Climate Change Response White Paper (NCCRP), published in 2011, is a detailed framework that addresses mitigation and adaptation measures. It is a guideline to build a resilient, low-carbon society and economy. This section will review the adaptation measures proposed, assessing their implementation and effectiveness.

The NCCRP lays out strategies both for reducing the impact of climate change and adapting to its effects, with the goal of creating a society and economy that are resilient to climate change and low in carbon emissions. This evaluation will specifically focus on the proposed adaptation measures in the White Paper, assessing their effectiveness and implementation.

3.4.1. Key adaptation measures in the NCCRP

The NCCRP prioritises cooperation, research promotion, and investment in, or the acquisition of adaptation, lower-carbon, and energy-efficient technologies and practices. This applies both to existing and new sectors or sub-sectors. All fields and flagship programmes incorporate research and development, data collection, and analysis tools in their respective areas.

South Africa understands that it is a country prone to climate change and as a result prioritises adaptation measures.¹⁶⁷ This includes developing early warning and forecasting systems to enhance disaster risk reduction. SA uses decade-scale climate forecasting to anticipate and tackle potential resource challenges in advance.¹⁶⁸ Further, the policy document also considers developing long-term climate projections to define a wide spectrum of future climate conditions.

¹⁶⁷ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁶⁸ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

Adaptation strategies have been incorporated into sectoral plans to ensure a coordinated and resilient response across governmental levels. As an illustration, the National Water Resource Strategy sets out strategies for critical catchments and water supply systems to secure long-term water availability.¹⁶⁹ From an agricultural perspective, the Strategic Plan for South African Agriculture incorporates adaptation measures to reinforce the sector against climate-related disruptions.¹⁷⁰

Biodiversity protection is guided by the National Biodiversity Strategy and Action Plan, which incorporates adaptation strategies into provincial biodiversity sector plans and local bioregional plans.¹⁷¹ The Department of Health Strategic Plan protects public health by prioritising climate adaptation to address health risks posed by climate change.¹⁷² Sustainable urban and rural development is supported through the Comprehensive Plan for the Development of Sustainable Human Settlements, ensuring that adaptation measures are incorporated in housing and infrastructure planning.¹⁷³

The National Framework for Disaster Risk Management incorporates adaptation measures into national disaster risk management strategies and plans, thereby ensuring the country can prepare and respond to climate-related risks.¹⁷⁴

The NCCRP establishes coordinating bodies to oversee the implementation of adaptation measures, to ensure alignment and consistency across the different sectors and the various levels of government. In addition, local governments are encouraged to integrate climate adaptation into their planning processes and to engage with communities regarding adaptation efforts.

¹⁶⁹ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷⁰ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷¹ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷² National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷³ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷⁴ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

3.4.2. Implementation mechanisms

The NCCRP incorporates climate adaptation measures across the various sectors to ensure that climate resilience is implemented in the national development plans and policies.¹⁷⁵ It emphasises the integration of climate adaptation measures in all levels of government's planning and decision-making processes.

The policy highlights the need for obtaining financial resources from both domestic and international sources to fund adaptation projects.¹⁷⁶ It supports the development of innovative financing mechanisms, such as public-private partnerships, to enhance funding for climate adaptation.

The NCCRP also includes measures for the capacity building of government officials, community leaders, and other stakeholders through training and skills development programmes.¹⁷⁷ This ensures that local government and communities are able to ensure the effective implementation of adaptation measures.

The policy also puts in place systems to monitor the implementation and effectiveness of the adaptation measures against indicators and benchmarks.¹⁷⁸ Regular reporting on the progress and challenges is required to ensure transparency and accountability. Furthermore, mechanisms for evaluation and feedback are included to allow for continuous learning and improvement of adaptation strategies.

3.4.3. Analysis of climate change adaptation measures in the NCCRP

The NCCRP has developed a comprehensive framework for climate adaptation, by integrating it across different sectors and the various levels of government. The IPCC's Fourth Assessment Report (2007) highlights southern Africa's significant exposure to rising temperatures and increasingly variable rainfall patterns, which give rise to

¹⁷⁵ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷⁶ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷⁷ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁷⁸ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

climate risks for communities and ecosystems.¹⁷⁹ Effective coordination and collaboration between the different sectors and stakeholders are critical for successful implementation. The establishment of coordinating bodies and local government involvement are positive steps toward achieving this. Therefore, the all-inclusive approach of the NCCRP ensures policy coherence and alignment with the national development goals.

At local government level, capacity constraints and disjointed institutional arrangements often undermine the practical implementation of the NCCRP.¹⁸⁰ Furthermore, many municipalities lack the necessary technical skills, capacity as well expertise to implement adaptation measures effectively.¹⁸¹ This also includes access to financial resources. However, the establishment of coordinating bodies and local government involvement are positive steps toward achieving resilience.

Trying to obtain sufficient financial resources for climate adaptation is a constant challenge.¹⁸² While the NCCRP outlines the need for investment, actual funding levels and mechanisms to ensure sustained financial flows are critical areas that need strengthening; thus, the emphasis on innovative financing mechanisms, including public-private partnerships and international climate finance.

The capacity of local governments to implement adaptation measures is also essential and needs to be strengthened.¹⁸³ The NCCRP's focuses on local governance because it requires a strong support system to be effective to ensure coordination across different sectors. The NCCRP sets out the framework for inter-ministerial collaboration, but implementing this coordination remains a challenge. The NCCRP also focuses on social

¹⁷⁹ IPCC, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press Cambridge 2007)

¹⁸⁰ IPCC, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press Cambridge 2007)

¹⁸¹ IPCC, Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press Cambridge 2007)

¹⁸² The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

¹⁸³ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

safety nets and community-based adaptation to ensure that vulnerable communities are prioritised.¹⁸⁴

3.5. National Climate Change Adaptation Strategy

SA's National Climate Change Adaptation Strategy (NCCAS) provides the necessary framework to improve resilience and reduce vulnerability to climate change impacts.¹⁸⁵ The NCCAS is aligned with SA's national and international commitments, to the Paris Agreement and the SDGs.

3.5.1. Key adaptation measures in the NCCAS

The NCCAS ensures alignment with South Africa's broader development goals, including the National Development Plan (NDP) 2030 and sector-specific policies. It promotes coordinated governance across the various levels of government and different sectors to ensure a consistent approach to adaptation.¹⁸⁶

The NCCAS highlights the importance for detailed vulnerability and risk assessments to identify the most climate-sensitive areas and sectors.¹⁸⁷ It advocates for the use of scientific data and climate projections to inform adaptation planning and policy development.¹⁸⁸ Within an international context, the NCCAS and South Africa's NDCs are required under the UN Agreements, such as the Paris Agreement to outline the country's commitments to global targets for reducing greenhouse gas emissions and dealing with the impacts of climate change.

¹⁸⁴ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

¹⁸⁵ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁸⁶ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁸⁷ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁸⁸ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

The NDCs provides adaptation goals to strengthen the country's resilience to climate change. As part of the implementation of the NCCRP from 2020 through to 2025, extending to 2030, the first goal focuses on developing and implementing a National Adaptation Plan.¹⁸⁹ The second goal aims to integrate climate considerations into national, sub-national, and sectoral policy frameworks over the same period, ensuring that climate adaptation becomes a core part of development planning.¹⁹⁰ To support these efforts, the third goal prioritises building institutional capacity for effective climate change response and implementation.¹⁹¹

The fourth goal establishes an early warning system and a monitoring framework under the National Adaptation Plan to track vulnerabilities and adaptation progress in key climate-sensitive sectors and geographic areas, with updates reported every five years.¹⁹² The fifth goal sets out to develop a vulnerability assessment and adaptation needs framework to provide ongoing insight into the country's evolving adaptation requirements.¹⁹³ The sixth goal focuses on communicating about past adaptation projects and initiatives to raise public awareness, support education initiatives, and gain international recognition for South Africa's efforts in addressing climate change.¹⁹⁴

The NCCAS promotes climate-smart agriculture, improved water management, and food security through integrated water resource management ensuring sustainable supplies amid changing climates. The NCCAS lays out strategies for preserving

¹⁸⁹ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹⁰ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹¹ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹² National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹³ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹⁴ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

biodiversity and rehabilitating ecosystems to uphold their resilience and ability to adapt.¹⁹⁵

The NCCAS encourages investment in climate research and innovation to develop new adaptation solutions. It supports initiatives to raise public awareness and educate communities about climate change and adaptation strategies.¹⁹⁶

The NCCAS also establishes a framework for monitoring and evaluating the implementation of adaptation measures to report on progress, challenges, and lessons learned to ensure transparency and accountability.

