South Africa's 2nd Annual
Climate Change Report
2016

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

2030 NDP

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FOREWORD BY MS. EDNA MOLEWA

MINISTER OF THE DEPARTMENT OF ENVIRONMENTAL AFFAIRS

South Africa has endorsed the National Climate Change Response Policy as a vision and a framework for an effective climate change response, and the long-term, just transition to a climate-resilient economy and society. The policy is the product of an extensive consultation process. It sets two high-level objectives:

- **Firstly**, to effectively manage the inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity; and

- **Secondly**, to make a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner.

South Africa's approach towards an effective climate change response is both developmental and transformational. It is developmental in that we are prioritising climate change responses that have significant mitigation or adaptation benefits, AND have significant economic growth, job creation, public health, risk management and poverty alleviation benefits. It is transformational in that we are seeking to address climate change at a scale of economy that supports the required innovation and finance flows needed for a transition to a lower carbon, efficient, job creating, equitable and competitive economy. In essence, it is about sustainable development.

Work is well advanced in implementing this National Climate Change Response Policy. One of the key elements of the climate change response is a country-wide monitoring and evaluation system that tracks South Africa's transition to a lower carbon and climate resilient economy and society.

The main output of South Africa's climate change monitoring and evaluation system is the climate change annual report. This year, the Department will publish

its second climate change annual report. This 2016/17 report includes chapters on (i) quantifying and profiling the impact of ongoing or recently completed mitigation actions (ii) progress in the work on climate change flagship programmes (iii) lessons learn from the recent drought phenomenon (iv) progress in the development of the national adaptation strategy and desired adaptation outcomes (v) progress in establishing a credible national tracking system for key climate change actions in the country (vi) implications of the Paris Agreement for South Africa and (vii) recognising and profiling climate change actions by SANBI and also by Youth.

Internationally, South Africa submitted its own Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat in September 2015. The annual report will indicate progress towards achieving South Africa's NDC.

Lastly, there is vast potential for co-operation in producing these annual reports. We recognise and thank all those who have assisted us to produce the first report. For this report, we received contributions from all three spheres of government, the private sector, civil society, foreign embassies, and academia. In addition, I would like to thank the German government for the extensive support that we have received through GIZ. We invite many others to continue the collaboration with us as we contribute towards the identification of opportunities for further climate change actions and management of current and future climate risks with the view to consolidating the gains that this country has attained so far by improving peoples' livelihoods, conserving biodiversity, and improving human well-being.

Thank you

Ms. Edna Molewa
Minister of the Department of Environmental Affairs

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CHAPTER I

INTRODUCTION

CHAPTER 1: INTRODUCTION

PREPARED BY: Molotsoane R.(Department of Environmental Affairs)

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1.1. NATIONAL CONTEXT

Climate change is already a measurable reality posing significant social, economic and environmental risks and challenges globally. Like many other developing countries, South Africa is especially vulnerable to the impacts of climate change (Kreft, Eckstein and Melchior, 2017). As such South Africa has the task of balancing the acceleration of economic growth and transformation with the sustainable use of environmental resources and responding to climate change.

Water is the primary medium through which the impacts of climate change are being felt in South Africa according to the National Water Resource Strategy (Department of Water Affairs, 2013). Increases in climate variability and climatic extremes are impacting both water quality and availability through changes in rainfall patterns, with more-intense storms, floods and droughts; changes in soil moisture and runoff; and the effects of increasing evaporation and changing temperatures on aquatic systems. South Africa has been experiencing a serious drought since 2015, with associated crop losses, water restrictions, and impacts on food and water security.

Simultaneously curbing climate change and responding to the unavoidable impacts of historic greenhouse gas (GHG) emissions both timeously and continuously, requires 'substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks' (IPCC, 2014:7). Climate change action presents a clear path towards the shared aim of a healthier, more prosperous and more secure future. South Africa has the task of balancing the acceleration of economic growth and transformation with the sustainable use of environmental resources and responding to climate change. The very policies and actions that must deal with climate change also offer the most effective, readily achievable set of responses to enable sustained economic growth and social upliftment.

South Africa's National Climate Change Response White Paper (NCCRWP) (DEA, 2011) and the National Development Plan (NDP) (NPC 2011), present a vision for an effective response to climate change. The NCCRWP and NDP address the immediate and observed threats of climate change to the country's society, economy and environment and provide the basis for tracking South Africa's transition to a climate resilient society and lower carbon economy.

Urgent and appropriate climate action offers South Africa and other countries in the region, and globally, a clear pathway towards the shared aim of attaining a more prosperous, inclusive, equitable and secure future, in which national priorities of eradicating poverty and reducing inequality are addressed. Therefore, taking immediate action to curb emissions as close as possible to the 2°C compatible emissions pathways, while building climate resilience to the current and near-term impacts of climate change, is vital to avoid costly mitigation and adaptation actions in the future.

1.2. PURPOSE OF THE CLIMATE CHANGE ANNUAL REPORT

South Africa is undertaking significant actions to respond to climate change risks and impacts. The Climate Change Annual Report reflects on the progress in undertaking these actions with the aim of recognising ongoing actions, quantifying their impact, catalysing new actions and indicating how these actions contribute to the national imperatives of reducing poverty and inequality, and achieving continued economic growth.

South Africa's climate change response is directed primarily by the country's climate change policy set out in the NCCRWP (DEA 2011). The NCCRWP together with the NDP addresses the immediate and observed threats of climate change to the country's society, economy and environment and provide the basis for tracking South Africa's transition to a climate resilient society and lower carbon economy.

The NCCRWP commits South Africa to monitoring, evaluating and reporting its progress in responding to climate change, in addition to coordinating an effective national response to the unavoidable impacts of climate change and reducing the country's greenhouse gas (GHG) emissions. To this end the Department of Environmental Affairs (DEA) finalised the National Climate Change Response Monitoring and Evaluation (M&E) Framework in 2015, to inform the tracking of South Africa's transition towards a climate resilient society and lower carbon economy as mandated by the NCCRWP.

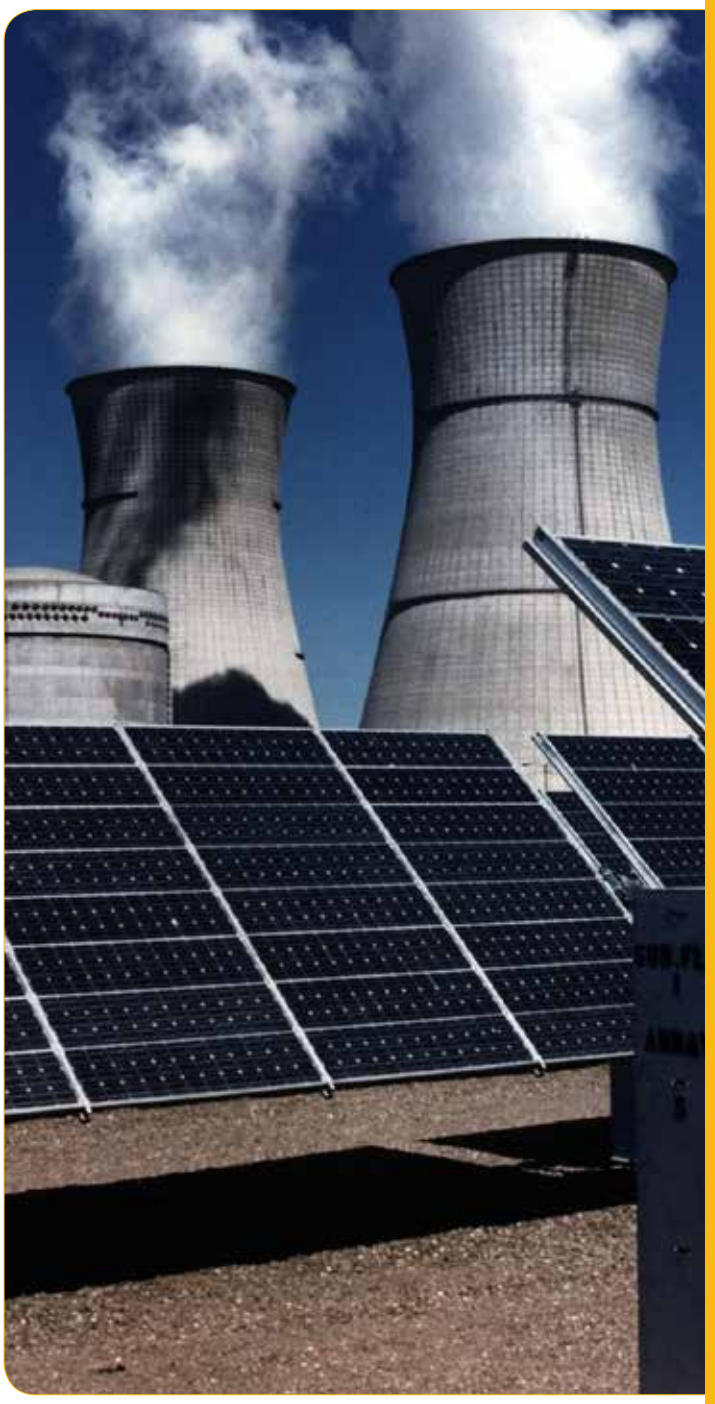
The 1st Climate Change Annual Report (CCAR), published in 2016 (DEA 2016), provided a comprehensive overview of South Africa's progress in catalysing action in response to climate change impacts and risks. This 2nd CCAR continues this tradition of documenting and building an evidence base to inform future responses to climate change.

1.3. OBJECTIVE AND TARGET AUDIENCE OF THE CLIMATE CHANGE ANNUAL REPORT

South Africa's climate change response landscape is dynamic, evolving and expanding, the Climate Change Annual Report communicates the progress and lessons learnt in tracking South Africa's transition towards a climate resilient society and a low carbon economy.

Thus the objectives of the climate change annual report are :

- To update the public on South Africa's climate change responses driven by a variety of role players across government, the private sector and civil society, in the spirit of building an inclusive society and economy.
- To profile and showcase climate change action and to recognise those leading / driving South Africa's climate change response.
- To enhance and broaden the understanding of the impact, effectiveness and gaps in South Africa's climate change actions, enhancing the capability of role players in all sectors of society to implement more effective and inclusive climate action.



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ABBREVIATIONS

CCAR	Climate Change Annual Report
DEA	Department of Environmental Affairs
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
M&E	Monitoring and Evaluation
NCCRWP	National Climate Change Response White Paper
NDP	National Development Plan
NPC	National Planning Commission

CHAPTER 2

THE PARIS AGREEMENT

IMPLICATIONS FOR SOUTH AFRICA

CHAPTER 2: THE PARIS AGREEMENT - Implications for South Africa

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REVIEWED BY: Molotsane R. (Department of Environmental Affairs)

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2.1. THE PARIS AGREEMENT

On 13 December 2015, 195 nations reached a historic agreement at the 21st Conference of the Parties (COP 21) held in Paris under the United Nations Framework Convention on Climate Change (UNFCCC), now known popularly as the Paris Agreement (UN, 2015). The Paris Agreement commits all countries to contribute to an ambitious global greenhouse gas (GHG) emissions reduction goal, and associated global goals for finance and adaptation, communicated through Nationally Determined Contributions (NDC) (UN, 2015). The Agreement also expects all Parties to put forward their best efforts through NDCs and to report regularly on the status of their emissions, as well as implementation efforts. The Agreement also aims to provide finance for developing countries to invest in low-carbon technologies and those which enhance climate resilience.

All countries will strive to keep global warming well below 2 degrees Celsius above pre-industrial levels, and will aim to scale up global efforts to reduce warming to 1.5 degrees. In practical terms, developed and developing countries alike are expected to undertake transformative measures to reduce greenhouse gas (GHG) emissions by the second half of the century, with GHG emissions anticipated to peak long before this. The Paris Agreement also, for the first time in the history of the UNFCCC, further elaborates the obligation to act on adaptation, requiring the COP to periodically take stock of the collective progress made towards achieving the global goal on adaptation.

The structure of the Paris Agreement is depicted in **Figure 1**, highlighting key provisions of the Agreement.

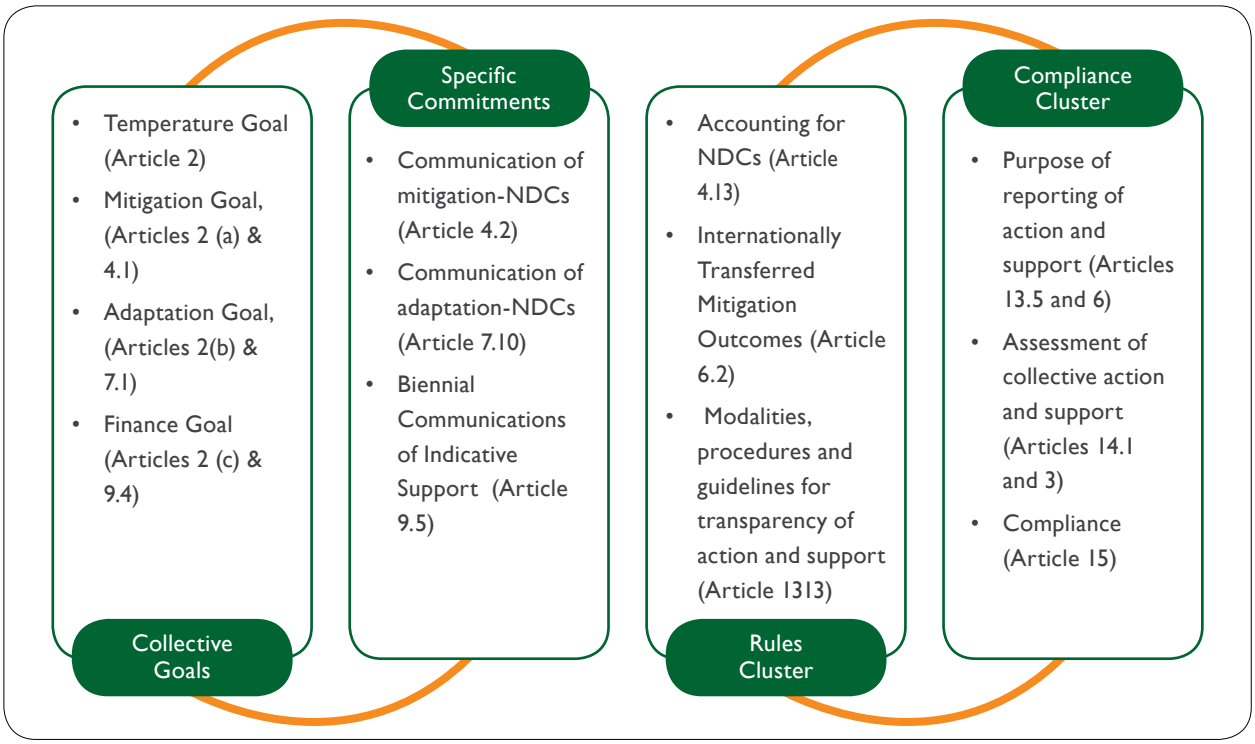

Figure 1: Structure of the Paris Agreement

Text Box 1
Key Elements of the Paris Agreement

- **Collective obligations and the NDCs:** The agreement sets collective obligations in the form of aggregate goals for mitigation, adaptation and finance, as well as entrenching the NDCs, which are broadly defined to include all elements (mitigation, adaptation, finance, technology, capacity building).

- **The commitments to action in respect of mitigation, adaptation, and financial support:** The agreement further outlines the commitments to action in respect of mitigation, adaptation, and financial support, without providing upfront pledges for technology development and transfer, and capacity building. All Parties are obliged to communicate adaptation and mitigation actions, with developed countries having an obligation to communicate indicative support from public sources.

- **A space for developing rules for GHG emissions and removals:** The agreement provides a space for developing rules on several aspects including accounting for emissions and removals with the parameters to be considered in developing such rules being explicit in the Paris Agreement. The Paris outcome further explicitly mandates the development of rules for Internationally Transferred Mitigation Outcomes (ITMOs) and common Modalities, Procedures and Guidelines (MPGs) for transparency of action and support.

- **Sustainable Development Mechanism:** Although rules for the Sustainable Development Mechanism envisaged in Article 6.4 are not explicit in the Agreement, the decision adopting the Agreement provides space for the development of such rules including the basis for their development. Similarly, for adaptation the decision to adopt the Agreement provides for the development of modalities to recognise the adaptation efforts of developing countries.