3.5.2. Implementation strategies

The NCCAS focuses on developing institutional and human capacity across all tiers of government to support the successful execution of adaptation initiatives.¹⁹⁷ It advocates for a multi-level governance model that engages stakeholders at the national, provincial, and municipal levels in the design and implementation of adaptation efforts.¹⁹⁸ Additionally, the NCCAS proposes targeted measures to secure financial support from both local and international sources to finance these initiatives. It promotes the creation and use of innovative financial tools, including green bonds and dedicated climate finance mechanisms, to strengthen and expand the funding base for climate adaptation.¹⁹⁹ Financial resource mobilisation strategies include domestic and international sources, supporting innovative mechanisms like green

¹⁹⁵ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹⁶ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹⁷ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹⁸ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

¹⁹⁹ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

bonds and climate funds. It encourages public-private partnerships to leverage resources and expertise for adaptation initiatives.

The NCCAS supports the establishment of knowledge platforms to facilitate the sharing of best practices, research findings, and adaptation experiences. It includes programmes to build the capacity of stakeholders to understand and implement effective adaptation measures.²⁰⁰

3.5.3. Analysis of adaptation measures in the NCCAS

The NCCAS is a detailed, integrated framework aligning adaptation with national and international development goals.²⁰¹ By emphasising vulnerability and risk assessments, based on scientific data and climate projections, it ensures that adaptation planning is evidence-based and targeted. Using data-driven decision-making processes enhances the measures' relevance and impact. By emphasising vulnerability and risk assessments, based on scientific data and climate projections, it ensures that adaptation planning is evidence-based and targeted.²⁰² Using data-driven decision-making processes enhances the measures' relevance and impact.

However, as is the case for the NCCRP, mobilising sufficient financial resources remains a challenge. The NCCAS acknowledges the importance of securing long-term investment to support climate adaptation; however, current funding levels and mechanisms remain insufficient and require significant enhancement.²⁰³ The emphasis placed on innovative financial tools such as green bonds and climate funds reflects progress in resource mobilisation.²⁰⁴ To strengthen resilience, it is essential that these

²⁰⁰ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10_november2019.pdf

²⁰¹ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10_november2019.pdf

²⁰² The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

²⁰³ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

²⁰⁴ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

financial instruments are expanded and made accessible to vulnerable communities who are most at risk from climate impacts.

Improving the capacity of local governments is important for effective adaptation planning and execution.²⁰⁵ Although the NCCAS identifies the significance of local governance in addressing climate challenges, its success depends on the establishment of robust institutional frameworks and sustained technical support at the local level.²⁰⁶ Successful adaptation depends on coordination across various sectors. While the NCCAS lays out a good framework for inter-ministerial collaboration, putting this coordination into action still poses a challenge.

It is vital that the climate adaptation measures prioritise vulnerable populations.²⁰⁷ The NCCAS's focus on social safety nets and community-based adaptation is aligned with this goal, but practical implementation must ensure these measures reach those most in need.

SA's NCCAS offers an integrated and far-reaching framework that embeds adaptation measures into both national and local development planning.²⁰⁸ Its primary aim is to improve the nation's capacity to manage the adverse effects of climate change. To ensure the successful implementation of this strategy, it is necessary to address the key challenges namely: insufficient funding, limited institutional capacity, and lack of coordination across different levels of governance.²⁰⁹ Advancing climate resilience under the NCCAS requires a focused effort on enhancing financial systems, empowering local government structures, and fostering inclusive, participatory approaches to adaptation.

²⁰⁵ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10_november2019.pdf

²⁰⁶ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10_november2019.pdf

²⁰⁷ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10_november2019.pdf

²⁰⁸ National Climate Change Adaptation Strategy, Version UE10, 13 November 2019 - https://www.dffe.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10_november2019.pdf

²⁰⁹ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

3.6. *National Environmental Management Act, 107 of 1998*

The National Environmental Management Act (NEMA) was implemented in 1998 and is a fundamental piece of environmental legislation in SA. It aims to provide a framework for sustainable development, environmental protection, and the promotion of environmental rights.²¹⁰ While the NEMA mainly concentrates on environmental management and conservation, it also indirectly supports measures for adapting to climate change.

3.6.1. Adaptation measures in NEMA

Even though NEMA does not refer to climate change adaptation, several of its provisions contribute meaningfully to broader adaptation goals.²¹¹ The Act highlights the importance of integrating environmental considerations within the broader context of social, cultural, and economic development.²¹² This integrative approach lays the foundational platform upon which climate adaptation strategies can be built and operated on. This approach supports climate adaptation by ensuring that development projects consider long-term environmental impacts and resilience to climate change.²¹³

One of the key regulatory mechanisms under NEMA is the requirement for Environmental Impact Assessments (EIAs) for projects that may significantly affect ecological systems.²¹⁴ This provision ensures that potential environmental risks are evaluated and mitigated early in the planning process.

NEMA places a strong emphasis on transparency and inclusivity.²¹⁵ It aims to give the public access to environmental information by encouraging them to play an active role in decisions that affect their surroundings.²¹⁶ This means that when communities are

²¹⁰ National Environment Management Act, 107 of 1998

²¹¹ National Environment Management Act, 107 of 1998

²¹² National Environment Management Act, 107 of 1998

²¹³ National Environment Management Act, 107 of 1998

²¹⁴ National Environment Management Act, 107 of 1998

²¹⁵ National Environment Management Act, 107 of 1998

²¹⁶ National Environment Management Act, 107 of 1998

meaningfully involved in decision-making, their local insights and needs can shape adaptation plans in ways that are more practical, relevant, and widely supported.

Beyond participation, the Act supports sustainable development by placing limits on pollution and encouraging responsible waste management.²¹⁷ These measures help reduce environmental stress, which can otherwise intensify the effects of climate change. Strengthening environmental systems in this way contributes to overall resilience.

NEMA promotes accountability and sets out enforcement mechanisms by ensuring that governance structures are in place to ensure that environmental rules are followed.²¹⁸ This level of oversight is essential for making sure that climate considerations are built into broader environmental planning and policy which helps turn adaptation policies into action

The Act further highlights the importance of conserving biodiversity and protecting ecosystems.²¹⁹ This is because healthy ecosystems play a pivotal role in climate adaptation as they serve as natural buffers against climate-related events such as floods and droughts.²²⁰ By prioritising ecosystem protection, NEMA acknowledges the interdependence between ecological integrity and human resilience in the face of climate change.

3.6.2. Effectiveness and implementation

NEMA is a comprehensive legislative framework for environmental management.²²¹ Its effectiveness in climate adaptation depends on its integration with specific climate policies and strategies, such as the NCCR White Paper.

The implementation of NEMA's provisions needs sufficient capacity and resources at national, provincial, and local levels.²²² Enhancing technical expertise and providing

²¹⁷ National Environment Management Act, 107 of 1998

²¹⁸ National Environment Management Act, 107 of 1998.

²¹⁹ National Environment Management Act, 107 of 1998

²²⁰ National Environment Management Act, 107 of 1998

²²¹ National Environment Management Act, 107 of 1998

²²² The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

sufficient funding are essential for effective environmental management and adaptation measures. Additionally, effective monitoring and enforcement mechanisms are essential to ensure compliance with NEMA's regulations.

Improving these mechanisms can help identify and address gaps in adaptation efforts.²²³ The active participation of local communities in environmental management is essential for successful adaptation.²²⁴ NEMA's focus on public participation provides a platform for involving communities in adaptation planning and implementation.²²⁵ The Act adheres to global sustainable development and environmental management principles.²²⁶ It emphasises integrated management, public participation, and ecosystem protection to support climate change adaptation.

Implementing NEMA's provisions requires adequate capacity and resources at the national, provincial, and local levels²²⁷. Enhancing technical expertise and providing sufficient funding are essential for the effective environmental management and adaptation measures.

NEMA plays an important role in South Africa by supporting climate change adaptation through its comprehensive approach to environmental management and sustainable development.²²⁸ While the Act does not explicitly focus on climate adaptation, its provisions indirectly contribute to building resilience against climate impacts.²²⁹ To maximise its potential in supporting climate change adaptation, it is important to strengthen the integration of NEMA with specific climate policies, enhance capacity and resources, and encourage community involvement.

²²³ National Environment Management Act, 107 of 1998

²²⁴ National Environment Management Act, 107 of 1998

²²⁵ National Environment Management Act, 107 of 1998

²²⁶ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

²²⁷ The South African Climate Finance Landscape 2023 - <https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/The-South-African-Climate-Finance-Landscape-2023.pdf>

²²⁸ National Environment Management Act, 107 of 1998

²²⁹ National Environment Management Act, 107 of 1998

3.7. South Africa's Climate Change Act, 22 of 2024

The Climate Change Act aims to establish a solid legal foundation for responding to climate change.²³⁰ It seeks to improve resilience and facilitate the shift toward a low-carbon economy.²³¹ This section examines the adaptation strategies detailed in the Act and assesses how well they align with both national and international environmental and sustainability objectives.