- **The compliance nexus:** The last feature of the agreement is a compliance nexus that includes transparency, the global stocktake, and compliance. These are undertaken at different levels of resolution where transparency and compliance are at an individual country level, while the global stock-take is undertaken at an aggregate level, albeit with a view to informing future actions of individual countries. The outcomes of the compliance nexus inform both the collective objectives and the enhancement of climate action and support, as well as international cooperation.

2.2. IMPLICATIONS OF THE PARIS AGREEMENT FOR SOUTH AFRICA

South Africa submitted its intended NDC to the UNFCCC in September 2015 (Republic of South Africa (RSA), 2015). The scope of the NDC covers adaptation and mitigation as well as finance and investment requirements for both (**Figure 2**).

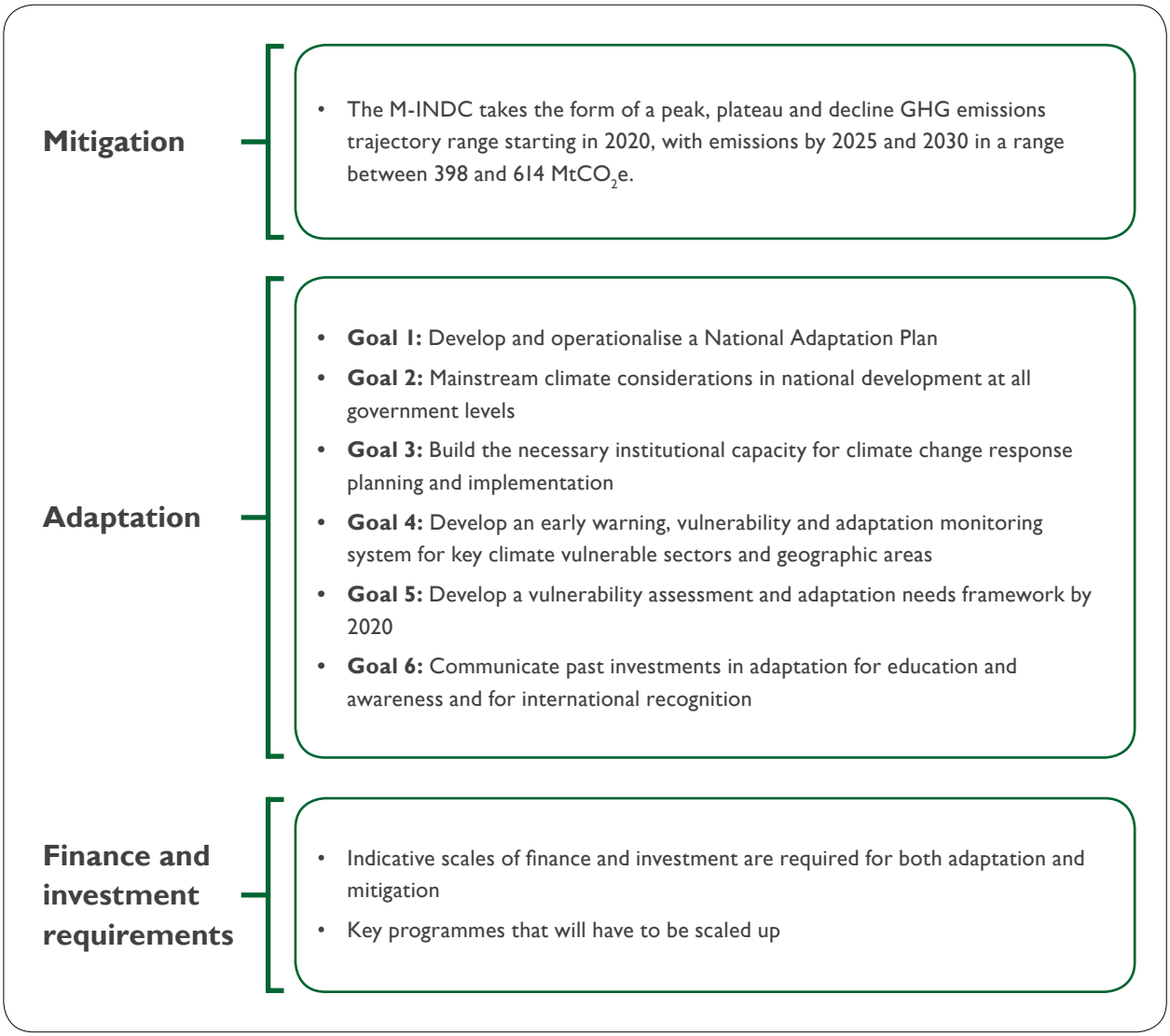

Figure 2: South Africa's Nationally Determined Contribution

One of the central principles of the Agreement, described in Article 3 and reiterated in Articles 4.3 and 9.3, is that countries will submit progressively more ambitious goals. South Africa will be expected to improve on mitigation and adaptation goals from 2030 and beyond.

As part of the Paris Agreement, all countries agreed to an enhanced transparency framework for action and support. Transparency and reporting of progress in responding to climate change are at the heart of the Paris Agreement and as such South Africa, along with other countries will need to enhance reporting on climate actions and their effects, among other things. South Africa will need to strengthen national institutional and technical capacities to meet the enhanced transparency requirements of the Paris Agreement.

South Africa's Climate Change Monitoring and Evaluation (M&E) System, covers all other aspects of the transparency requirements of the Paris Agreement including mitigation, adaptation and the compilation of the national GHG inventory and, furthermore, anchors South Africa's efforts to meet the provisions of the Paris Agreement. The compilation of reports required under the UNFCCC, primarily the National Communications and more recently, the Biennial Update Reports are coordinated through the Climate Change M&E System. The Climate Change M&E System is described in detail in the National Climate Change Response Monitoring and Evaluation System Framework (DEA, 2015). Progress made in the implementation of the M&E system is described in more detail in Chapter 3 of this report.

2.3. CLIMATE CHANGE MITIGATION

The Paris Agreement commits all countries to take ambitious steps to guarantee a low-carbon future. As our contribution to this global effort, South Africa committed to a medium-term goal of 398–614 $MtCO_2e$ between 2025 and 2030, which will represent South Africa's peak GHG emissions phase, and to reduce emissions thereafter up to 2050. South Africa has developed a Climate Change Mitigation System to enable the country to meet its mitigation ambitions.

Two key components of the post–2020 SA Mitigation System, Sector Emissions Targets (SETs) (previously known as Desired Emission Reduction Outcomes (DEROs)) and entity-level carbon budgets, are instruments that place quantitative limits on future GHG emissions to allow South Africa to fulfil its climate change mitigation ambition (DEA, 2017). The first phase of the Mitigation System extends from 1 January 2016 to 31 December 2020. The second phase will commence in 2021. **Chapter 6** of this report lays out the steps that will be taken in implementing South Africa's Mitigation System and the overall approach to achieving South Africa's mitigation NDC.

The National Climate Change Response Policy (NCCRWP) identifies desired emission reduction outcomes (DEROs) as a key element in the overall approach to mitigation (DEA, 2011). The NCCRWP sets out further details on the quantification of DEROs:

1. They should be set based on an 'in depth assessment of mitigation potential, best mitigation options, science, evidence and a full assessment of the costs and benefits' (DEA, 2011:25);
2. defined for the short-, medium- and long-term;
3. consistent with the Benchmark National GHG Emissions Trajectory Range (BNETR); and
4. be defined for each sector and sub-sector of the economy and where appropriate, be cascaded to the company or entity level.

In reviewing DEROs for Phase 2 and subsequent phases of the Climate Mitigation System, the following points of departure are identified:

- The DEA has renamed DEROs to better reflect their purpose. In Phase 2 and subsequent phases the terminology **Sector Emission Targets (SETs)** will be used for this element of the climate mitigation system. The NCCRWP must be updated every five years and it is expected that this name change and accompanying approach will be reflected in the NCCRWP update when and if it happens.
- SETs will provide sectoral and sub-sectoral **targets** for individual government departments. It is not considered necessary, appropriate or possible to cascade SETs down to a company or entity level – except for the electricity generation sector (as discussed below).
- SETs will ultimately be based on an 'in-depth assessment of the mitigation potential, best available mitigation options, science,[1] evidence and a full assessment of the costs and benefits' (DEA, 2011:25) as specified in the NCCRWP as a requirement for DEROs. However, the difficulty in doing so currently is recognised and, therefore, in Phase 2 a simplified approach is necessary. As data becomes available and modelling capabilities improve the methodology to calculate SETs will evolve. Both the methodology for Phase 2 and subsequent phases is presented is presented below.

1 Note that the science component refers to the setting of the agreed national trajectory rather than the mitigation potential.

The DEA has set out the following further specific characteristics of SETs. The short-term SETs are mandatory, while the medium-term and long-term SETs are indicative:

- **SETs will be quantified for three rolling phases.**[2] At the end of every phase, the SETs are reviewed and updated for the following three phases. The SETs may also be revised within a phase should local conditions change significantly. The first SET is considered a short-term target and the subsequent two SETs are medium-term targets.

The purpose of SETs is to:

- Provide long-term **signals** of required emission reductions.
- Provide short, medium and long-term sectoral and sub-sectoral **targets** for individual **government departments**.
- Drive **mainstreaming** of greenhouse gas mitigation into all relevant sector government departments, and in so doing drive the development and implementation of policies and measures to reduce greenhouse gas emissions within sectors (particularly aimed at entities which are not subject to carbon budgets).
- SETs align with carbon budgets insofar as they both have the overall goal of contributing towards the achievement of the national emissions trajectory.

SETs cover emissions from all sectors of the economy and will be defined at sector and sub-sector level. These sectors will align with those in the National GHG Inventory, and thus the Intergovernmental Panel on Climate Change (IPCC) categorisation of sectors, to facilitate monitoring of progress towards meeting SETs. The level of completeness in terms of emissions coverage will mirror that of the National GHG Inventory.

The fact that the current NDCs are not sufficient to meet the 2-degree target, combined with the agreement in Paris about strengthening efforts in the direction of 1.5 degrees, means that there will be additional pressure on all countries, including South Africa, to make more ambitious commitments in the future; particularly given South Africa's position as one of the largest economies on the continent, and the energy-intensive nature of the economy.

2 A phase is a five-year period. Phase 2 is 2021–2025; Phase 3 is 2026–2030; Phase 4 is 2031–2035 and so on.

2.4. ADAPTATION IMPLICATIONS

South Africa's NDC under Article 4.4 (Republic of South Africa (RSA), 2015) and the provisions of Article 12 of the Paris Agreement (UN, 2015) set out how national commitments for adaptation will be met over the period 2020 to 2030. South Africa's NDC will address adaptation through six adaptation NDC (A-NDC) goals covering adaptation objectives and planning, adaptation needs and costs and adaptation investments (**Figure 3**).

The Paris Agreement highlights the importance of monitoring, evaluation and learning from adaptation practice (UN, 2015; Article 7, para 9d). To understand progress towards achieving climate resilient development, it requires all countries to provide information on climate change impacts and adaptation. It also stipulates a 'global stocktake' (Article 14, para 1), which will include a review of adaptation effectiveness and progress made towards the global adaptation goal.

South Africa has developed a set of Desired Adaptation Outcomes (DAOs), which were introduced in the 1st Climate Change Annual Report (CCAR), to provide a means of fulfilling its transparency obligations under the Paris Agreement (DEA, 2016). The DAOs structure the M&E of South Africa's adaptation response and will also inform adaptation planning and decision making, both within South Africa and in the wider international community.

Progress made in the development and operationalisation of the DAOs, since the publication of the 1st CCAR, is discussed in more detail in **Section 3.3** of this report.

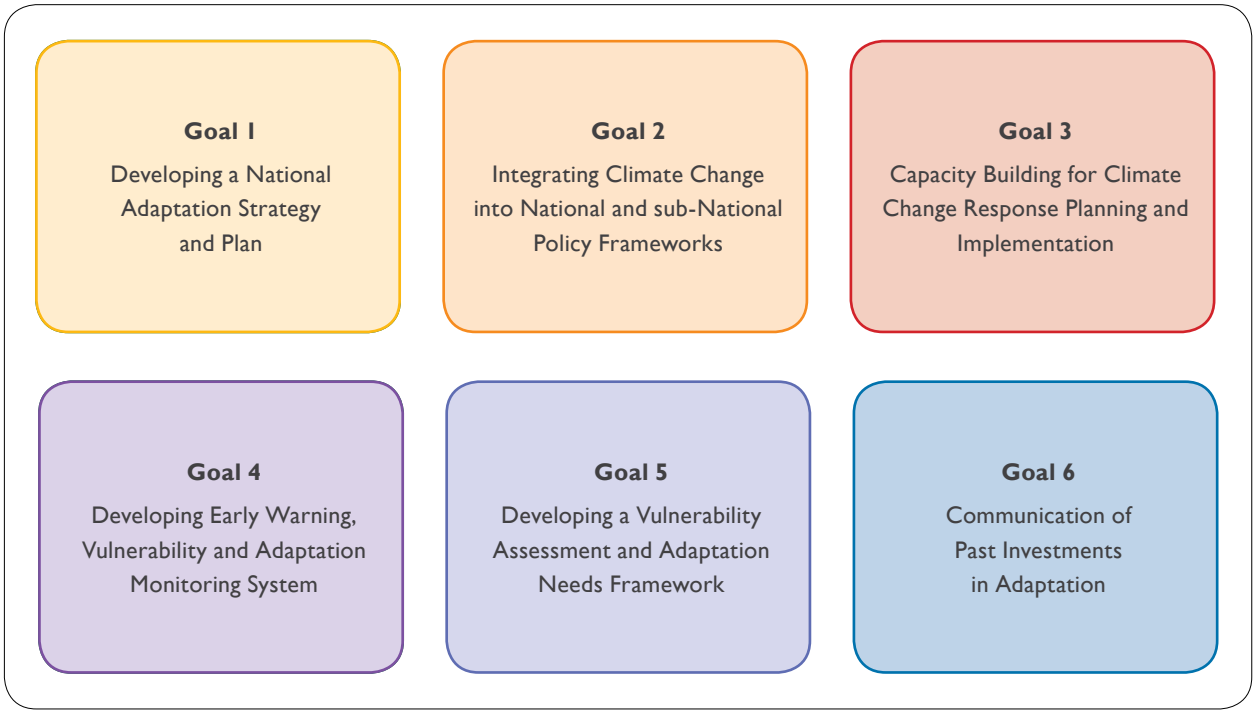

Figure 3: Overview of South Africa's Adaptation NDC

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ABBREVIATIONS

A-NDC	Adaptation Nationally Determined Contribution
BNETR	Benchmark National GHG Emissions Trajectory Range
CCAR	Annual Climate Change Report
COP 21	21st Conference of the Parties
DAOs	Desired Adaptation Outcomes
DERO	Desired Emission Reduction Outcome
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
ITMOs	Internationally Transferred Mitigation Outcomes
M-INDC	Mitigation Nationally Determined Contribution
M&E	Monitoring and Evaluation
MPGs	Modalities, Procedures and Guidelines
NDC	Nationally Determined Contribution
NCCRWP	National Climate Change Response White Paper
SET	Sector Emissions Target
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER 3

SOUTH AFRICA'S CLIMATE CHANGE MONITORING AND EVALUATION SYSTEM

CHAPTER 3: SOUTH AFRICA'S CLIMATE CHANGE MONITORING AND EVALUATION SYSTEM

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3.1. OVERVIEW OF NATIONAL CLIMATE CHANGE MONITORING AND EVALUATION SYSTEM

South Africa's climate change monitoring and evaluation (M&E) system addresses measurement, reporting and verification (MRV). The M&E system goes beyond a monitoring function, also aiming to evaluate climate change impacts and the effectives of responses in South Africa.

This system is currently, broadly composed of the following elements shown in **Figure 4**.

It is through this overall system, that monitoring and evaluation of all climate change information, such as the National Greenhouse Gas (GHG) Inventory, policies, strategies and actions will be undertaken; including the elements of the Mitigation System – carbon budgets and sectoral emission targets; and the Adaptation Goals, described in the previous Chapter.

Figure 5, presented on the following pages, provides an overview of South Africa's Climate Change M&E system and progress made in the implementation of various aspects of the system, as detailed in subsequent sections of this chapter.