3.7.1. Adaptation measures in the Climate Change Act

The Act outlines the adaptation measures designed to enhance SA's resilience to climate change impacts and mandates the development and implementation of a National Adaptation Strategy and Plan (NASP).²³² This strategy aims to identify and prioritise adaptation actions, integrate climate change considerations into development planning, and allocate resources for implementation. The Act also requires regular risk and vulnerability assessments to identify areas and sectors most at risk from climate change impacts.²³³ These assessments are essential to make informed decisions and targeted adaptation interventions.²³⁴

Various sectors, such as water, agriculture, health, and infrastructure, are required to develop sector-specific adaptation plans to address unique vulnerabilities and implement appropriate adaptation measures within the sector.²³⁵ Enhancing early warning systems for extreme weather events and integrating climate change into disaster risk reduction strategies are emphasised. This risk management system aims to improve preparedness and response to climate-related disasters.

The Act encourages infrastructure development that can withstand the impacts of climate change, such as floods, heatwaves, and rising sea levels.²³⁶ This involves

²³⁰ Climate Change Act, 22 of 2024

²³¹ Climate Change Act, 22 of 2024

²³² Climate Change Act, 22 of 2024

²³³ Climate Change Act, 22 of 2024

²³⁴ Climate Change Act, 22 of 2024.

²³⁵ Climate Change Act, 22 of 2024.

²³⁶ Climate Change Act, 22 of 2024

designing buildings, roads, and other essential infrastructure to be resilient to these climate-related challenges.²³⁷

The Act emphasises the importance of protecting and restoring ecosystems as a critical strategy for adapting to climate change.²³⁸ It promotes the use of ecosystem-based adaptation approaches and highlights the importance of involving local communities in adaptation planning and implementation. It emphasises the need to build local capacity and knowledge to enhance the communities' resilience.²³⁹

3.7.2. Alignment with national and international environmental and sustainability goals

3.7.2.1. National alignment

The Climate Change Act aligns with the objectives of the NCCR White Paper, which emphasises both mitigation and adaptation strategies to address climate change.²⁴⁰

The Act provides a legislative framework to operationalise the policies outlined in the White Paper.

The Act promotes integrated planning, risk assessments, and the development of climate-resilient infrastructure which is in line with the NDP's vision of a resilient and sustainable society.²⁴¹ It also aligns with the NDP on sustainable development and the reduction of vulnerability to climate impacts.

3.7.2.2. International alignment

The Act aligns with SA's commitments under the Paris Agreement by focusing on adaptation planning, risk assessments, and community involvement.²⁴² The Act also aims to strengthen the coordination between national sector departments to enable South Africa to meet its commitments in terms of NDCs.

²³⁷ Climate Change Act, 22 of 2024.

²³⁸ Climate Change Act, 22 of 2024

²³⁹ Climate Change Act, 22 of 2024.

²⁴⁰ National Climate Change Response Policy White Paper (NCCRP) - Climate Change Laws of the World (climate-laws.org).

²⁴¹ Climate Change Act, 22 of 2024

²⁴² Climate Change Act, 22 of 2024

The Act also aligns with the broader objectives of the SDGs by promoting sustainable development, ecosystem conservation, and community resilience.²⁴³ In this regard, the Act supports several of the SDGs with specific reference to goal 13 which relates to climate action.

The Act further emphasises the development and enhancement of early warning systems and integrating climate change into disaster risk reduction strategies.²⁴⁴ This is in line with the Sendai Framework's goals of reducing disaster risk and building resilience to natural hazards.²⁴⁵

3.7.3. Effectiveness and implementation

The Climate Change Act sets out a structured and responsive approach to climate adaptation, by establishing comprehensive legal framework aimed at improving resilience.²⁴⁶ In this regard, there must be meaningful institutional capacity and financial support at national, provincial, and local government levels to ensure that the Act is successfully implemented.

This is because without adequate resources and strong institutions, even the best-designed policies can fail to translate into practical and effective action. The Act also encourages inclusive adaptation processes by recognising the role of local communities.²⁴⁷ When people are informed and involved in planning and implementation, adaptation strategies are more likely to reflect local needs and succeed in the long term.

The Act further emphasises the need for coordinated planning and collaboration between the different levels of government and sectors.²⁴⁸ This would therefore require ongoing communication and cooperation between the different departments and agencies to avoid duplication and ensure policy alignment.

²⁴³ Sustainable Development Goals: Country Report 2023 South Africa - https://www.statssa.gov.za/MDG/SDG_Country_report.pdf

²⁴⁴ <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>

²⁴⁵ <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>

²⁴⁶ Climate Change Act, 22 of 2024

²⁴⁷ Climate Change Act, 22 of 2024

²⁴⁸ Climate Change Act, 22 of 2024

The Climate Change Act also establishes effective monitoring and evaluation frameworks to assess the impact of adaptation measures.²⁴⁹ Regular monitoring allows for flexible management and adjustment of strategies based on feedback and changing conditions. In this regard, the Act, outlines the detailed adaptation measures to be incorporated into national and sectoral planning, risk assessments, resilient infrastructure, and community participation.²⁵⁰

It is a significant step in enhancing SA's resilience to climate change impacts as the Act aligns with national policies and international agreements.²⁵¹ It also highlights its commitment to sustainable development and climate resilience. Effective implementation, adequate resources, and strong coordination are important to realise the Act's potential in building a climate-resilient South Africa.

3.7.4. Analysis of the adaptation measures in the Climate Change Act

The adaptation measures enshrined in the Act are designed to reduce SA's exposure and vulnerability to the adverse effects of climate change. These measures include a range of strategies aimed at reducing vulnerability, building adaptive capacity, and ensuring that development trajectories are aligned with the realities of a changing climate.²⁵²

In terms of sections 19 and 20, the Climate Change Act mandates the formulation of a National Adaptation Strategy (NAS) to develop a guideline in adapting to climate change. The Minister is required to set national adaptation objectives within one year of the Act coming into effect, which will guide the country's adaptation to climate change impacts, fostering resilience and sustainable development.²⁵³ Indicators will be created to measure progress toward achieving these adaptation objectives. A deadline will be set for incorporating these objectives into all relevant national plans, policies,

²⁴⁹ Climate Change Act, 22 of 2024

²⁵⁰ Climate Change Act, 22 of 2024

²⁵¹ Climate Change Act, 22 of 2024

²⁵² Climate Change Act, 22 of 2024

²⁵³ Climate Change Act, 22 of 2024.

and programmes relevant to climate change. Additionally, the Minister must regularly review and update these objectives.²⁵⁴

The Act states that the Minister must also develop adaptation scenarios to predict climate change impacts and associated vulnerabilities over the short, medium, and long term.²⁵⁵ These scenarios should be based on the best available science, consider the impacts on the environment and vulnerabilities, and include climate monitoring systems and adaptation response options.²⁵⁶ Periodic reviews and updates of these scenarios are also required.

Section 22 of the Act sets out the development of sector-specific adaptation strategies, recognising that different sectors face unique challenges from climate change.²⁵⁷ With reference to the electricity sector, section 25 is especially relevant, as it empowers the Minister to set Sectoral Emission Targets (SETs).²⁵⁸ These targets are aimed at limiting the total greenhouse gas emissions that can be emitted by the sector over a specified period.

On 26 April 2024, the Minister published the draft SETs allocation targets to be adopted by the identified sectors, including electricity to support SA in meeting its domestic and international commitments to combat climate change.²⁵⁹

The Act focuses on enhancing adaptive capacity by promoting infrastructure that can withstand the impact of climate change.²⁶⁰ This involves constructing and maintaining resilient roads, bridges, water supply systems, and energy infrastructure to endure extreme weather events.²⁶¹ The aim is to proactively plan to prevent future losses, with a focus on both public and private infrastructure projects.

The Act acknowledges that local communities, especially in rural and marginalised areas, are often on the front lines of climate change impacts.²⁶² Community-based

²⁵⁴ Climate Change Act, 22 of 2024.

²⁵⁵ Climate Change Act, 22 of 2024.

²⁵⁶ Climate Change Act, 22 of 2024.

²⁵⁷ Climate Change Act, 22 of 2024.

²⁵⁸ Climate Change Act, 22 of 2024.

²⁵⁹ https://www.dffe.gov.za/sites/default/files/legislations/draft_sectoralemissionstargets2024_g50571gon4763.pdf

²⁶⁰ Climate Change Act, 22 of 2024.

²⁶¹ Climate Change Act, 22 of 2024.

²⁶² Climate Change Act, 22 of 2024.

adaptation initiatives empower these communities to develop and implement local solutions. This could involve improved agricultural practices, water management techniques, or disaster preparedness plans that are tailored to specific local conditions.²⁶³

The Act requires regular monitoring and reporting on adaptation progress, establishing a framework for collecting and sharing climate data to ensure transparency and accountability in adaptation efforts.²⁶⁴ It also mandates comprehensive climate risk assessments and the development of early warning systems to better prepare for and respond to climate-related disasters.²⁶⁵ These systems aim to provide timely information to governments, businesses, and communities to take preventive actions and prioritise investments in adaptation.

3.8. Adaptation themes from a South African perspective

As discussed in chapter 2, the UNFCCC, Paris Agreement and the Glasgow Climate Pact, identifies important themes related to adaptation that influence climate action at both global and national levels. These themes serve as a valuable framework for examining South Africa's adaptation strategies in the electricity sector.

The Act and NAS identify the need to improve the resilience of energy infrastructure, especially in the face of heatwaves, droughts, and other climate impacts.²⁶⁶ However, the ageing electricity grid and reliance on coal-fired power plants remain significant vulnerabilities and barriers to resilience.

SA's adaptation efforts include the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), which has successfully attracted investment in solar and wind projects.²⁶⁷ However, the slow pace of grid modernisation and energy storage development impedes the integration of renewable energy.

²⁶³https://www.dffe.gov.za/sites/default/files/legislations/draft_sectoralemissionstargets2024_g50571gon4763.pdf

²⁶⁴ Climate Change Act, 22 of 2024.

²⁶⁵ Climate Change Act, 22 of 2024

²⁶⁶ <https://www.climatecommission.org.za/just-transition-framework>

²⁶⁷ <https://www.climatecommission.org.za/just-transition-framework>

The Just Transition Framework aims to address the socio-economic challenges of moving away from coal, focusing on supporting coal-dependent communities and creating green jobs.²⁶⁸ However, the implementation of these measures have been slow, with limited progress in addressing political and economic challenges.

South Africa's electricity sector remains highly dependent on water-intensive coal-fired power plants and hydropower, making it especially vulnerable to water scarcity.²⁶⁹

Therefore, national adaptation strategies, such as improving water-use efficiency in energy systems, are crucial for creating resilience.²⁷⁰ However, financial constraints and limited access to adaptation funding are significant barriers in South Africa's electricity sector.

3.9. Identification of essential stakeholders

Section 7(1) of the Act states that every organ of state responsible for climate-related functions or environmental sustainability must review and, if necessary, revise its policies, laws, and programmes to consider the risks and vulnerabilities associated with climate change and to align with the principles and objectives of the Act.²⁷¹

Furthermore, section 7(2) of the Act states that to give effect to the principles and objectives set out in the Act, stakeholders – such as organised labour, civil society, businesses, traditional leaders, and other relevant stakeholders – may provide input on climate change response, the mitigation of climate change, impacts and adaptation to the effects of climate change toward the attainment of the just transition to a climate-resilient and low-carbon economy and society.²⁷²

Thus, the successful implementation of the adaptation measures outlined in the Act depends on the collaboration of a wide range of stakeholders.²⁷³ Each stakeholder

²⁶⁸ <https://www.climatecommission.org.za/just-transition-framework>

²⁶⁹ Odeku, and Meyer "Climate Change Surge: Implementing Stringent Mitigation and Adaptation Strategies in South Africa" *Journal of African Law*, 54, 2 (2010), 159-183.

²⁷⁰ Ciscar J-C, and Dowling P "Integrated assessment of climate impacts and adaptation in the energy sector" *Energy Economics* 46 (2014) 531-538.

²⁷¹ Climate Change Act, 22 of 2024.

²⁷² Climate Change Act, 22 of 2024.

²⁷³ Giordano, Thierry, Leonie Hall, Andrew Gilder, and Marie Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011

group has an important role to play in ensuring that the country can effectively adapt to the changing climate.

From a national government perspective, the DFFE plays a crucial role in the implementation of the Act. It is responsible for overseeing the development of the National Adaptation Strategy, coordinating sectoral adaptation plans, and ensuring compliance with the Act.²⁷⁴ National government is responsible for policy development, setting national adaptation priorities, and securing funding for implementation.²⁷⁵ It also coordinates the integration of climate adaptation into the national development plans and policies.²⁷⁶

Provincial and local governments are crucial for the practical implementation of adaptation measures on the ground as they are pivotal in translating national adaptation policies into actionable plans that address regional and community-specific vulnerabilities.²⁷⁷ Their role includes the integration of climate adaptation into urban planning, infrastructure development, and disaster management.²⁷⁸

The private sector, and specifically industries that are vulnerable to climate impacts or that have a significant environmental footprint, is a key stakeholder in the adaptation process.²⁷⁹ Businesses, and especially those in the electricity sector, must adapt their operations to mitigate climate risks. The private sector also has an important role to play in investing in climate-resilient infrastructure and in developing innovative solutions for climate adaptation.²⁸⁰

Non-governmental organisations and civil society groups are instrumental in advocating for climate action, raising awareness, and implementing community-based

²⁷⁴ Giordano, Thierry, Leonie Hall, Andrew Gilder, and Marie Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011.

²⁷⁵ Giordano, Thierry, Leonie Hall, Andrew Gilder, and Marie Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011.

²⁷⁶ Climate Change Act, 22 of 2024.

²⁷⁷ Climate Change Act, 22 of 2024.

²⁷⁸ Giordano, Thierry, Leonie Hall, Andrew Gilder, and Marie Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011.

²⁷⁹ Giordano, Thierry, Leonie Hall, Andrew Gilder, and Marie Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011.

²⁸⁰ Giordano, Hall, Gilder, and Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011.

adaptation projects.²⁸¹ Their involvement ensures that adaptation efforts are inclusive and equitable. They are essential for advocating effective adaptation measures, raising public awareness about climate risks, and mobilising communities to act. They also serve as watchdogs and hold government and businesses accountable for their commitments under the Act.

Universities and research institutions provide the scientific knowledge and expertise necessary for informed decision-making.²⁸² Their research contributes to the development of adaptation strategies, risk assessments, and monitoring frameworks. They conduct climate risk assessments, develop adaptation technologies, and monitor the effectiveness of adaptation measures.²⁸³ Their work is essential for ensuring that adaptation strategies are based on the best available science and are tailored to SA's specific conditions.

Given the global nature of climate change, international cooperation and support are critical for South Africa's adaptation efforts.²⁸⁴ International organisations, such as the United Nations and the World Bank, along with donor agencies, provide technical and financial support for adaptation initiatives.²⁸⁵ Their involvement is crucial in facilitating knowledge exchange and in helping SA to meet its international climate commitments.

3.10. Assessment of potential ramifications on the electricity sector

The electricity sector in South Africa is both a significant contributor to greenhouse gas emissions and highly vulnerable to the impacts of climate change.²⁸⁶ The adaptation measures outlined in the Act have profound implications for this sector, in terms of challenges and opportunities.

²⁸¹ Giordano, Hall, Gilder, and Parramon. *Governance of climate change in South Africa*. Pretoria: Department of Environmental Affairs, 2011.

²⁸² Sarpong, Boakye, Ofosu, Botchie "The three points of research and development (R&D) for growth boosting sustainable innovation system" Technovation 122 (2023)

²⁸³ Sarpong, Boakye, Ofosu, Botchie "The three points of research and development (R&D) for growth boosting sustainable innovation system" Technovation 122 (2023)

²⁸⁴ Sarpong, Boakye, Ofosu, Botchie "The three points of research and development (R&D) for growth boosting sustainable innovation system" Technovation 122 (2023)

²⁸⁵ Sarpong, Boakye, Ofosu, Botchie "The three points of research and development (R&D) for growth boosting sustainable innovation system" Technovation 122 (2023)

²⁸⁶ Odeku, and Meyer "Climate Change Surge: Implementing Stringent Mitigation and Adaptation Strategies in South Africa" *Journal of African Law*, 54, 2 (2010), 159-183.

The electricity infrastructure in South Africa is facing major challenges based on the ageing facilities.²⁸⁷ The country heavily depends on water-intensive processes for electricity generation, especially in coal-fired power plants.²⁸⁸ With the expected exacerbation of water scarcity caused by climate change, there is an increasing risk of disruptions in electricity generation and increased competition for water resources.²⁸⁹

The frequency and intensity of extreme weather events, such as severe storms, floods, and heatwaves, also pose considerable risks to the electricity infrastructure.²⁹⁰ Transmission lines, substations, and power plants are vulnerable to damage, which will lead to outages and increased maintenance costs. Furthermore, climate change can lead to fluctuations in electricity demand, especially regarding increased cooling needs during heatwaves and changes in agricultural water use.²⁹¹ This variability can strain the electricity grid and negatively affect the stability of supply.²⁹²

To address these vulnerabilities, the Act requires the adoption of several adaptation strategies in the electricity sector.²⁹³ Among these strategies is the demand that the sector must invest in water-efficient cooling technologies and explore alternative water sources, such as recycled or desalinated water, to reduce dependency on freshwater resources.²⁹⁴ Enhancing the resilience of electricity infrastructure is critical. This includes reinforcing transmission lines, elevating substations in flood-prone areas, and incorporating climate risk assessments into the design and construction of new facilities.²⁹⁵

²⁸⁷ Ebinger J, and Vergara W "Climate Impacts On Energy Systems: Key Issues for Energy Sector Adaptation" World Bank Publications, 2011

²⁸⁸ Ebinger J, and Vergara W "Climate Impacts On Energy Systems: Key Issues for Energy Sector Adaptation" World Bank Publications, 2011

²⁸⁹ Odeku K, and Meyer E "Climate Change Surge: Implementing Stringent Mitigation and Adaptation Strategies in South Africa" *Journal of African Law*, 54, 2 (2010), 159-183.