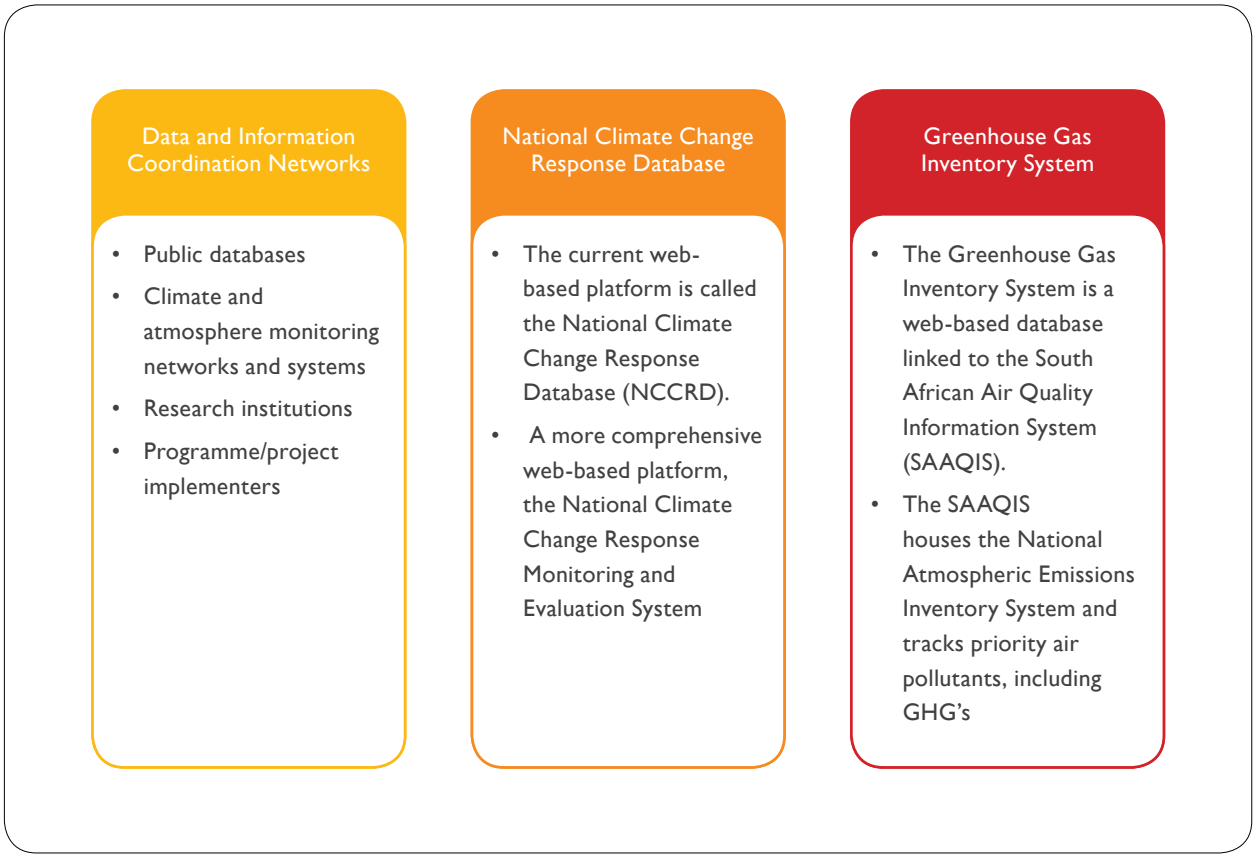

Figure 4: The main elements of South Africa's Climate Change monitoring and evaluation system

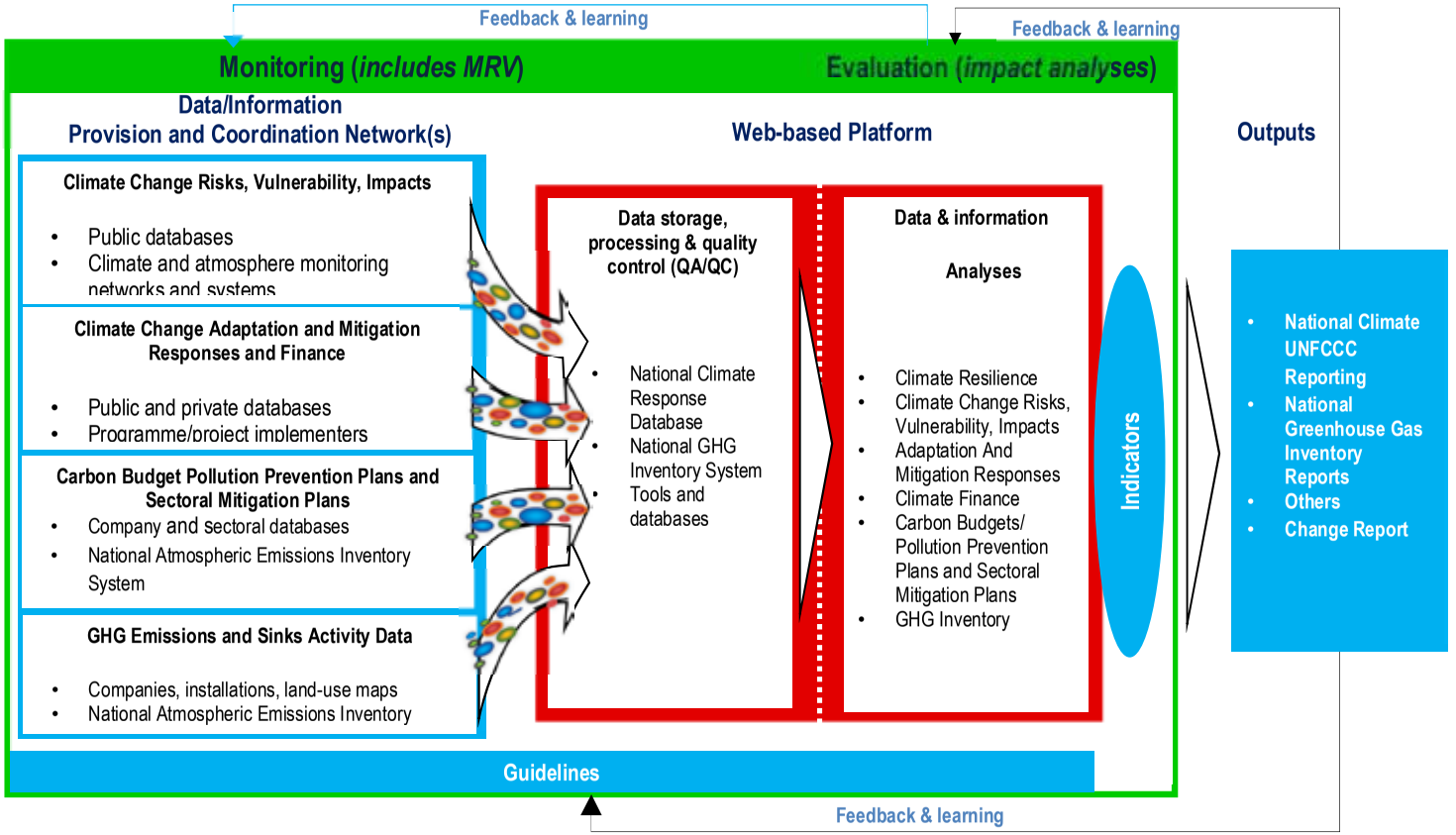

Figure 5: South Africa's overall climate change monitoring and evaluation system

3.2. DEVELOPMENTS IN THE MONITORING AND EVALUATION OF MITIGATION

3.2.1 The National Greenhouse Gas Emission Reporting Regulations and National Atmospheric Emissions Inventory System

The GHG inventory is a critical part of South Africa's transparency framework and informs the scope and form of national mitigation policy and actions. South Africa has recently introduced National Greenhouse Gas Emission Reporting Regulations, under the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004). The Regulations took effect in April 2017 as part of a single national reporting system for the GHG emissions, which will be used predominantly to update and maintain the National GHG Inventory (DEA, 2017).

The Regulations apply to both entities engaged in activities which result in atmospheric GHG emissions and those entities which hold relevant GHG emission data. The National Atmospheric Emissions Inventory System (NAEIS), managed by the South Africa Weather Service, serves as the electronic filing cabinet to manage atmospheric emissions inventory reporting forms submitted by regulated facilities, including the mandatory reporting of GHG emissions.

3.2.2 The National GHG Improvement Programme and Development of the National GHG Inventory System

In an effort to respond to a set of challenges, encountered during the compilation of the 2010 National GHG Inventory, including:

- The application of lower tier methods due to unavailability of disaggregated activity data.
- A lack of well-defined institutional arrangements.
- An absence of legal and formal procedures for reporting GHG emission data and information.

South Africa is implementing a GHG Improvement Programme (GHGIP), which includes a series of sector-specific projects and, more broadly, the National GHG Information System (NGHGIS). The NGHGIS seeks to improve the data management, documentation, governance and institutionalisation of the GHG preparation process. More than 15 partners are included in this programme implemented from 2016–2018.

3.2.3. The Agriculture, Forestry and Other Land-use Measurement, Reporting and Verification Capacity Building Project

The NAEIS is structured to capture reporting from the Energy, Industrial Processes and Product Use (IPPU) and Waste sectors and does not currently include GHG emissions reporting from Agriculture, Forestry and Other Land Use (AFOLU).

The AFOLU sector is multi-functional and diverse; with the additional unique characteristic of being both a source and potential sink for GHGs. To this end, the Commonwealth of Australia provided fast start finance to South Africa to implement a MRV Capacity Building project for the land sector. The MRV of AFOLU project team has since developed a MRV of AFOLU strategic plan (2016–2020). The long-term strategic objective for the development and implementation of the AFOLU sector MRV is to enhance South Africa's capacity to transparently monitor and report emissions from land use and the impact of mitigation actions Some of the central achievements from the MRV of AFOLU capacity building project to date, include:

- Enhancing DEA's capacity to compile National GHG inventories for the AFOLU sector
- Identification of indicators to track the impact of sectoral response measures. A set of the MRV of AFOLU guidelines is currently under development. :

3.2.4 MRV of GHG Emissions for the Carbon Tax

The Carbon Tax Policy Paper was published in 2013 as the basis for a national carbon tax. It is envisaged that the GHG emissions data reported onto the NAEIS system will also inform the application of a national carbon tax. Companies, with carbon tax liabilities will use the NEAIS to self-report to the South African Revenue Services (SARS) for carbon tax purposes.

The GHG emissions data reported through the NAEIS would enable verification and auditing of tax returns submitted to SARS. The carbon tax liability will be determined based on GHG emissions resulting directly from fuel combustion, gasification and non-energy industrial processes, emitted at an entity level. The approach is also consistent for companies that will be assigned carbon budgets under the broader Climate Change M&E system, and those that will be reporting energy management plans in terms of the Department of Energy's (DOE's) mandatory energy reporting regulations (Government Gazette, No.336145, March 2015, Department of Energy, Government Notice R.259 27, National Energy Act, 2008). The regulations were promulgated for public comment in March 2015 (Department of Energy, 2015).

Guaranteeing the linkages between the various reporting regimes mentioned above ensures consistency in the quantification, assessment and reporting of GHG emissions for carbon tax purposes. It means that similar companies shall be subjected to a similar mix of measures and most importantly, there will be no administrative risk in terms of managing the system in the short-to-medium term.

3.3. DEVELOPMENT IN MONITORING AND EVALUATION OF ADAPTATION

Desired Adaptation Outcomes for Monitoring and Evaluating climate resilience have been developed to complement the building blocks of the monitoring and evaluation framework. The concept of Desired Adaptation Outcomes (DAOs) has been devised to facilitate, inform and focus the assessment of progress. DAOs identify desired states that, individually and in combination, will contribute to climate resilience in the short to medium-term. They aim to provide clear insights into climate change adaptation in South Africa and help capture the country's unique circumstances to aid reporting on adaptation at national and international levels. They also provide a means of assessing whether the measures being taken are appropriate, efficient and effective. The monitoring and evaluation of adaptation actions is discussed further in **Chapter 4**.

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ABBREVIATIONS

AFOLU	Agriculture, Forestry and Other Land Use
DAO	Desired Adaptation Outcomes
DEA	Department of Environmental Affairs
DoE	Department of Energy
GHG	Greenhouse gas
GHGIP	GHG Improvement Programme
IPPU	Industrial Processes and Product Use
M&E	Monitoring and Evaluation
MRV	Measurement, Reporting and Verification
NAEIS	National Atmospheric Emissions Inventory System
NCCRD	National Climate Change Response Database
NGHGIS	National GHG Information System
SAAQIS	South African Air Quality Information System
SARS	South African Revenue Services

CHAPTER 4

ADAPTATION

SOUTH AFRICA'S TRANSITION TO
A CLIMATE RESILIENT SOCIETY

CHAPTER 4: ADAPTATION - South Africa's Transition to a Climate Resilient Society

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4.1. MONITORING AND EVALUATION OF ADAPTATION ACTIONS IN SOUTH AFRICA

4.1.1 Development of the Desired Adaptation Outcomes for Monitoring and Evaluating Climate Resilience

Desired Adaptation Outcomes (DAOs) are premised on a set of desired actions and prerequisites to achieve a climate resilient South Africa over the next five to 20 years. The DAOs facilitate and focus the M&E of the country's progress towards climate resilience, providing a framework for the articulation of sectoral adaptation goals in plans, policies and actions for all spheres of government. Eight **overarching DAOs** have been developed (**Table 1**). In addition, 75 **sector-specific DAOs** have been proposed for eight 'at risk sectors.

The DAO's are multi-dimensional and provide an approach to monitoring and evaluating progress towards climate resilience. They can be applied to climate action at varying scales – encompassing national provincial and local scale climate change response measures. In addition, the DAOs address different aspects of South Africa's transition from policies, plans and actions to coordination (**Figure 6**).

Table 1: Overarching Desired Adaptation Outcomes

DAO	Description
G1	Robust / integrated plans, policies and actions for climate change adaptation, together with resources and capacity (e.g. financial, human, legal and regulatory) for effective delivery (with monitoring, evaluation and review over the short, medium and longer-term).
G2	Appropriate processes and mechanisms for coordinating climate change adaptation (i.e. institutional and governance structures).
G3	Reliable climate information, including seasonal predictions and future projections, and effective early warning systems for extreme weather and other climate-related events (i.e. to inform adaptation planning and disaster risk reduction / management).
G4	Capacity development, education and awareness programmes (formal and informal) for climate change adaptation (e.g. informed by adaptation research and with tools to utilise data / outputs).
G5	New and adapted technologies / knowledge and other cost-effective measures (e.g. nature-based solutions) used in climate change adaptation.
G6	Systems, infrastructure, communities and sectors less vulnerable to climate change impacts (e.g. through effectiveness of adaptation interventions / response measures).
G7	Non-climate pressures and threats to human and natural systems reduced (particularly where these compound climate change impacts).
G8	Secure food, water and energy supplies for all citizens (within the context of sustainable development).

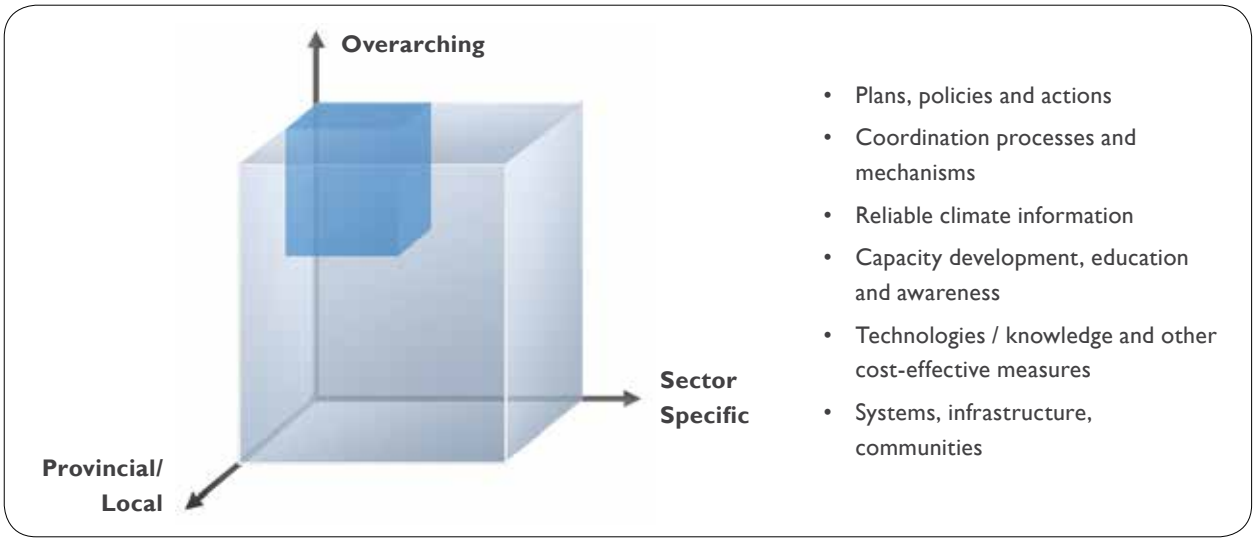

Figure 6: Applying the DAOs at all scales of climate action

This section provides an analysis of South Africa's climate resilience transition using the DAOs to understand the following:

1. Data and information required to monitor progress under each DAO in key sectors and one province.
2. How the evaluation of effectiveness will be done under each DAO.
3. How ongoing actions contribute to DAOs.

Each of these activities are addressed in more detail in the sections below.

4.1.2. Data and information required to monitor the DAOs

The DEA has engaged in extensive consultation throughout the course of 2016, to ensure ownership and acceptance of DAOs amongst key stakeholders. The DAOs were presented and discussed at a range of inter-government platforms including the Intergovernmental Committee on Climate Change (IGCCC); the Adaptation Technical Working Group (TWG) and at post-COP 21 provincial dialogues.

Consultative dialogues also took place focusing on the water and forestry sectors hosted by the Department of Water and Sanitation (DWS) and the KwaZulu-Natal provincial Department of Economic Development, Tourism and Environmental Affairs, respectively. The purpose of these was to fine-tune the selected DAOs, to understand the data and information needs, and identify potential data sources to facilitate tracking of these DAOs. In addition, a national sectoral workshop on DAOs was hosted by the Department of Environmental Affairs.

The outcomes of the consultations with the water sector, the forestry sector and the KwaZulu-Natal province are summarised below.

a) Water sector DAOs

South Africa was experiencing a serious drought at the time of preparing this report, with associated crop losses, water restrictions and impacts on water and food security. The

adaptation responses to drought, including risk reduction, monitoring and forecasting, are addressed in **Chapter 5**.

Nine DAOs have been identified specifically for the water sector. These are presented in **Table 2**, alongside links to the corresponding overarching DAOs (in square brackets, e.g. [G1]), together with the data and information needed to monitor progress towards achieving each DAO.

Table 2: Desired Adaptation Outcomes and associated data/information needs for the water sector

Desired Adaptation Outcomes	Data and information needed to monitor progress
1. **Climate change adaptation fully integrated into planning processes in water-dependent sectors (e.g. agriculture, industry, economic development, health, spatial planning, and science and technology) [G1 & G3].**	Data on inclusion of water-related climate change adaptation in sector plans, including number of plans informed by weather observations, forecasts and seasonal predictions, climate projections, and water-specific issues such as floods, droughts, and ground and surface water levels.
2. **Capacity development programmes in water-dependent sectors informed by water-related adaptation research (e.g. high quality data and tools to analyse data) [G4].**	Data on influence of water-related adaptation research in capacity development programmes, including: • number of capacity development programmes in water-dependent sectors addressing adaptation • level of influence of adaptation research in informing these programmes.
3. **Regional (international) adaptation policies and programmes established for South Africa's trans-boundary river systems [G1].**	Data on inclusion of climate change adaptation in trans-boundary river management plans, including number of water management plans and development plans (i.e. plans that have a water component) with adaptation policies, programmes and actions
4. **Water security and resource protection enhanced by adaptation of catchment and water management practices (e.g. investment in water conservation and water demand management) [G8].**	Data on: • water security strategies, plans, programmes and projects in provinces and municipalities that support development and implementation of climate resilient production and distribution / supply systems and infrastructure • integration of climate-related risks to water security in relevant provincial and municipal strategies, plans, programmes and projects • how engineered and non-engineered adaptation measures have increased resilience of water supply systems and infrastructure.

5. New and unused water resources utilised sustainably in areas of water stress (e.g. groundwater, effluent re-use, and desalination – with cost-benefit and maladaptation risk assessments undertaken) [G5].	Data on alternative sources of water, including initiatives and technological innovations such as fog harvesting, water harvesting, groundwater extraction, desalination, and wetland rehabilitation.
6. Vulnerable communities, sectors and infrastructure more resilient to water-related climate change impacts [G6].	Data on: • number of vulnerable systems, resources or communities with water-related adaptation plans • effectiveness of these plans and measures in reducing vulnerability.
7. Water sector has resources (i.e. human, legal, regulatory, institutional, governance, and financial) and capacity to properly address climate change challenges [G1].	Data on availability of resources and capacity in water sector for climate change adaptation.
8. Efficiency and effectiveness of water-related climate change adaptation policies and programmes monitored and evaluated over short, medium and longer-term time scales [G1 & G2].	Data on effectiveness of water sector's climate change adaptation policies, programmes and actions, including evidence from procedures and indicators to monitor and evaluate water-related adaptation activities in the short, medium and longer-term.
9. Non-climate pressures and threats to water quality and availability reduced (particularly where these compound climate change impacts) [G7].	Data on land use and land use change, population demographics, pollution, water quality and siltation of dams.

The adaptation responses to drought, including risk reduction, monitoring and forecasting, are addressed in more detail in **Chapter 5** of this report.

b) Forestry sector

The forestry sector includes complex ecosystems that provide a wide range of economic, social and environmental goods and benefits to a wide range of people. The forestry sector in South Africa is undergoing significant changes, with increasing temperatures and decreasing rainfall impacting forest crop productivity. A notable escalation in the number of pests has been reported and pathogens are spreading much faster and with increased intensity. The frequency and level of devastation of forest fires has also increased in recent years. The rehabilitation and restoration

of forest plantations and conservation areas, together with mitigation of and rapid response to forest fires, are amongst the climate-related challenges facing the forestry sector (Department of Agriculture, Forestry and Fisheries (DAFF), 2013).

Four DAOs have been identified specifically for the forestry sector. These are presented in **Table 3**, alongside links to the corresponding generic DAOs (in square brackets, e.g. [G1]), together with the data and information needed to monitor progress towards achieving each DAO.

Table 3: Desired Adaptation Outcomes and associated data/information needs for the forestry sector

Desired Adaptation Outcomes	Data and information needed to monitor progress
1. Climate resilience integrated into forestry development plans (adaptation measures/interventions incorporated into national, provincial and local management plans, and resources and capacity available to address climate change challenges) [G1 & G2].	Data on: • number of sector plans incorporating climate change adaptation • dissemination of adaptation measures / interventions through management plans • availability of resources and capacity for adaptation (e.g. human, legal, regulatory, institutional, governance, financial) • integration of climate change considerations into legislation and related regulations (e.g. NEMBA, Water Act, National Forest Act, National Fire Act).
2. New opportunities, areas and crops utilised sustainably by forestry sector and negative impacts of existing practices reduced (development and implementation of new technologies and knowledge, vulnerability to climate and non-climate pressures and threats reduced, and security of supply of forest products and resources increased) [G5, G6, G7 & G8].	Data on: • adoption of new technologies / knowledge from South Africa • adoption of new international technologies / knowledge • establishment of small-grower cooperatives • value addition to product variety • access to research outcomes / findings and management systems / extension support • access to genetically adapted material • alignment of policies and legislation • gains / losses of planted species • yield gains through new technologies • harvest of wood for biomass and energy from natural forests • reduction in wild fires through proactive fire management.

3. Stakeholders in forestry sector better understand climate change and need for adaptation (capacity development programmes informed by forestry-related adaptation research) [G4].	Data on: • number of capacity development programmes (including students, staff, researchers and institutions) addressing climate change adaptation in forestry sector • scope of adaptation training and research being undertaken and financed by sector • uptake of research outcomes and human capacity trained in adaptation by sector.
4. Foresters alerted to adverse weather conditions by early warning systems, and provided with up-to-date climate information and decision-support tools to assess vulnerabilities and inform management decisions [G3].	Details of: • fine-scale projections, forecasts (seasonal to inter-annual and intra-seasonal variability) and early warning systems for forestry sector • predictive models and critical thresholds for pests and diseases • availability of free high-resolution accurate/reliable data • utilisation and uptake of data/information products by end-users.

c) Provincial DAOs

South Africa's provinces are all experiencing the impacts of climate change and have already taken concerted action towards building adaptive capacity and prioritising adaptation responses. All provinces have undertaken vulnerability mapping assessments to prioritise the areas and sectors most 'at risk'. Some provinces are compiling climate change/adaptation strategies. Table 4 presents a set of DAOs for KwaZulu-Natal province, alongside links with the corresponding generic DAOs (in square brackets, e.g. [G1]), together with the data and information needed to monitor progress towards achieving each DAO. This will be used as the basis for further engagements with other provinces in order to review, refine and finalise their DAOs and associated data/information needs.

Table 4: Desired Adaptation Outcomes and associated data/information needs for KwaZulu-Natal province

Desired Adaptation Outcomes	Data and information needed to monitor progress
1. Climate change adaptation fully integrated into provincial and municipal planning processes, including governmental, sectoral and multi-sectoral planning [G1].	Data on number of provincial and municipal development plans (e.g. Spatial Development Frameworks, Growth and Development Strategies, Disaster Management Plans, Conservation Plans, Food Security Strategies, Energy Security Strategies, Coastal Management Programmes) and sectoral plans incorporating climate change adaptation initiatives.
2. Appropriate processes and mechanisms for coordinating climate change adaptation in province and municipalities [G2].	Details of: • dedicated climate change champions / nodes / units for provincial sectors and municipalities (metropolitan, district and local) • climate change training programmes facilitated by DEA local government officials • climate change agendas of provincial and municipal forums / committees (e.g. KwaZulu Natal Provincial Committee for Environmental Coordination, Provincial Climate Change Sustainability Council, Municipal Climate Change Task Team, Disaster Management Forums) • implementation of climate change action plans in province and municipalities.
3. Accurate weather forecasting, seasonal predictions, climate projections and effective early warning systems for extreme weather and other climate-related events provided for province and municipalities [G3].	Details of: • fine-scale projections, forecasts (seasonal to inter-annual and intra-seasonal variability) and early warning systems for provincial and municipal use • dissemination and communication platforms for weather and climate-related events (e.g. SMS and media) • utilisation and uptake of data/information products by end-users.
4. Capacity development programmes in province and municipalities informed by locally-specific adaptation research [G4].	Data on: • number of capacity development programmes (including students, staff, researchers and institutions) addressing climate change adaptation in province and municipalities • scope of adaptation research and training being undertaken and financed by province and municipalities • uptake of research outcomes and human capacity trained in adaptation by province and municipalities • partnerships/collaborations between province, municipalities and researchers • incorporation of climate change issues in curriculum.

5. Development and implementation of new technologies or knowledge on climate change adaptation for province and municipalities [G5].	Data on: • new technologies / knowledge adopted in province and municipalities • indigenous knowledge systems • technology needs assessments • technology transfer and access (national and global • web-based tools on technologies and technology transfer opportunities • other adaptation challenges and opportunities.
6. Systems, infrastructure, communities and sectors in province and municipalities less vulnerable to climate change impacts [G6].	Details of provincial and municipal risk profiles and vulnerability assessments in easily accessible formats; and data on number of vulnerable systems, resources or communities with provincial or municipal adaptation plans to reduce risk and vulnerability.
7. Reduction in non-climate pressures and threats in province and municipalities [G7].	Data on land use and land use change, population demographics, pollution, water quality and siltation of dams, protection and enhancement of natural resources and other environmental assets, service delivery protests, non-maintenance of infrastructure, and socio-economic status / factors.
8. Secure food, water and energy production and supplies in province and municipalities take climate change considerations into account [G8].	Details of food, water and energy security strategies, plans, programmes and projects in province and municipalities to support development and implementation of climate resilient production and distribution/supply systems and infrastructure.

The main outcome of these consultations was wider understanding of DAOs and of the sorts of data required for their effective monitoring and evaluation. The next step is to carry out assessments within sectors to determine the suitability of existing datasets and where improvements or additional data might be needed. The relevant stakeholder focal points will continue to be consulted to assist in coordinating inputs to finalise the development of DAOs.

4.1.3. Evaluating the Effectiveness of Adaptation Actions in South Africa through the DAOs

Tracking the effectiveness of adaptation actions has been prioritised in the National Climate Change Response White Paper (NCCRWP), the National Development Plan (NDP) and the Climate Change Monitoring and Evaluation Framework. In addition, there is growing need to track effectiveness of actions through global climate funding mechanisms, such as the Adaptation Fund (AF) and the Green Climate Fund (GCF).

To monitor and evaluate the progress being made in achieving individual DAOs, a simple pragmatic approach has been developed. The approach uses traffic light colours as the basis of a scoring system to summarise progress and differentiate proportionately between:

- Adaptation priorities not addressed / effectively addressed by plans, policies or actions; lack or low level of progress in increasing resilience (red).
- Adaptation priorities partially (effectively) addressed by policies, plans and actions; some or medium level of progress in increasing resilience (amber).
- Adaptation priorities fully addressed by policies and plans; adaptation actions completed or on-track; significant or high level of progress in increasing resilience (green).

The responsibility for delivering individual DAOs for sectors considered to be 'at risk', will rest with a range of stakeholders operating at different spatial scales (i.e. national and/or provincial and/or municipal). This approach will enable all stakeholders to gather basic data for each DAO, from which a cumulative 'score' of progress can be derived.

Stakeholder groups will be informed of specific data needs and of the time period for which data are required. The data collected from individual groups will be aggregated to provide a total for that DAO. A summary of progress for the specified time period will then be presented graphically as percentage point increments of the aggregated dataset. Table 5 illustrates the approach by providing a hypothetical summary of progress towards DAOs for the forestry sector. By comparing progress summaries for DAOs over time (i.e. for successive reporting periods), the effectiveness of adaptation policies, measures and actions in addressing adaptation priorities and, therefore, delivering climate resilience can be determined. Each sector-specific DAO corresponds with at least one overarching DAO (e.g. DAO 1 and G1 in **Table 5**). Building on the sectoral assessments of progress, it would be possible to further aggregate this data to enable a cumulative 'score' of progress for each generic DAO to be determined.

Table 5: 'Hypothetical' summary of progress towards Desired Adaptation Outcomes for the forestry sector

Desired Adaptation Outcomes	**Summary of progress** (for a specified time period)
1. Climate resilience integrated into forestry development plans [G1 & G2].	
2. New opportunities, areas and crops utilised sustainably by forestry sector and negative impacts of existing practices reduced [G5, G6, G7 & G8].	
3. Stakeholders in forestry sector better understand climate change and need for adaptation [G4].	
4. Foresters alerted to adverse weather conditions by early warning systems, and provided with up-to-date climate information and decision-support tools to assess vulnerabilities and inform management decisions [G3].	

Whilst some stakeholder groups may have systems in place to evaluate their activities, others will not. A range of approaches and methodologies have been developed by project implementers to understand the effectiveness of responses. An overview of these approaches and methodologies is provided below.

4.1.4. Methodologies and Approaches for Assessing the Effectiveness of Responses

This section seeks to provide an overview of approaches and methodologies for assessing the effectiveness of South African adaptation actions. Understanding the effectiveness of the adaptation actions is one of the key elements for monitoring and evaluating climate resilience.

The aim is to gain insights into the approaches and methodologies that are being used to determine the effectiveness of adaptation interventions by analysing a selected set of ongoing / recently completed adaptation related projects in South Africa. This selected set of projects covers a geographical range across South Africa, and represents a diversity of sectors and adopted adaptation approaches. It builds on the first climate change annual report which highlighted key climate change adaptation projects in South Africa (DEA 2016).

4.1.5. Methodology for Analysis

Relevant projects were selected from a number of climate adaptation project databases, including the National Climate Change Response Database (NCCRD), the Western Cape Government Climate Adaptation Database, as well as drawing on project knowledge from the writing team. Telephonic and/or face-to-face interviews were conducted with the project leaders, in order to obtain first-hand accounts of the project and programme progress following selection of projects.