²⁹⁰ Ebinger J, and Vergara W "Climate Impacts On Energy Systems: Key Issues for Energy Sector Adaptation" World Bank Publications, 2011

²⁹¹ Ebinger J, and Vergara W "Climate Impacts On Energy Systems: Key Issues for Energy Sector Adaptation" World Bank Publications, 2011.

²⁹² Ebinger J, and Vergara W "Climate Impacts On Energy Systems: Key Issues for Energy Sector Adaptation" World Bank Publications, 2011.

²⁹³ Climate Change Act, 22 of 2024

²⁹⁴ Donnenfeld, Crookes, Hedden "A delicate balance: Water Scarcity in South Africa" <https://futures.issafrica.org/>

²⁹⁵ Donnenfeld, Crookes, Hedden "A delicate balance: Water Scarcity in South Africa" <https://futures.issafrica.org/>

The transition to renewable energy sources, such as solar and wind, not only contributes to mitigation efforts, but it also enhances the resilience of the electricity sector.²⁹⁶ Renewable energy is less vulnerable to water scarcity and extreme weather events when compared to conventional fossil fuel-based generation.²⁹⁷

Modernising the electricity grid to improve flexibility and resilience is thus essential. This includes the integration of smart grid technologies, demand-side management, and the development of decentralised energy systems.²⁹⁸ Implementing adaptation measures will require major investment in infrastructure upgrades, technology development, and capacity-building.²⁹⁹ These costs may be passed on to consumers, potentially increasing electricity prices even further.

The implementation of adaptation measures will likely lead to new regulations for the electricity sector.³⁰⁰ These might include stricter environmental standards, requirements for climate risk assessments, and incentives for green energy investments. Such regulations could increase operational costs for existing coal-fired power plants and could affect the financial viability of future coal projects.³⁰¹ This, in turn, could influence investor confidence and shift capital toward renewable energy and other low-carbon technologies.

The adaptation measures in the Act relating to the electricity sector also have far-reaching economic and social implications.³⁰² The electricity sector is a major employer in SA, especially in regions dependent on coal mining and power generation. The adaptation measures in the Act, which promote a shift away from coal, could have

²⁹⁶ Odeku K, and Meyer E "Climate Change Surge: Implementing Stringent Mitigation and Adaptation Strategies in South Africa" *Journal of African Law*, 54(2 2010) 159-183.

²⁹⁷ Odeku K, and Meyer E "Climate Change Surge: Implementing Stringent Mitigation and Adaptation Strategies in South Africa" *Journal of African Law*, 54(2 2010) 159-183.

²⁹⁸ <https://electricityforum.com/td/smart-grid/grid-modernization>

²⁹⁹ <https://electricityforum.com/td/smart-grid/grid-modernization>

³⁰⁰ Ciscar J-C, and Dowling P "Integrated assessment of climate impacts and adaptation in the energy sector" *Energy Economics* 46 (2014) 531-538.

³⁰¹ Ciscar J-C, and Dowling P "Integrated assessment of climate impacts and adaptation in the energy sector" *Energy Economics* 46 (2014) 531-538.

³⁰² <https://electricityforum.com/td/smart-grid/grid-modernization>

serious social implications.³⁰³ Job losses in coal-dependent regions could lead to economic instability and social unrest – if not managed carefully.³⁰⁴

The shift toward renewable energy and the modernisation of the grid will create new employment opportunities in sectors such as manufacturing, construction, and technology.³⁰⁵ However, the growth of the renewable energy sector presents opportunities for job creation, if there is sufficient investment in skills development and retraining programmes to support the transition.³⁰⁶

Strengthening the resilience of the electricity sector will be essential for maintaining energy security and ensuring access to reliable electricity, especially for vulnerable communities.³⁰⁷ Therefore, implementing the necessary adaptation measures can help mitigate the risk of power outages and ensure a stable supply of electricity.

3.11. Conclusion

The adaptation measures outlined in the Act are crucial for enhancing the country's resilience to climate change. The successful implementation of these measures requires the active involvement of a wide range of stakeholders, from government and industry to civil society and international organisations. In the electricity sector, adaptation strategies must address the vulnerabilities posed by looming water scarcity, extreme weather events, and demand fluctuations, while also seizing the opportunities presented by the transition to renewable energy and grid modernisation. The economic and social implications of these climate adaptation measures must be cautiously managed to ensure a just transition that benefits all South Africans.

³⁰³ <https://electricityforum.com/td/smart-grid/grid-modernization>

³⁰⁴ Ciscar J-C, and Dowling P "Integrated assessment of climate impacts and adaptation in the energy sector" Energy Economics 46 (2014) 531-538.

³⁰⁵ Ciscar J-C, and Dowling P "Integrated assessment of climate impacts and adaptation in the energy sector" Energy Economics 46 (2014) 531-538.

³⁰⁶ Ebinger J, and Vergara W "Climate Impacts on Energy Systems: Key Issues for Energy Sector Adaptation" World Bank Publications, 2011.

³⁰⁷ Ciscar J-C, and Dowling P "Integrated assessment of climate impacts and adaptation in the energy sector" Energy Economics 46 (2014) 531-538.

Chapter 4 Denmark's adaptation measures to climate change and its impact on the electricity sector: a comparative analysis with South Africa

4.1. Introduction

As covered in earlier chapters, climate change presents challenges for the electricity sector; the sector will need to adopt adaptation strategies within the national context. Chapter 2 outlined international climate frameworks, such as the UNFCCC, the Paris Agreement, and the Glasgow Climate Pact, which emphasise the importance of climate adaptation through resilient infrastructure, renewable energy integration, socio-economic adaptation, and financial mechanisms. Chapter 3 analysed South Africa's adaptation efforts in the electricity sector by highlighting some of the key challenges, including its current reliance on coal, an ageing grid, and addressing socio-economic complexities to ensure a just transition.

This chapter examines Denmark's adaptation measures implemented in its electricity sector, focusing on their relevance to SA's challenges. Denmark's climate policy framework is considerably more advanced, characterised by high renewable energy penetration, specifically wind power, and substantial investments in grid modernisation and energy storage.³⁰⁸ By structuring the comparison under identified key themes, this chapter identifies lessons South Africa can learn from Denmark's experience, while also addressing its own unique challenges.

4.1.1. Denmark's climate change adaptation measures

Denmark's National Adaptation Strategy (NAS)³⁰⁹, first published in 2008 and regularly updated, identified 11 key sectors' vulnerabilities to climate change and outlined measures to increase climate resilience. As energy was identified as a key sector, the strategy proposed several actions for the energy sector adaptation. Proposed actions include improving energy efficiency to decrease overall demand and minimize the

³⁰⁸ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁰⁹ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

disruption caused by climate change.³¹⁰ They also included increasing the share of renewable energy sources, such as wind, solar, and biomass, to reduce dependency on fossil fuels and enhance energy security; upgrading and maintaining energy infrastructure to withstand extreme weather events and other climate impacts; and supporting research into new technologies and practices that can improve the resilience and sustainability of the energy sector.³¹¹

Denmark is regarded as a leader in climate policy, with ambitious goals to achieve carbon neutrality by 2050 and to reduce greenhouse gas (GHG) emissions by 70% by 2030, compared to its 1990 levels.³¹² These goals are encapsulated in the Danish Climate Act, which was passed in 2020.³¹³ The Act provides the legal framework for the country's mitigation and adaptation policies.

Denmark's climate adaptation strategies were also designed within the context of its membership in the European Union (EU), by aligning its initiatives and programs with EU climate policies and frameworks, including the European Green Deal.³¹⁴

The Danish Climate Adaptation Plans was developed in 2012 and is continually updated.³¹⁵ The plan's objective is to reduce the country's vulnerability to climate change impacts and includes specific measures directed at sectors such as energy, infrastructure, agriculture, and water management. In terms of the energy sector, Denmark's adaptation measures are focused on integrating renewable energy, especially wind power, enhancing grid resilience, and investing in smart grid technology to manage the changes in electricity supply and demand.³¹⁶

³¹⁰ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³¹¹ Danish strategy for adaptation to a changing climate Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³¹² Danish strategy for adaptation to a changing climate Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³¹³ Climate Act, No 965 of 26 June 2020,
https://www.en.kefm.dk/Media/1/B/Climate%20Act_Denmark%20-%20WEBTILG%C3%86NGELIG-A.pdf

³¹⁴ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³¹⁵ How to manage cloudburst and rain water. Action plan for a climate-proof Denmark Danish Nature Agency https://en.klimatilpasning.dk/media/590075/action_plan.pdf

³¹⁶ Danish strategy for adaptation to a changing climate Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

4.1.2. Adaptation measures in terms of Denmark's electricity sector

Denmark's electricity sector advanced in terms of renewable energy integration, with wind power making up more than 50% of its total electricity production.³¹⁷ This means significant adaptation measures have been implemented to ensure the reliability and stability of the electricity grid.³¹⁸

Denmark has modernised its electricity grid through the implementation of smart grids. The systems allow for the better management of changes in electricity supply from various renewable energy sources, such as wind and solar.³¹⁹ They also enhance the ability of the grid to cope with disruptions caused by extreme weather events, such as storms or prolonged periods of calm that reduce wind power generation.³²⁰

Denmark has strategically increased its electricity grid interconnections with neighbouring countries, Norway, Sweden, and Germany.³²¹ These interconnections improve Denmark's resilience by allowing it to import electricity during periods of low renewable energy generation, thereby reducing vulnerability to localised climate impacts.³²²

Denmark is increasing investment in energy storage solutions, including battery storage and the development of hydrogen as an energy carrier in order to adapt to the inconsistent supply of renewable energy sources.³²³ The country is also exploring flexible demand-side management strategies, enabling consumers to adjust their electricity usage based on supply conditions.

³¹⁷ Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" Clean Energy, 2017, Vol. 1, No. 1, 23-35.

³¹⁸ Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" Clean Energy, 2017, Vol. 1, No. 1, 23-35.

³¹⁹ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²⁰ Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" Clean Energy, 2017, Vol. 1, No. 1, 23-35.

³²¹ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²² Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²³ <https://www.trade.gov/country-commercial-guides/denmark-renewable-energy-products>

Recognising the threat of sea-level rise and extreme weather, Denmark has taken steps to protect critical energy infrastructure.³²⁴ Coastal areas, where many wind farms are located, have been prioritised for resilience planning, including the construction of protective barriers and the elevation of key infrastructure.³²⁵

The adaptation measures implemented by Denmark's electricity sector have been mostly successful. Denmark is regarded as a world leader in wind energy production and can maintain grid stability, despite fluctuating levels of renewable energy. Furthermore, Denmark is able better to manage the inconsistency of renewable energy resources by integrating smart grids and energy storage technologies into its adaptation plans.³²⁶

However, Denmark now faces the challenge of ensuring that there is ongoing investment for the continued expansion of wind and solar energy for grid modernisation and energy storage capabilities. While Denmark's reliance on renewable energy reduces its carbon footprint, the transition poses new risks, such as the reliance on weather-dependent energy sources and the need to manage both supply and demand.³²⁷

Denmark's electricity sector provides a leading example of integrating renewable energy, while maintaining grid stability, and aligning closely with the principles and objectives set forth in the Paris Agreement and the Glasgow Climate Pact.³²⁸ These instruments emphasise resilience, renewable energy integration, and the protection of

³²⁴ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²⁵ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²⁶ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²⁷ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

³²⁸ Denmark 2023 – Energy Policy Review International Energy Agency
https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf

critical infrastructure, principles that are reflected in Denmark's strategic adaptation measures.

4.1.3. Renewable energy integration and grid modernisation

South Africa is the largest carbon emitter in Africa and faces challenges in balancing economic development against climate action.³²⁹ Its electricity generation is predominantly coal-based, with coal-fired power plants contributing over 80% of the country's electricity output. The dependence on a carbon-intensive energy source makes adaptation efforts difficult, as coal is both climate-vulnerable and a significant contributor to GHG emissions.³³⁰

Denmark's transition to a renewable energy-driven electricity sector has been successful, with wind power accounting for more than 50% of its electricity production.³³¹ This achievement was made possible due to Denmark's environmental policy frameworks, such as the Danish Climate Act, and long-term investment in renewable energy technologies. Denmark's grid modernisation efforts, especially the implementation of smart grids, allow for real-time management of electricity supply and demand, ensuring stability, despite the variability of wind and solar energy.

South Africa's renewable energy efforts is led by the REIPPPP, which continues to be instrumental in promoting private sector investment in renewable energy projects.³³² While this shift represents progress, the country still faces serious challenges related to grid reliability and energy storage.

As set out in Chapter 3, South Africa's grid infrastructure is ageing and vulnerable to climate impacts, such as extreme weather events, which can lead to blackouts and equipment failures. Eskom, the state-owned electricity utility, has initiated some grid

³²⁹ The Carbon Brief Profile: South Africa <https://www.carbonbrief.org/the-carbon-brief-profile-south-africa/> October 2018.

³³⁰ The Carbon Brief Profile: South Africa <https://www.carbonbrief.org/the-carbon-brief-profile-south-africa/> October 2018.

³³¹ <https://powerefficiency.com/wind-energy-denmark/>

³³² Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" Science Progress 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

modernisation projects, but progress has been slow because of financial constraints and the company's debt burden.

SA will potentially experience challenges in making sure that there is sufficient electricity supply during periods of drought, which can reduce the output of hydropower stations.³³³ Furthermore, South Africa's adaptation efforts in the electricity sector are still in their early stages as the country's heavy reliance on coal remains a significant barrier to achieving adaptation goals.

The REIPPPP has successfully attracted investment in renewable energy, but the slow pace of grid modernisation and energy storage development continues to impede progress.³³⁴ In addition, financial constraints and political instability adds to the challenge of implementing adaptation measures.

South Africa can accelerate its grid modernisation programs by maximising international policy agreements like the Paris Agreement. Furthermore, South Africa can improve grid reliability to accommodate renewable energy by learning from Denmark on how to enhance grid flexibility and reliability. The introduction of smart grid systems and regional interconnections, as seen in Denmark's collaborations with neighbouring countries, can also help South Africa to better understand how to manage renewable energy variability.

4.2. *Socio-economic adaptation and the Just Transition*

South Africa's challenge is trying to manage the socio-economic impacts of moving away from coal. The government's Just Transition Framework hopes to address the needs of communities dependent on coal mining, while promoting green energy alternatives.³³⁵ South Africa's adaptation strategy within the energy sector, therefore, is not only about infrastructure resilience, but it is also concerned about socio-

³³³ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" Science Progress 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

³³⁴ Just Transition Framework Just Transition Framework (climatecommission.org.za)

³³⁵ Just Transition Framework Just Transition Framework (climatecommission.org.za).

economic adaptation to a low-carbon economy.³³⁶ As noted in Chapter 3, SA's implementation has been slow, due to political and financial constraints.

Denmark's adaptation measures, on the other hand, are primarily technological, with relatively few socio-economic challenges to overcome.³³⁷ Workforce retraining programmes and green job creation initiatives ensure a smooth transition to a low-carbon economy without significant social disruption. These measures align with the Glasgow Climate Pact's emphasis on equitable adaptation planning.

Denmark's proactive approach to workforce development and community engagement offers valuable insights for South Africa.³³⁸ By strengthening the Just Transition Framework and aligning it with international principles of equity and inclusivity, South Africa can ensure a fair and sustainable transition for affected communities.

4.2.1. Water-energy nexus and resilience

Denmark's electricity sector relies on wind power, thereby reducing the sector's vulnerability to water scarcity and climate-induced droughts.³³⁹ Coastal wind farms, a cornerstone of Denmark's renewable energy strategy, are safeguarded through resilience planning, including protective barriers and elevated infrastructure to withstand sea-level rise and extreme weather events.

South Africa's electricity sector faces major challenges from its water-intensive coal-fired power plants and hydropower systems which are water dependant due to potential water scarcity.³⁴⁰ Climate-induced droughts worsen water scarcity, which directly impacts electricity generation. National adaptation strategies emphasise improving water-use efficiency and transitioning to less water-intensive renewable

³³⁶ Just Transition Framework (climatecommission.org.za).

³³⁷ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³³⁸ Akinbami OM, Oke SR, and Bodunrin, MO "The state of renewable energy development in South Africa: An overview" Alexandria Engineering Journal Volume 60, Issue 6, December 2021, Pages 5077-5093.