4.1.6. Results and Discussion

4.1.6.1 Methodologies and approaches for setting baselines to track effectiveness

Consistent with the National Climate Change Response Policy (NCCRP) and the current Climate Change Monitoring and Evaluation Framework, the effectiveness of adaptation interventions in South Africa will result in increased climate resilience. An increase in climate resilience is therefore an indicator of the effectiveness of adaptation. Little evidence of increased climate resilience was found from the projects that were assessed. However, there are projects and programmes that provide examples of best practice which could constitute components of what could become baselines for tracking effectiveness.

The two best practices below illustrate robust but different approaches applied in separate contexts where they have both sought to make visible the complexities inherent in their respective project sites. Both cases have used the project itself to develop a deeper understanding of local context through co-production with local stakeholders and project partners. This kind of knowledge exchange around specific contextual issues such as current and anticipated climate impacts, current state of capacity (governance, institutional, environmental, social capital, agency, financial, innovative, etc.) and current state of vulnerability (socio-economic and environmental) is key to providing a baseline against which to monitor change, but will also serve to establish where the project or programme is located on the continuum that signifies the transition away from contexts characterised by high vulnerability, towards a context characterised by high capacity / resilience. Tracking effectiveness cannot take place if these kinds of local context assessments are not conducted at the start of project engagement.

The first two cases of best practice therefore provide examples of robust methodologies, including making the case for adequately assessing and describing the context in which the project or programme is taking place as a first step towards tracking effectiveness.

a) Best practice case study: Conservation South Africa – an example of ecosystem-based adaptation

An example containing a comprehensive outline of local context was provided by Conservation South Africa's (CSA) adaptation projects in both the Northern and Eastern Cape provinces. These projects included a Climate Change Vulnerability Assessment for the Namakwa District Municipality (Northern Cape) and the Alfred Nzo District Municipality (Eastern Cape), as well as a Climate Change Response Strategy for the Alfred Nzo District Municipality. These assessments provide the basis for further work to be undertaken in the Mopani District in Limpopo funded by the Adaptation Fund (AF) Small Grants Facility (SGF). This innovative approach, predominantly based on spatial analysis, integrates climate, ecological and social information by applying conservation planning techniques at sub-national level. It identifies vulnerable systems, interactions between social and ecological systems, as well as identifying how local ecosystems can help people adapt. This approach therefore provided exemplars of rigorous, but accessible methodologies, extensive data collection that ensured a well-informed outcome, broad stakeholder engagement in the process, and the development of composite indices against which to monitor change.

This resulted in the collection and collation of extensive locally specific context related data, presented in spatial, statistical and narrative form, which painted a picture of vulnerability and, in some cases, of capacity in the areas concerned. In the case of the Alfred Nzo District Municipality, this provided key information to the development of the district's Climate Change Response Strategy. In addition, a composite vulnerability index was developed which reflects ecological and socio-economic

vulnerability across the parameters of exposure, sensitivity and adaptive capacity.

As this work is underpinned by a vulnerability assessment, ongoing monitoring of change in climate risk and vulnerability makes sense. However, in doing so it does not directly track the effectiveness of the adaptation effort but provides the baseline for tracking effectiveness. In addition, some of the sub-indicators only address part of the complex parameter they are seeking to represent, as well as being subjective at times. However, this work represents a brave and useful starting point on which to build.

b) Best practice case study: Rhodes University – an example of Community-based Adaptation

The following case of best practice illustrates quite a different but equally exemplary approach using participatory 'social learning' methods in order to assess local context and, through the project implementation process, developing capacity amongst all project partners and participants. With reference to this case study, a definition of the term 'social learning' is included below from a handbook that was developed as part of the project outputs.

DEFINITION – Social Learning

A change in understanding that goes beyond the individual and spreads within communities or groups through social interactions between people.

Reed et al. 2010. Cited in Cundill. et al. 2014, 39

This case of best practice emerged from a partnership between Rhodes University and Alberta University in Canada, under the project title Vulnerability, Coping and Adaptation with the context of Climate Change and HIV/Aids in South Africa. This four-year trans-disciplinary project, located in rural Eastern Cape, aimed to:

> *… gain a more nuanced understanding of how multiple interacting shocks and risks, including climate variability and HIV/Aids, influence capital stocks, local livelihood choices, and consequently vulnerability and food security, and use this knowledge to inform and support community and municipal adaptation practices, development efforts and regional/national policies (Hamer et al., 2014).*

The project applied a mixed method approach – including social learning, co-production and other participatory methods – to develop a comprehensive picture of the local context, particularly with respect to livelihoods and vulnerability. A key component of the project was a social learning process that focused on developing capacity and agency amongst community members through the formation of social learning groups in both project sites. This facilitated knowledge exchanges between the researchers and a select group of community members, who in turn did the same with broader groups of community members.

One of the innovative methods co-produced as a result of the social learning groups was a certified problem-solving course which included the use of drama and other hands-on approaches. The process of conducting the project, from quantitative data collection at household level through to social learning facilitated knowledge exchanges, resulted in a comprehensive local context being presented by the end of the project. The narrative-styled reporting cited examples of strengthened capacity in both community members and researchers engaged in the project. These served as indicators for outcomes such as knowledge transfer, increased agency, increased social capital, strengthened local initiatives, improved understanding of complexity, improved understanding of the combined effect of HIV/Aids at the local level, and so on.

In addition to using examples to serve as retrospective indicators, the project also provided best practice in making visible, and reporting on some of the characteristics of capacity seldom reported on. The handbook developed during the course of the project, 'The Social learning for adaptation: a descriptive handbook for practitioners and action researchers' (Cundill et al. 2013), is included in the references and readers interested in this methodology are encouraged to explore the handbook.

The two cases of best practice above therefore provide examples of robust methodologies, including making the case for adequately assessing and describing the context in which the project or programme is taking place as a first step towards tracking effectiveness.

4.1.6.2 *Methodologies and approaches for assessing effectiveness across multiple projects*

The next two examples of best practice make the case for assessing effectiveness across project scales. The first provides an example of ongoing work conducted by one of the metro's which is only reported on at project scale, but when assessed across this 'string of projects', provides an example of increasing resilience which is almost invisible at a discrete project scale. The second provides an example of where this approach, in the form of 'project pathways' has been used to tell the story of another metro's climate change programme.

In addition to these examples, ongoing work at the DEA, aimed at painting a clearer picture of what success in building climate resilience looks like, has resulted in the development of the Desired Adaptation Outcomes (DAO's) outlined in earlier chapters.

a) Best practice case study: City of Cape Town – an example of municipal infrastructure adaptation

The City of Cape Town conducted its first sea-level rise study in 2008. One could argue that this built on the adoption of the Coastal Zone Management Strategy in 2003 that sought to mainstream coastal management across key functions within the City. This initiative

resulted in three annual reports produced between the 2003/4 year and the 2005/6 year. These annual reports reported on management of both progress and issues within the coastal zone as per the City's mandate.

The initial four phases of the City of Cape Town's Sea-level Rise Study, commissioned in 2008 by the Environmental Resource Management Department (ERMD), aimed at assessing climate change risk in the coastal zone. This predominantly biophysical modelling resulted in the development of a city-scale Geographic Information System altitude-based sea level rise model incorporating three incremental sea level rise scenarios over a period of 25 years. Model outputs were used to conduct an initial risk and impact identification, followed by a detailed sea level risk assessment. The final phase saw the identification of sea level rise adaptation and risk mitigation measures.

At the end of 2009 the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) (ICMA) became legally enforceable and required that municipalities develop coastal regulatory mechanisms to achieve the goals of the ICMA and to promote sustainable coastal management. As the City of Cape Town had already completed an iterative climate change risk assessment for its coastal areas, it was in a position to move directly into the policy space.

In seeking to delineate a coastal set-back line as required by the Act, the same officials who managed the earlier phases of this work commenced what was to become a drawn out and extensive engagement with different stakeholder groups across the city. The resultant methodology departed from the conventional approach of focusing exclusively on the empirical modelling of biophysical processes in favour of one that considered a range of socio-economic and broader environmental factors. In other words, the process informed the outcome, as opposed to a pre-determined outcome, which dictated a process. A set-back line was finally drafted which doubled as the Coastal Urban Edge and was incorporated into Cape Town's Spatial Development Framework (SDF) and District Plans in 2012.

In order to manage and regulate these coastal set-back or coastal management lines, the City initiated the development of overlay zones which form part of their Integrated Zoning Scheme. The development and management of overlay zones is a mandate of the Planning, Building, and Development Management Department (PD&DMD) within the City, whereas the coastal and climate change mandates reside within the Environmental Resource Management Department (ERMD).

The emergent narrative here centres around a step-wise 'learning-by-doing' approach characterised by regular critical assessment, extensive communication, and co-production between officials, experts, councillors, provincial and national government, affected residents, other sectors and the public at large. This required the exchange and incorporation of 'different knowledge' and perspectives; the articulation and incorporation of lessons learnt; compromise that builds trust in the ability of diverse voices to be heard; effective communication of climate and coastal information; development of capacity within governance structures to manage coastal climate risk; and more. Climate resilience increases with a reduction in vulnerability and an increase in capacity. Both of these are demonstrated in this case, but the reporting has focused on the physical reduction in coastal vulnerability. By stringing together the narrative detailing the progression of this work programme, the capacity component becomes more evident.

This approach, if included as a component of the National M&E Framework, could bolster tracking and reporting on climate resilience at national scale, alleviating some of the short-termism associated with reporting at project scale only. It could be applied equally well to specific groups of actors or sectors, to adaptation themes or to specific geographies.

KEY MESSAGE – Assessment Scale

Tracking adaptation effectiveness can be done across project scales in cases where there is a common element linking the projects, such as location, actors, or theme. This provides a longer temporal scale in which to assess progress, and makes visible unreported or underreported resilience gains.

b) Best practice case study: EThekwini Municipality – using project pathways to track progress

The final example of best practice draws on Roberts et al. (2015) Working Towards Transformative Adaptation in an African City, which provides an excellent South African example of the use of 'project pathways' (similar to the 'project cluster' approach highlighted above) to tell a story of Durban's progress towards transformative adaptation. As illustrated in **Figure 7**, the individual projects are tracked over time in relation to one another as well as noting drivers and catalysts, project timelines and work streams, and non-adaptive outcomes.

The text accompanying the figure in the publication provides a background narrative drawing out lessons learnt: "The experience and knowledge gained through early interventions has shaped and refined subsequent actions and thinking" (Roberts et al. 2015, 105).

It also claimed a focus on "no-regrets" projects in order to ensure that outcomes were beneficial across a range of climate change scenarios, thus accommodating uncertainty in the climate change projections. Referring to the "… constantly evolving adaptation pathways …" as a set of "… manageable steps over time, each triggered by a change in the contextual conditions of the project" (Roberts et al. 2015, 105) highlights the importance of context, and the need to be able to respond to changes

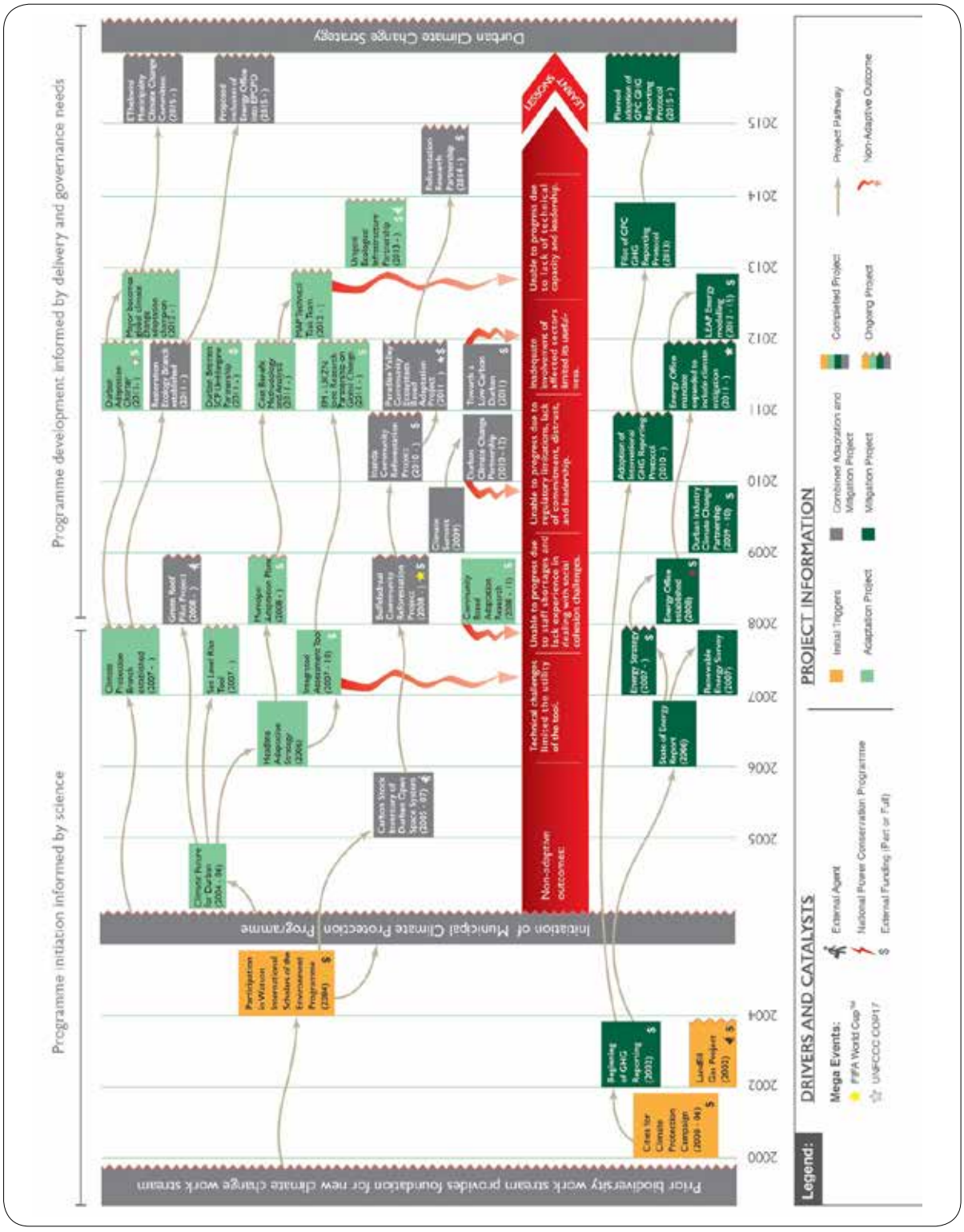

Figure 7: Flow diagram of project pathways depicting the development of the adaptation and mitigation work-streams of the Climate Protection Branch and the Energy Office in eThekwini Municipality, (adapted from Roberts et al., 2015).

in context. As discussed above, context plays a pivotal role in the design of adaptation interventions.

In reflecting on these pathways, the authors state that:

> *The resulting successes and failures have generated a cycle of continuous learning that has helped build a clearer understanding of the complexity of local-level adaptation action and enabled systematic adjustment in response to new information and changing circumstances (Roberts et al. 2015, 105).*

Both this reference to the process of continuous learning and the earlier reference to experience and knowledge gained highlight the important role in monitoring and evaluation of incorporating lessons learnt into future design. This is particularly relevant to the field of climate change adaptation where conditions are by nature changing, and there is little previous experience to guide responses.

KEY MESSAGE – Project Pathways

- *Retrospectively tracking project pathways provides a useful method of identifying successes and failures, of interrogating why these occurred, documenting the opportunities and catalysts that lead to specific project activity, and clearly defining the starting point and pathway to current adaptation action status quo.*
- *Step-wise action informed by continuous learning and in response to context guards against ongoing inappropriate action.*

There are a number of examples of growing climate resilience taking place across the country, but these are either under reported, or not being reported on at all. Through a number of initiatives, primarily the use of the National Climate Change Response Database (NCCRD), this can be addressed. However, it is important to highlight the NCCRD will need to be reviewed in order to adequately address this.

4.2. CONTRIBUTION OF ONGOING ACTIONS TO THE DESIRED ADAPTATION OUTCOMES

This section highlights how the DAOs as a M&E tool in South Africa are already being operationalised in tracking the transition towards becoming a climate resilient and low carbon economy through the work conducted by various organisations and institutions.

The development of the National Adaptation Strategy (NAS) forms part of **DAO 1** on developing robust and integrated policies and actions for effective delivery of climate change adaptation. It is important, however, to highlight that a considerable amount of work has been done under this DAO. This report focuses mainly on the NAS as all the policies and plans which have been developed should be anchored through the NAS. The work on the NAS also contributes to the DAO on appropriate mechanisms and processes for coordinating climate change adaptation.