³³⁹ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁴⁰ Akinbami OM, Oke SR, and Bodunrin, MO "The state of renewable energy development in South Africa: An overview" Alexandria Engineering Journal Volume 60, Issue 6, December 2021, Pages 5077-5093.

energy sources.³⁴¹ Thus, Denmark's approach to climate-resilient infrastructure planning provides a model for South Africa to enhance its water-energy nexus strategies.

Therefore, as part of its adaptation strategy, South Africa needs to focus on developing its water-energy nexus strategy by adopting Denmark's approach to climate-resilient infrastructure planning which ensures sustainability in the face of increasing water stress by using less water-intensive renewable energy sources.

The adaptation measures under the Paris Agreement and the Glasgow Climate Pact emphasise the importance of international cooperation, financial support, and technology transfer.³⁴² South Africa could leverage these frameworks to secure funding and technical expertise for grid modernisation projects and energy storage systems, addressing its current limitations in managing renewable energy variability.

4.2.2. Financial and institutional barriers

Denmark's successful implementation of adaptation measures is attributed to having stable institutions and making substantial investments in renewable energy and strengthening the grid.³⁴³ Denmark's financial mechanisms such as green bonds and public-private partnerships help facilitate ongoing funding for adaptation initiatives.

South Africa, on the other hand, faces considerable financial and institutional challenges.³⁴⁴ Eskom's debt burden, and political instability limit the country's ability to modernise its electricity sector and scale renewable energy integration.³⁴⁵ Leveraging international financial mechanisms, such as the Green Climate Fund under the

³⁴¹ Akinbami OM, Oke SR, and Bodunrin, MO "The state of renewable energy development in South Africa: An overview" Alexandria Engineering Journal Volume 60, Issue 6, December 2021, Pages 5077-5093.

³⁴² Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008) http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁴³ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008) http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁴⁴ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" Science Progress 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

³⁴⁵ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" Science Progress 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

UNFCCC, and building public-private partnerships are options to raise the financial resources needed to overcome these barriers.

4.2.3. Comparative analysis: Denmark and South Africa

Denmark's climate legislative and policy frameworks are considerably more advanced than South Africa's. There are defined targets for carbon neutrality and detailed adaptation strategies for the energy sector.³⁴⁶ South Africa's adaptation strategies are less comprehensive in comparison, with a stronger focus on mitigation in the form of renewable energy integration through REIPPPP.³⁴⁷ Furthermore, South Africa relies heavily on coal and its socio-economic dependence on coal mining communities also complicates its adaptation efforts.

Denmark has successfully incorporated renewable energy, specifically wind power.³⁴⁸ This is in contrast with South Africa's slower implementation of renewable energy. Denmark's smart grid investments and energy storage initiatives have enabled it to manage the variability of renewable energy,³⁴⁹ whereas South Africa continues to struggle with grid reliability issues and insufficient storage capacity. South Africa's ageing grid infrastructure makes it vulnerable to climate impacts.

The adaptation measures implemented by Denmark in its electricity sector focuses primarily on technological advancements and infrastructure resilience.³⁵⁰ Furthermore, Denmark experiences limited socio-economic challenges in comparison to South Africa. In this regard, South Africa's adaptation strategies must address the socio-economic impacts linked to transitioning away from coal. This poses significant political and economic challenges to the country.³⁵¹ The Just Transition Framework is therefore an

³⁴⁶ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁴⁷ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" Science Progress 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

³⁴⁸ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁴⁹ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁵⁰ <https://powerefficiency.com/wind-energy-denmark/>

³⁵¹ Akinbami OM, Oke SR, and Bodunrin, MO "The state of renewable energy development in South Africa: An overview" Alexandria Engineering Journal Volume 60, Issue 6, December 2021, Pages 5077-5093.

important component of South Africa's adaptation strategy, but its implementation has been slow.

Both countries experience the challenges of ensuring that climate adaptation and energy transitions are socially equitable but the social inequalities in Denmark are not experienced to the same level as in South Africa. It should also be noted that Denmark has been more proactive in incorporating social equality into its climate policies and frameworks.³⁵²

South Africa's adaptation strategy is linked to the Just Transition Framework.³⁵³ The framework aims to address the social and economic implications of moving away from a reliance on coal mining and fossil fuel industries.³⁵⁴ South Africa must therefore balance reducing carbon emissions and adapting to climate impacts against the need to protect vulnerable communities. In this regard, South Africa can incorporate the lessons learnt from the Danish experience in terms of workforce retraining, job creation in renewable sectors, and community engagement to ensure vulnerable communities are not left behind in the transition.³⁵⁵

The transition to renewable energy is a critical part of both countries' adaptation strategies, but the challenges differ significantly. South Africa has made strides with initiatives such as the REIPPPP, but progress is hampered by slow grid modernisation and limited energy storage capacity.³⁵⁶ The country's grid, heavily reliant on coal infrastructure, struggles to integrate variable renewable energy sources such as wind and solar, and it faces the risk of power outages and infrastructure failure caused by extreme weather events.

Denmark, on the other hand, has modernised its grid to accommodate a high proportion of renewable energy, especially wind power, and invested in smart grid

³⁵² Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁵³ Just Transition Framework (climatecommission.org.za)

³⁵⁴ Just Transition Framework (climatecommission.org.za)

³⁵⁵ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008)
http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

³⁵⁶ Akinbami OM, Oke SR, and Bodunrin, MO "The state of renewable energy development in South Africa: An overview" Alexandria Engineering Journal Volume 60, Issue 6, December 2021, Pages 5077-5093.

technologies to improve flexibility and stability.³⁵⁷ Denmark was able to incorporate wind power into its energy system by facilitating grid interconnections with its neighbouring countries. This enables Denmark to have backup electricity during periods of low renewable generation. Furthermore, Denmark's continuous investments in energy storage and smart grid technology ensure the ability to manage intermittent renewable energy sources even under extreme conditions.

South Africa faces a unique adaptation challenge because of the water-intensive nature of its coal-fired power plants and hydropower systems, which is vital for both cooling processes in coal plants and the operation of hydropower stations.³⁵⁸ Climate change-induced droughts further worsen water scarcity. This makes the energy-water nexus a challenge for South Africa, as the availability of water resources directly affects the reliability and sustainability of the electricity supply.

Denmark has reduced its dependence on water for electricity generation due to the transition to wind power.³⁵⁹ This means that Denmark is less prone to the effects of water scarcity.

Both South Africa and Denmark face financial and institutional barriers to optimally effective climate adaptation, but the severity and nature of these barriers differ.³⁶⁰ South Africa's financial constraints and political instability limit its ability to implement adaptation measures.³⁶¹ Despite efforts such as the Climate Change Act and REIPPPP, South Africa struggles to obtain sufficient investment, and the slow pace of adaptation planning reflects the challenges of coordinating across sectors and levels of government.

³⁵⁷ How to manage cloudburst and rain water. Action plan for a climate-proof Denmark Danish Nature Agency https://en.klimatilpasning.dk/media/590075/action_plan.pdf

³⁵⁸ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" *Science Progress* 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

³⁵⁹ Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" *Clean Energy*, 2017, Vol. 1, No. 1, 23-35.

³⁶⁰ Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" *Clean Energy*, 2017, Vol. 1, No. 1, 23-35.

³⁶¹ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" *Science Progress* 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

Denmark has a more stable political environment compared to South Africa. As a result, it has been able to attract significant public and private investment for climate adaptation, for example through green bonds and innovative financing mechanisms.³⁶² The Danish government has been able to facilitate the integration of adaptation measures in its national development policies across all sectors.³⁶³ Denmark's institutional frameworks are more developed and allow for more effective implementation of climate policies, reducing barriers to adaptation.

4.3. Conclusion

Denmark and South Africa have adopted contrasting approaches to climate change adaptation in the electricity sector. Denmark has a developed, advanced renewable energy integration, smart grid investments, and proactive climate policies.³⁶⁴ South Africa, on the other hand, faces many challenges, which include the country's dependence on coal, water scarcity, and socio-economic complexities – despite making progress in renewable energy.³⁶⁵ For South Africa, grid modernisation, energy storage capacity expansion, and addressing the socio-economic impacts of transitioning away from coal are essential for climate change adaptation in the electricity sector.

Denmark's adaptation measures have positioned it as a global leader.³⁶⁶ Its adaptation measures have shaped its electricity sector by promoting renewable energy integration. The country has comprehensive strategies involve risk assessments, public engagement, and infrastructure investments.

³⁶² Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" *Clean Energy*, 2017, Vol. 1, No. 1, 23-35.

³⁶³ Wang J, Zong Y, You S, and Træholt C "A review of Danish integrated multi-energy system flexibility options for high wind power penetration" *Clean Energy*, 2017, Vol. 1, No. 1, 23-35.