The work on the NAS and drought is unpacked further in the section below. Furthermore, the linkages between the DAO on appropriate processes and mechanisms for coordinating climate change adaptation and climate finance (Green Climate Fund and the Adaptation Fund) is provided.

4.2.1. The National Adaptation Strategy

4.2.1.1 An Overview of the National Adaptation Strategy

South Africa's NCCRWP (DEA 2011) underscores the need to develop a National Adaptation Strategy (NAS) for South Africa to provide a framework for systematic and coordinated adaptation planning and response across the various sectors in the country.

Further to the NCCRWP, the development of the NAS responds to the Cancun Adaptation Framework (UNFCCC 2010), under the United Nations Framework Convention on Climate Change (UN 1992), which underscores the significance of enhanced action on adaptation. The formulation of the strategy also responds to the Paris Agreement, particularly Article 7 which recognises adaptation as a key component of the long-term global response to climate change to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of vulnerable communities to adapt to the adverse effects of climate change. Finally, the development of the NAS is one of the six goals in the adaptation component of South Africa's Nationally Determined Contribution (NDC) (RSA 2015).

The NAS (DEA 2016b) seeks to guide climate change adaptation efforts in South Africa in a manner that will build resilience, avoid the worst of the unavoidable climate change impacts, and facilitate beneficial transformational change to support sustainable development. Its primary purpose is therefore to link adaptation efforts more coherently to South Africa's national developmental goals.

A robust NAS is important to ensure not only that development remains unhindered by climate change, but also to make climate change adaptation itself a vehicle for sustainable economic and social development.

The objectives of the NAS are to:

- Encourage synergy in climate change adaptation efforts at the three levels of government (national,

provincial, local), with these efforts contributing to shared priorities.

- Enable climate change adaptation in any one sector to leverage the work of other sectors, creating co-benefits and reducing trade-offs between sectors.
- Allow resources to be sought and allocated in a more deliberate way.
- Support alignment of investments and efforts to limit the potential for non-complimentary actions. (DEA 2016, 19)

The formulation of the NAS is led by the DEA through an extensive consultative process that includes existing governance structures, namely the Intergovernmental Committee on Climate Change (IGCCC); the National Committee on Climate Change (NCCC); and the Adaptation Technical Working Group (TWG).

4.2.1.2 Formulation of the National Adaptation Strategy

The NAS formulation process is shown in **Figure 8** below.

In addition to the existing structures the Department established a National Task Team comprising officials from national and provincial government, the South African Local Government Association (SALGA), the private sector, research institutes as well as government entities and state enterprises. The role of the Steering Committee is to provide strategic guidance to the project management team and the Department on the strategy. Furthermore, a reference group was established to enhance the science–policy interface and ensure that policy action emanating from the NAS is informed by scientific discourse. The group includes academics from various disciplines relevant to climate change adaptation

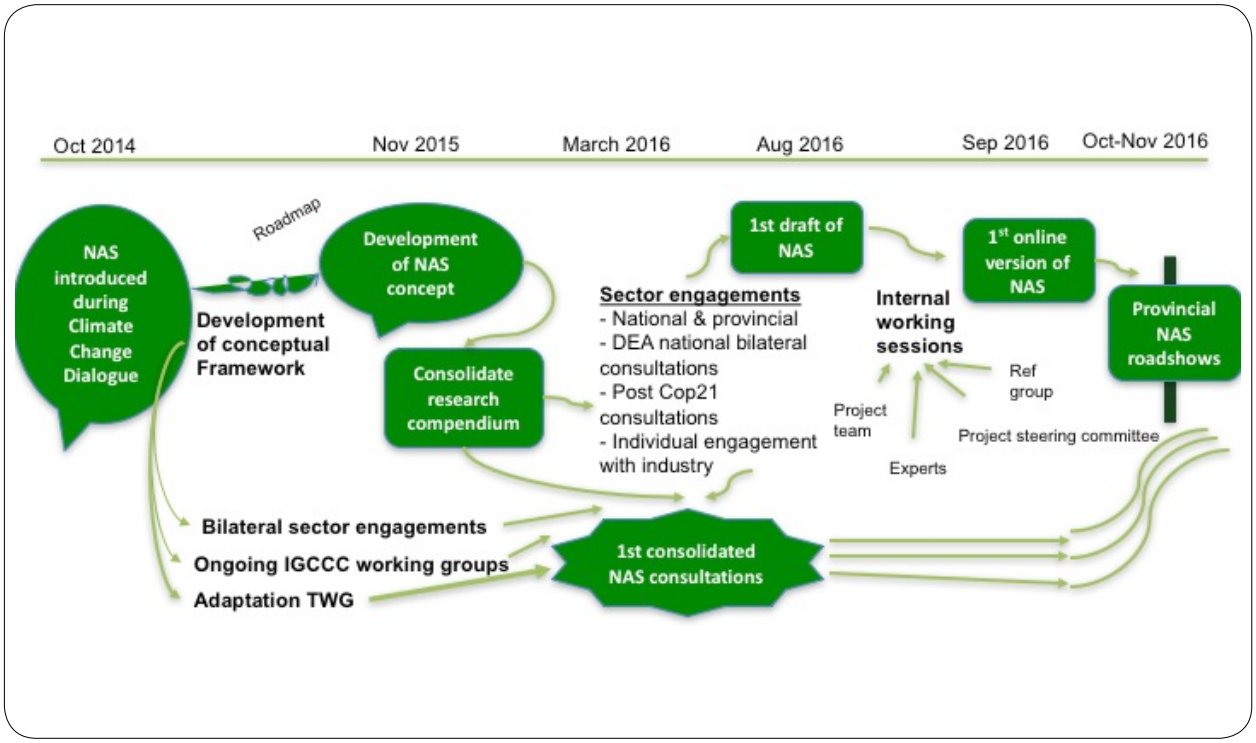

Figure 8: The NAS framework for building a climate resilient South Africa (DEA, 2016b)

such as social sciences, environmental and agricultural sciences, climate and economic sciences. The group helps in bringing science based input into the process, reviewing the document and providing scientific advice to the project team and the DEA.

The first draft NAS was released in August 2016 and subject to extensive stakeholder engagement. Following incorporation of the feedback from this stakeholder engagement process, a second draft will be released for review. The process of formulating the NAS is anticipated to continue in the 2017/18 financial year as shown in **Figure 8**.

The 3rd CCAR will provide an update on progress with the development and implementation of the NAS.

The draft NAS, published in September 2016, is structured around a set of National Adaptation Priority Strategies and Sectoral Adaptation Priority Strategies (DEA 2016b: viii, ix). While the former must essentially be government-driven, the latter speak to South Africa as a whole, including the country's many sectoral institutions, provincial and local governments, as well as non-governmental entities including the private sector and civil society.

The draft NAS is framed around a suite of adaptive measures that seek to reduce human and economic vulnerability, as well as a set of strategic enabling measures that create the means for effective implementation. The adaptive and enabling measures will be structured to achieve enhanced capacity to cope with climate variability in the short-term, and a more robust and resilient economy and society in the long-term through changing investment and resource use patterns. An implementation plan is intended to be developed as part of the NAS.

Figure 9 shows the NAS framework for building a climate resilient South Africa.

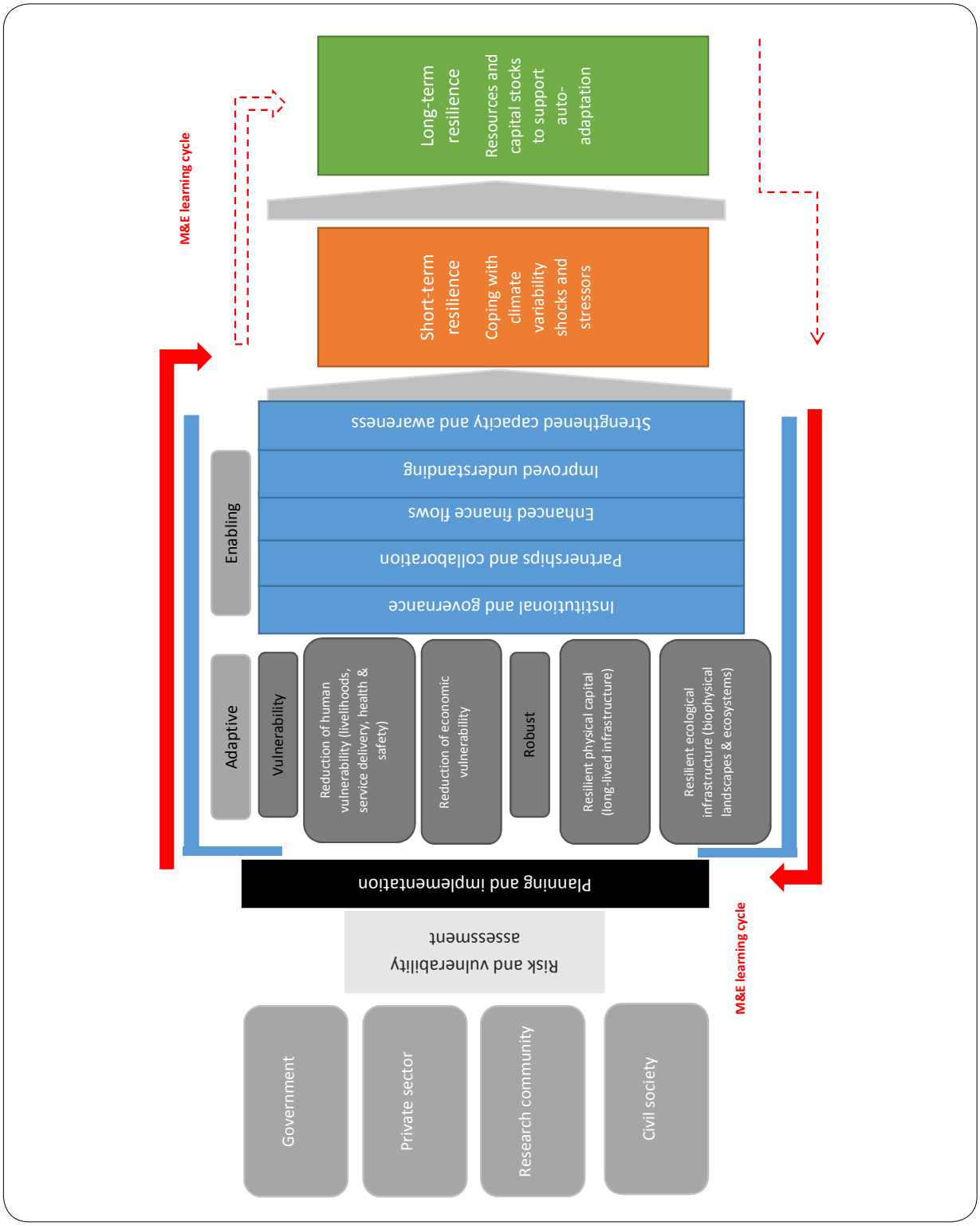

Figure 9: The NAS framework for building a climate resilient South Africa (DEA, 2016b)

4.3. CLIMATE FINANCE IN SOUTH AFRICA

Climate finance is linked to the DAO on appropriate processes and mechanisms for coordinating climate finance. Key international adaptation climate finance mechanisms facilitated by the Department of Environmental Affairs will be highlighted. Although the focus in this section is mainly adaptation, mitigation finance will be mentioned in cases where the funding includes both adaptation and mitigation.

DAO 2

Appropriate processes and mechanisms for coordinating climate change adaptation (i.e. institutional and governance structures).

4.3.1. South Africa's Green Climate Fund

South Africa is committed to implementing the necessary ambitious mitigation and adaptation actions that enhance national climate resilience, protect vulnerable communities and contribute to the global efforts to limit global warming to well below 2 degrees Celsius above pre-industrial levels. South Africa's climate change response commitments are premised on the availability of and access to significant international climate finance and investment, accessible and affordable technology, and substantial capacity building commitments.

An effective climate change response requires significant financial resources. The GCF presents South Africa with a potential opportunity to access a significant part of the financial support required to drive the national climate change response. South Africa's GCF investment portfolio must advance the country's climate change response objectives, as articulated in the NCCRP, and contribute substantially to the NDP and to achieving South Africa's international commitments captured in the country's INDC.

To fully utilise the opportunity presented by the GCF, a national GCF Strategic Framework has been developed to enable a coherent engagement with the GCF and to ensure that South Africa's GCF investments are aligned to the national climate change response priorities. The purpose of this strategic framework is to ensure that South Africa's GCF investments are aligned with national climate change response priorities, addressing both mitigation and adaptation to drive South Africa's transition to a climate-resilient economy and society and facilitate national social and economic development objectives. The main outcome, envisaged as a result of the GCF Strategic Framework, is a national portfolio of transformative climate actions that anchor and ignite systemic transformation in key climate change response sectors, leveraging opportunities and undertaken in a strategic and systematic way.

The priority areas for the scaled-up implementation of South Africa's climate response, are aligned with the Climate Change Flagship Programmes discussed in **Chapter 6** of this report.

A list of these priority areas is provided:

- Agriculture, food systems and food security
- Energy efficiency and energy demand management
- Carbon capture and storage
- Disaster risk reduction and management
- Health
- Land, oceans, biodiversity and ecosystems
- Low carbon, climate resilient built environment,

communities and human settlements

- Low carbon climate resilient spatial development
- Low carbon, climate resilient transport systems
- Renewable energy
- Social protection systems and public works programmes
- Waste management
- Water conservation and water demand management

4.3.2. The Adaptation Fund National Implementing Entity

The Adaptation Fund is a global fund established to finance climate adaptation projects and programmes in developing countries that are parties to the UNFCCC Kyoto Protocol and are particularly vulnerable to the adverse effects of climate change. Funds are accessed via implementing entities, who are responsible for endorsing project and programme proposals. Following nomination by the DEA, the South African National Biodiversity Institute (SANBI)

was accredited to the Adaptation Fund in September 2011 as South Africa's National Implementing Entity (NIE).

Since accreditation, and in support of its intention to operate transparently, the NIE has established a high-level Steering Committee, comprising several national government departments, and an investment framework to guide its work. The NIE Investment Framework was finalised in November 2012 following extensive consultation, including a national stakeholder meeting. The Framework recognises that the Adaptation Fund provides a key opportunity for South Africa to learn how to develop, resource and implement adaptation projects, scale-up implementation, and demonstrate how investments in climate change adaptation can deliver tangible and lasting benefits to those who are most vulnerable to climate change. In this way, successful project outcomes will provide a foundation for future investments in climate change adaptation.

The NIE issued a call for proposals in November 2012. The response was overwhelming, with a rich variety of over seventy concept proposals received. With the support of the NIE Steering Committee and an associated task team, two clusters of projects were selected for further development. A comprehensive 18-month project development process followed. This included undertaking vulnerability assessments for the project sites, consultation with authorities and many meetings with local stakeholders and communities so that locally relevant adaptation responses could be identified.

This process culminated in both project clusters being approved for funding in October 2014, projects include:

a. **The uMngeni Resilience Project:** This project aims to increase resilience of vulnerable communities in the uMngeni River catchment (KwaZulu-Natal) through implementing climate smart agriculture, climate proofing settlements, investing in ecological infrastructure and installing early warning systems, using near real-time weather stations and community monitors. The project budget is just under 7.5 million US Dollars.

b. **Community Adaptation Small Grants Facility:** The project is being implemented in the Mopani District in Limpopo Province, and the Namakwa District in the Northern Cape. It is designed to support 12 small grants of approximately 100 000 US Dollars each. The fund will release small grants so that communities can run projects that will deliver tangible and sustainable benefits. To date, ten local organisations have been contracted to implement climate change adaptation responses in their communities. The total value of the project is around 2.5 million US Dollars.

4.4. CONCLUSION

DAOs provide clarity and understanding about the measures to be taken by South Africa in adapting to climate change. They help capture the country's unique circumstances to aid reporting on adaptation at national and international levels. They also help determine whether 'at risk' sectors are doing enough of what is needed in order to build resilience to climate change.

Work on DAOs will continue during the 2017/18 financial year and will be reported in South Africa's 3rd Annual Climate Change Report.

The following activities comprise the work on DAOs going forward:

a. Undertake further consultations with stakeholders to ensure ownership of DAOs and highlight the need to collect data for monitoring and evaluating progress.

b. Encourage stakeholders to assess the availability of adaptation data for individual DAOs and the need for additional data or improvements to existing data to enhance their use in monitoring and evaluation.

c. Operationalise monitoring and evaluation of DAOs in one 'at risk' sector.

d. Prioritise what could be reported and profiled in a web-based platform.

e. Identify and, where necessary, improve synergies between DAOs and South Africa's reporting commitments under its National Adaptation Strategy and for the adaptation goals in its (Intended) Nationally Determined Contribution under the Paris Agreement.

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ABBREVIATIONS

AF	Adaptation Fund
GCF	Green Climate Fund
CSA	Conservation South Africa
DAO	Desired Adaptation Outcome(s)
ERMD	Environmental Resource Management Department
GHG	Green House Gas
GHGIP	Green House Gas Improvement Programme
ICMA	Integrated Coastal Management Act (No. 24 of 2008)
IGCCC	Intergovernmental Committee on Climate Change
INDC	Intended Nationally Determined Contribution
NAS	National Adaptation Strategy
NCCRWP	National Climate Change Response White Paper
NCCRD	National Climate Change Response Database
NCCRP	National Climate Change Response Policy
NDP	National Development Plan
NEMBA	National Environmental Management Biodiversity Act
NGHGIS	National Green House Gas Inventory System
NIE	National Implementing Entity
PD&DMD	Planning, Building, and Development Management Department (City of Cape Town)
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SDF	Spatial Development Framework
SGF	Small Grants Facility (of the Adaptation Fund)
TWG	Technical Working Group
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER 5

UNDERSTANDING DROUGHT IN SOUTH AFRICA

CHAPTER 5: UNDERSTANDING DROUGHT IN SOUTH AFRICA

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5.1. INTRODUCTION

South Africa has been experiencing a severe drought, which coincided with the El Niño Southern Oscillation (ENSO) conditions. Furthermore, the socio-economic and ecological impacts of drought events are becoming more onerous as they converge with increasing urban water demand and issues of social vulnerability.

While the relationship between the frequency and intensity of ENSO events and climate change is still unknown, the severity of the current event has further sensitised South Africans to climate-related risk. Climate change is predicted to further increase the intensity of droughts in South Africa, as well as the severity of associated impacts. The highlights in this section include the following:

- Maximum drought extent was reached by 2015, with a steady decline in drought affected areas towards 2016. The 2015–16 drought was accompanied by extremely high near-surface temperatures across South Africa. The annual mean temperature anomalies for the period January 2015 to December 2015, as recorded by 26 South African Weather Service climate stations, was on average 0.86 °C above the reference period (1981–2010), making 2015 the warmest year on record since 1951. Prolonged heatwaves (at least three consecutive days with maximum temperature more or equal to 5 °C higher than the average maximum of the hottest month for a particular station) occurred in some areas in Pretoria, Johannesburg, Limpopo, Mpumalanga and North West in 2015.
- Due to the drought, the availability of water resources has declined drastically, leading to water restrictions being introduced in several major cities. There was a significant decrease in dam levels nationally, and boreholes and natural springs dried up in many rural areas, affecting water availability for people, livestock, and crop irrigation. Nationally, dam water storage levels decreased from 93% of full storage capacity in March 2014 to 53% by mid-2016. Record low streamflow due to low dam levels was also observed in some areas. Streamflow ceased altogether in 2015 in one of the gauged catchments for the first time since records began in 1950s.
- Agricultural losses have been significant amongst many commercial and small-scale producers during this period. In the worst hit areas, thousands of livestock have died from lack of food or water. Major crop losses for farmers have been reported and are a cause for concern as food prices escalate and pressure increases on poor rural households.
- The ecological impacts have also been substantial. The impact of two consecutive years of below-average rainfall on the grass layer on semi-arid savannas has been profound, with far greater mortality of perennial grass plants in the 2nd year compared to the 1st year. A switch from perennial to annual grasslands in many of the communal rangelands in the arid and semi-arid parts has also been observed. As regards herbivores, thousands of cattle deaths have been reported for the drier parts of the Lowveld. In the Kruger National Park (KNP), many hippo have died, and the total mortality reached many hundreds by the end of the 2016 dry season. Buffalo mortalities had also begun and increased abandonment of elephant calves has been reported. Similar mortalities have been reported for some of the neighbouring private reserves, although proactive selling of game seems to have averted this in some cases.
- South Africa has a multi-layered and functioning system of disaster declaration and response. The recent drought points to the need to design more flexible operational systems for effective drought risk reduction. There is also a need to evaluate what has/has not worked and what should be in place to deal

with extreme droughts. Enhancing communication of drought (early warning and capacity to enhance risk reduction) is also crucial. More support for science on understanding the impacts and atmospheric systems (to provide early warning of El-Niño events, drought conditions and high temperatures; proactive planning and effective response) is required. Serious attention must be given to the failing capacity to monitor rain gauges. Co-engagement of users to information channels and networks must be improved and strengthened. Rigorous assessments of losses (livelihoods, crops, livestock, economic, ecological, etc.) and systematic understanding of drought risks at national level need to be undertaken.

5.1.1. Linking the DAOs and Drought in South Africa

A range of backward and forward looking indicators to track drought and drought risk reduction is summarised and presented below. These indicators are linked with the following DAOs:

- Appropriate processes and mechanisms for coordinating climate change adaptation
- Reliable climate information, including seasonal predictions and future projections, and effective early warning systems for extreme weather and other climate-related events (i.e. to inform adaptation planning and disaster risk reduction/management
- New and adapted technologies/knowledge and other cost-effective measures (e.g. nature-based solutions) used in climate change adaptation
- Systems, infrastructure, communities and sectors less vulnerable to climate change impacts (e.g. through effectiveness of adaptation interventions/ response measures

5.2. GOVERNANCE AND COORDINATION

DAO 2

Appropriate processes and mechanisms for coordinating climate change adaptation (i.e. institutional and governance structures).

Responses to drought have traditionally been reactive (that is after a drought disaster). However, international (for example the United Nations Sendai Framework for Disaster Risk Reduction 2015–2030 (UN 2015)) and national agreements , legislation, science and responses are increasingly trying to encourage a pre-drought response that is more proactive and aligns national development planning more closely to drought risk reduction (Vogel & Van Zyl 2016). In this section of the report we examine the progress being made by the country in these critical areas.

a) Declaration of drought disaster and the National disaster response

The criteria for declaring a drought are well defined in Section 23 of the National Disaster Management Act (Act No. 57 of 2002). Seven provinces had declared a state of provincial disaster at the time of drafting this report, as well as one province with a local state of disaster as a result of drought. The provincial declarations were in KwaZulu-Natal, North West, Free State, Limpopo, Mpumalanga, Northern Cape and Eastern Cape, with a local state of disaster declared for two municipalities in the Western Cape Province (Sethusha 2016).

In response to such dry conditions and drought, the Department of Cooperative Governance and Traditional Affairs (DCoG) has established disaster grants through the National Treasury. The relief grants (both municipal and provincial), are emergency responses targeted to address the immediate needs of affected communities. Post-disaster rehabilitation and reconstruction (recovery) grant funding has also been operationalised to address medium to long-term disaster damage. Both types of grants can only be released once a disaster has been declared by all three spheres of government (Sethusha 2016).

In the most recent drought of the past few years, the National Disaster Management Centre ensured that funding provisions in the disaster legislation were implemented by drawing on various legislation (for example, the Disaster Management Act, 2002 (Act No. 57, 2002)) and the National Disaster Management Framework 2005 (National Disaster Management Centre (NDMC), 2005). Section 56 of the Disaster Management Act prescribes that when a disaster occurs at any level, either provincial or local, the three spheres of government may financially contribute to response efforts. In addition, sections 7.7.1.3 and 7.7.1.4 of the National Disaster Management Framework of 2005 emphasise that all affected sectors and spheres must first exhaust all the available funding and resources to respond to the disaster before requesting funding from the next sphere of government. Furthermore, the Act requires affected stakeholders to also address disaster-related conditions through other existing legislation as stipulated in Section 2 (1) (b) (i) of the Disaster Management Act, 2002 (NDMC 2005; Sethusha 2016).

In the recent 2015/16 drought fiscal stresses and the impacts across several provinces and communities resulted in funding from different affected sectors to provide relief in affected areas. Sources included reprioritisation within existing internal grants, capital budgets and programmes to ensure implementation of response measures in affected communities. In addition, the country received support from civil society and the

private sector in the form of temporary relief through the donation of bottled water as well as contributions to promote sustainable interventions through the drilling and equipping of boreholes. Contributions by civil society were also undertaken within the agricultural sector through the donation of livestock feed to affected communities. The involvement of civil society and the private sector endorses the notion that disaster management is everybody's business (Sethusha 2016).

The Department of Agriculture, Forestry and Fisheries (DAFF) also plays a major role in alleviating the impacts of drought. The following steps were taken during the 2015/16 drought to alleviate the plight, especially of small-scale and subsistence agriculture, as presented in **Figure 10**. DAFF's role, in issuing climate alerts and in promoting improved agricultural extension and farming practices can assist farmers and those engaged in agriculture to become more resilient to future drought risks.

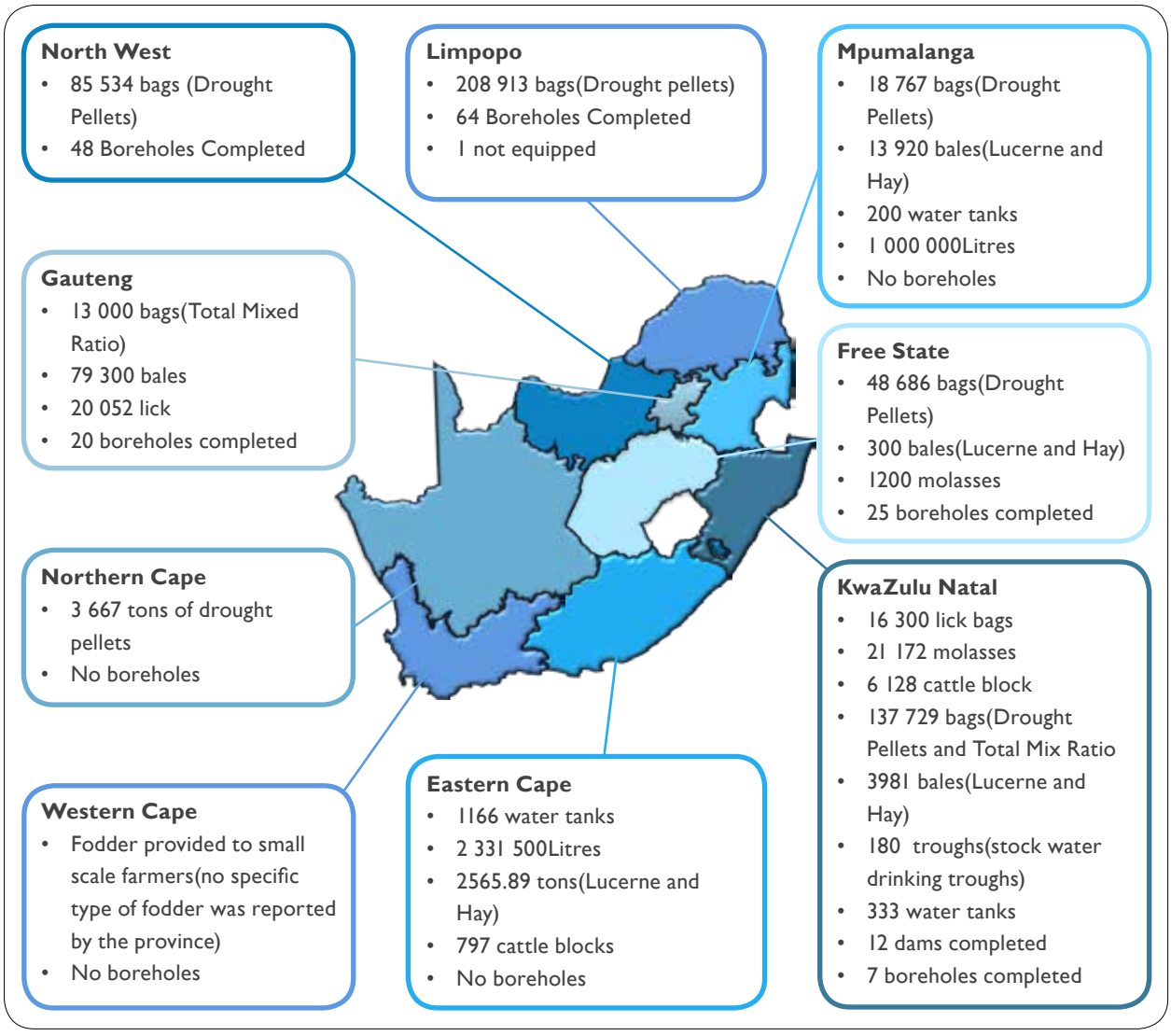


Figure 10: Department of Agriculture, Forestry and Fisheries responses to drought. Source: DAFF 2016

5.2.1. Climate information and Effective early warning systems

DAO 3

Reliable climate information, including seasonal predictions and future projections, and effective early warning systems for extreme weather and other climate-related events (i.e. to inform adaptation planning and disaster risk reduction / management) [G3].

A range of backward- and forward-looking indicators to track drought is summarised and presented below. Such indicators have been used to assist in natural resource and socio-economic drought risk reduction and management. This can be linked to the **DAO** on "Accurate climate information (e.g. historical data trends, seasonal predictions and early warning of extreme weather events)".

Figure 11 shows the indicators commonly used to track drought.

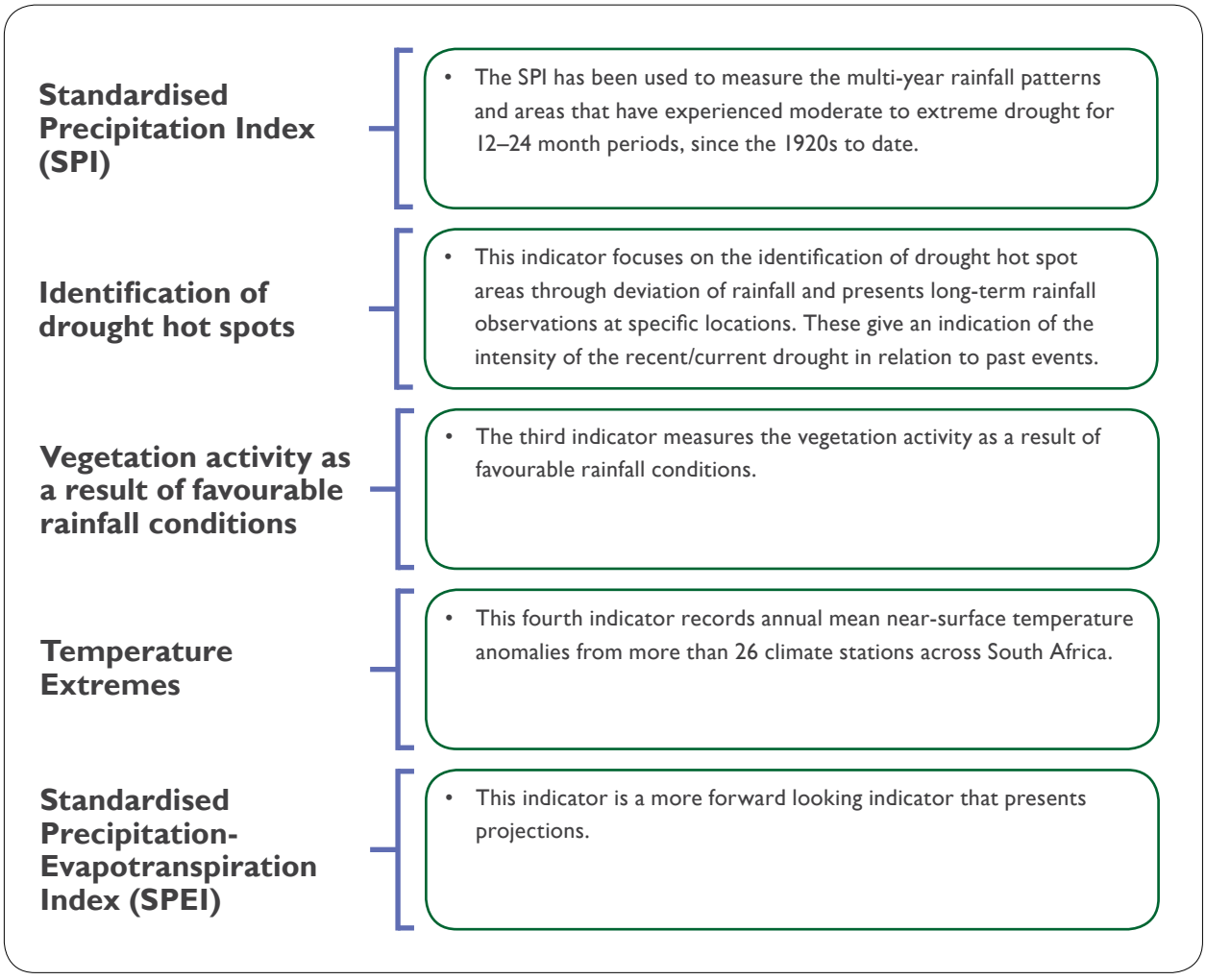


Figure 11: Indicators for tracking drought

These indicators provide accurate and essential climate information for informing decision making and enhancing adaptation planning and disaster risk reduction. A substantial amount of work, which fits into the DAO on research, and technological and monitoring tools has also been done.