³⁶⁴ <https://powerefficiency.com/wind-energy-denmark/>

³⁶⁵ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" *Science Progress* 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

³⁶⁶ Danish strategy for adaptation to a changing climate. Danish Energy Agency (2008) http://www.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

In contrast, South Africa's approach, while recognising similar climate risks, faces distinct socio-economic and infrastructural challenges that complicate adaptation efforts in the electricity sector.³⁶⁷

This comparative analysis emphasised South Africa's need to develop its climate adaptation strategies to address both environmental and socio-economic realities. It also highlighted the importance of continued knowledge-sharing and collaboration between South Africa and Denmark to enable South Africa in its efforts to enhance its global adaptation efforts.

³⁶⁷ Anekwe IMS, Akpasi SO, Mkize MM, Zhou H, Moyo RT, and Gaza, L "Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review" *Science Progress* 2024;107(2) <https://journals.sagepub.com/doi/10.1177/00368504241237347>

Chapter 5 Recommendations for strengthening South Africa's adaptation strategies in the electricity sector

5.1. Introduction

The research examined the adaptation strategies of South Africa's electricity sector and compared them to Denmark's more advanced measures. Chapter 2 established the global frameworks that informed national adaptation efforts, including the UNFCCC, the Paris Agreement, and the Glasgow Climate Pact. Chapter 3 analysed South Africa's progress and challenges faced when aiming to address climate change impacts, highlighting its reliance on coal, socio-economic complexities, and limited infrastructure modernisation. Chapter 4 provided a comparative analysis, emphasising Denmark's leadership in renewable energy integration, grid modernisation, and resilience planning.

Building on these insights, this chapter offers actionable recommendations for South Africa to enhance its adaptation strategies in the electricity sector. These recommendations address the unique challenges South Africa faces while drawing lessons from Denmark's success. The chapter focused on key areas, including renewable energy integration, infrastructure resilience, socio-economic adaptation, and leveraging international frameworks and finance.

5.1.1. Significance of the Climate Change Act

The Climate Change Act is a comprehensive framework designed to help South Africa in its transition to a low-carbon and climate-resilient future.³⁶⁸ It offers legislative and policy tools to integrate climate adaptation into national development planning, aligning these efforts with South Africa's international climate change commitments.³⁶⁹

The implications are that the electricity sector needs to make considerable reforms to address climate threats. Key adaptation strategies identified in the research include:

- a) Improving water efficiency in coal-fired power plants;

³⁶⁸ Climate Change Act, 22 of 2024

³⁶⁹ See chapters 2 and 3 general discussions

- b) Transitioning to less water-intensive renewable energy sources, such as wind and solar;
- c) Upgrading and modernising grid infrastructure to manage the increased frequency of extreme weather events; and
- d) Diversifying energy supply through decentralised generation and smart grid technologies.³⁷⁰

Furthermore, the Act is important for the integration of adaptation measures into sectoral plans, including the electricity sector. It is a crucial step toward enhancing the resilience of energy infrastructure. The SETs, for example, offers an opportunity to set clear, enforceable goals for reducing emissions in the electricity sector.³⁷¹

5.1.2. Accelerating grid modernisation and energy storage development

The negative consequences of climate change are being felt in South Africa's electricity sector. The country relies heavily on coal-based energy production, which requires significant amounts of water and is highly vulnerable to extreme weather events.³⁷² This exposes the sector to serious environmental and operational risks. Furthermore, South Africa's electricity infrastructure, especially the grid, is at risk from extreme weather events.³⁷³ This can lead to frequent power supply disruptions and increased maintenance costs.

Denmark's investment in smart grid technologies and energy storage highlights the importance of modernising infrastructure to effectively manage the changes encountered in renewable energy production.³⁷⁴

It is, therefore, essential to update and modernise South Africa's electricity grid.³⁷⁵ Priority should be given to smart grid technologies allowing for better management of supply and demand, as well as decentralised energy systems. Investing in grid resilience and grid maintenance, such as strengthening transmission lines and

³⁷⁰ See para 4.2.3

³⁷¹ See para 3.7.4

³⁷² See para 4.1.3

³⁷³ See para 4.1.3

³⁷⁴ See para 4.1.2

³⁷⁵ See para 4.1.3

protecting key infrastructure, will also reduce the risk of outages and improve reliability.

It is recommended that South Africa prioritise smart grid development to enhance real-time monitoring and management of electricity supply and demand. The country should also investigate expanding battery storage and explore innovative technologies, such as hydrogen storage, to address renewable energy intermittency. As undertaken by Denmark, it is also proposed that South Africa needs to strengthen collaborations with neighbouring countries to improve energy security and grid resilience.

Furthermore, the South African government must accelerate the transition to renewable energy, due to the vulnerability of coal-based power generation to climate change and water scarcity. The REIPPPP was successful in attracting some private investment, but its implementation must be scaled up. Government must review the regulatory, licensing and approval processes of renewable energy development and embedded generation projects and simplify and streamline the processes to be able to enhance the move toward renewables.

5.1.3. Addressing the water-energy nexus

South Africa's adaptation strategies must focus on improving water-use efficiency in the electricity sector. This is because water scarcity is a challenge and South Africa's reliance on water-intensive coal-fired power plants and hydropower exposes its electricity sector to severe water scarcity risks.³⁷⁶ As a result, government must explore the adoption of water-efficient cooling technologies and alternative water sources, such as treated wastewater or desalinated water for power generation.

These measures must be implemented to enhance water efficiency in existing coal-fired power plants. Government also needs to develop policies that align energy planning with water resource management to mitigate risks associated with droughts and climate-induced water shortages.

³⁷⁶ Para 4.2.1

Denmark's reduced reliance on water-dependent energy sources highlights the benefits of transitioning to renewable energy. It is therefore proposed that the shift to wind and solar energy needs to be accelerated to reduce the reliance on water.

5.1.4. Strengthening the Just Transition Framework

South Africa's transition from coal will have major socio-economic implications for coal-dependent and vulnerable communities.³⁷⁷ The Danish approach to social equity in its energy transition will provide South Africa with valuable lessons in addressing these challenges. It is also hoped that the transition to renewable energy will help South Africa achieve its broader economic goals by reducing the country's reliance on coal mining and coal for energy creation, and instead, it will create jobs in the green energy sector.³⁷⁸

The success of the Just Transition Framework is dependent on the implementation of retraining programmes, green skills development and government support for affected workers within the coal sector or fossil fuel industry.³⁷⁹ As per the Danish model, South Africa must provide economic opportunities and target support to coal-dependent regions to mitigate the social impacts of the transition.

There must be collaboration between government, labour unions, civil society, and private sector stakeholders to ensure an inclusive and equitable transition process. This is to ensure that the transition to renewable energy is managed properly to protect workers and communities dependent on coal. The Just Transition Framework must be fully implemented to mitigate the socio-economic impacts of the transition.

5.1.5. Leveraging international frameworks and finance

South Africa requires substantial financial and technical resources to implement the adaptation measures outlined in the Act.³⁸⁰ Government must prioritise securing international climate finance through mechanisms such as the Green Climate Fund and Special Climate Change Fund. Public-private partnerships must be encouraged to

³⁷⁷ See para 4.2

³⁷⁸ See chapter 3 discussions

³⁷⁹ See para 4.2

³⁸⁰ See para 4.2.2

leverage private investment in adaptation projects, including grid modernisation and renewable energy expansion.

The Paris Agreement and Glasgow Climate Pact emphasise the importance of financial mechanisms and technology transfer for supporting developing countries.³⁸¹ In this regard, South Africa must leverage access to these frameworks to develop technical capacity-building programmes to ensure that local municipalities, industries, and communities can effectively implement adaptation strategies.

5.1.6. Enhancing policy coherence and implementation

Denmark's successful implementation of adaptation measures to mitigate climate change risks supported by comprehensive policies and frameworks and institutional assistance.³⁸² South Africa's policies, such as the Climate Change Act lays the foundation to address climate change, but it requires coordination, political buy-in and financial support for effective implementation.

It is recommended that South Africa needs to strengthen and build institutional capacity in its key institutions to improve the implementation and monitoring of climate adaptation strategies to ensure that national policies and strategies are closely aligned with international commitments to attract support and maintain credibility.

Mechanisms must be implemented to enable the periodic review of adaptation efforts to identify and address climate challenges as well as to monitor compliance with international standards to improve adaptation strategies.

5.2. Conclusion

The recommendations presented in this chapter focused on grid modernisation, water-energy resilience, socio-economic adaptation, financial mechanisms, and policy coherence. It proposed a pathway for strengthening South Africa's climate adaptation strategies. Implementing these measures will enable the country to align its electricity sector with global climate adaptation priorities and address its unique national

³⁸¹ See chapter 2 discussions

³⁸² See para 4.1.1 and 4.1.2

circumstances. As a result of escalating climate impacts, this approach will ensure a sustainable and equitable energy future for South Africa.

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