The South Africa Weather Service (SAWS) and other climate tracking organisations use various indicators to monitor rainfall and temperature extremes and trends on an ongoing basis. SAWS present their information through climate summaries and weather reports. In addition, the Agricultural Research Council Institute for Soil, Climate and Water (ARC–ISCW) uses a network of near real-time recording stations to monitor rainfall conditions, in combination with Earth-Observation rainfall estimates and vegetation activity products. The ARC products are published in its monthly newsletter Umlindi (http://www.arc.agric.za/Pages/Newsletters.aspx).

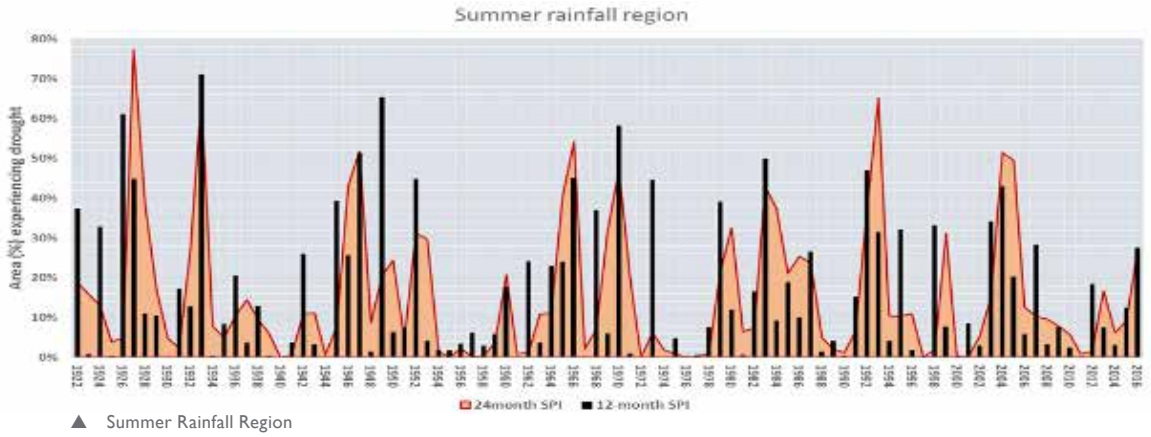
For selected locations, the South African Environmental Observation Network (SAEON) maintains a long-term record of temperatures, rainfall and streamflow. Amongst the catchments monitored by SAEON, some of the most important are located in the Drakensberg (http://gfw.dirisa.org/) supplying the major urban-industrial areas of the summer rainfall regions, and the Cape mountains supplying the urban areas of the Western Cape (http://www.saeon-fynbos.org/). Dam levels and stream flows are also monitored across the country (https://www.dwa.gov.za/Hydrology/Weekly/Province.aspx) by the Department of Water Affairs and Sanitation (DWS). The National Integrated Water Information System (http://niwis.dws.gov.za/niwis2/DroughtStatus) provides free online access to drought status.

a) The Standardised Precipitation Index

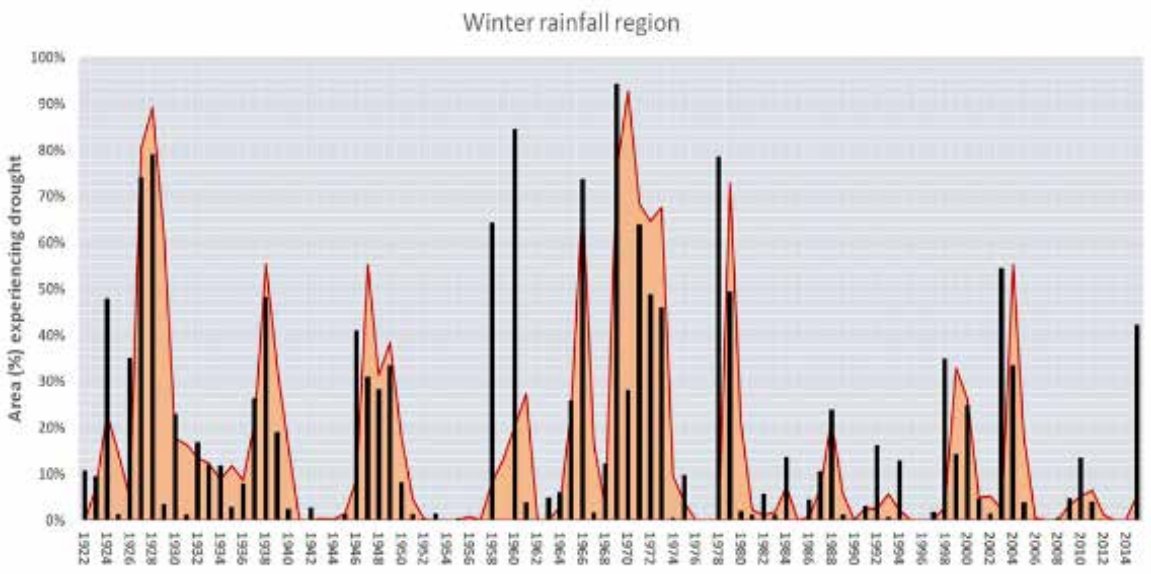
Most extensive multi-year droughts occurred in the late 1920s and the late 1960s to early 1970s in the winter rainfall region. Other secondary maxima occurred around the late 1930s, 1940s, 1950s, 1970s and 1990s, together with the early 2000s. During 2015/16 moderate to extreme drought extent at the 12-month time scale according to the Standardised Precipitation Index (SPI) reached the 85th

percentile by December 2015. Major, extensive droughts over the summer rainfall regions centred around the late 1920s to early 1930s, late 1940s to early 1950s, mid-1960s to early 1970s, early to mid-1980s, early 1990s and early to mid-2000s.The estimated real extent of moderate to extreme drought at the 12-month time scale (28%) reached the 80th percentile by June 2016, but surpassed that during December 2015 (60% - not shown) when it reached the 90th percentile.

Figure 12 depicts the estimated percentage of total area of the summer and winter rainfall regions experiencing moderate to extreme drought according to the SPI.



▲ Summer Rainfall Region



▲ Winter Rainfall Regional

Figure 12: Estimated percentage of total area of the summer and winter rainfall regions experiencing moderate to extreme drought according to the Standardised Precipitation Index (SPI) for 12-month and 24-month periods, as indicated, ending by December (December 1922–December 2015). Source: ARC

One of the reasons for an apparent decrease in drought extent over time is an upward trend in rainfall over the central parts of the country during the 20th century. While several of the droughts during the 1920s to 1950s had their major expression over the central parts of South Africa, the tendency during later years was for droughts to focus more over the north-eastern parts of the country, including a smaller portion of South Africa than the droughts in the early twentieth century (Malherbe et al. 2016).

The 2015/16 drought was preceded by low rainfall in the 2014/15 season in the KwaZulu-Natal, eastern Free State, Mpumalanga and North-West provinces. The drought reached its maximum extent in 2015, according to the SPI, with a steady decline in drought-affected areas during 2016 as shown in **Figure 13**.

Drought hotspots, areas which required interventions by all key role players, were identified based on 24 month SPIs as shown in **Figure 14**.

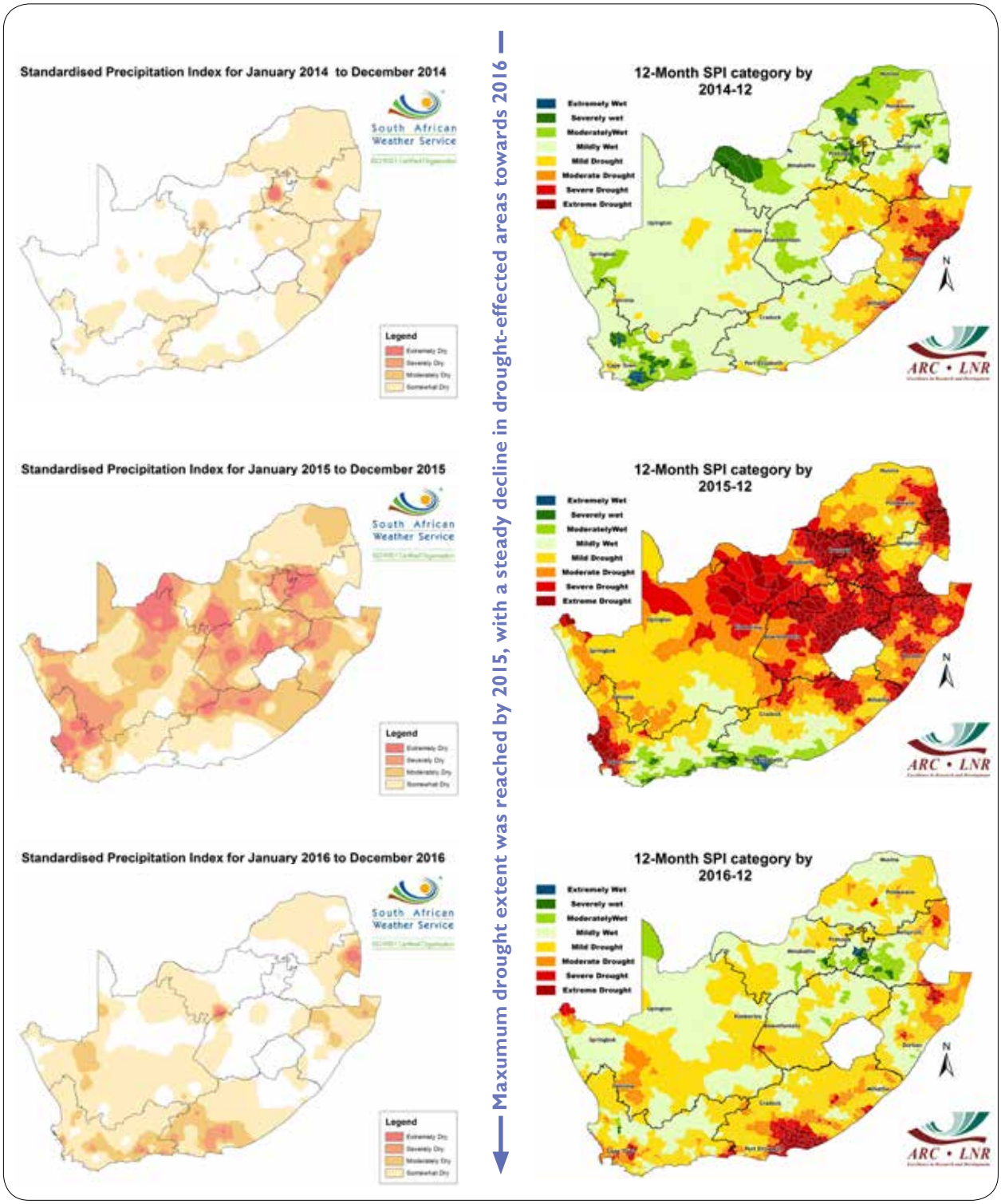


Figure 13: The 12 month SPI (January to December) for 2014 to 2016. Source: SAWS

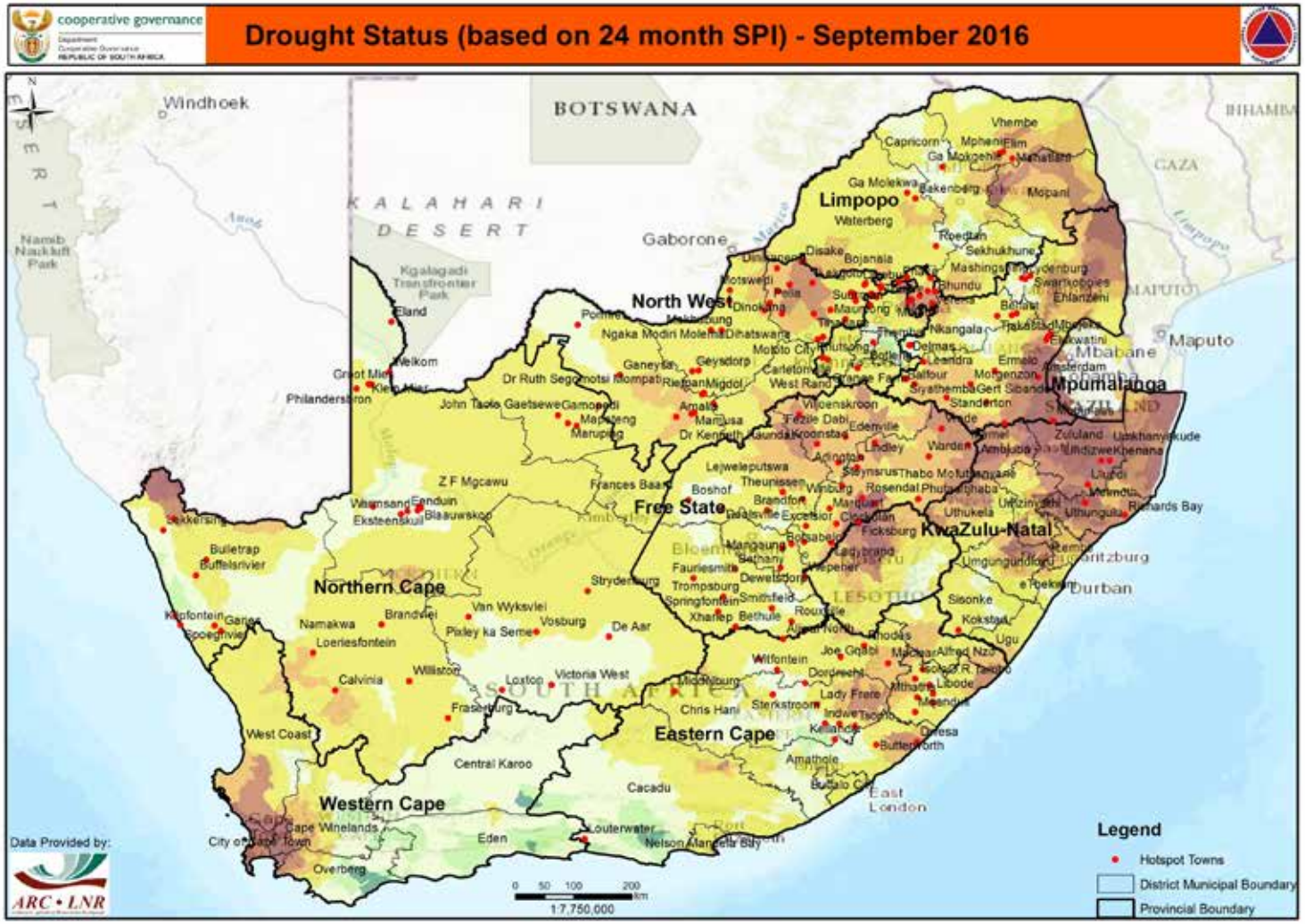


Figure 14: Drought hotspot areas. Source: ARC-LNR

b) *Long-Term Rainfall Observations*

Long-term rainfall observations at specific locations give an indication of the intensity of the current drought in relation to past events. Anomalies observed in rainfall per year since the middle of the 20th century for specific locations in the Lowveld (semi-arid savanna) and the south-western Cape (fynbos biome), respectively give an indication of the severity of the 2015/16 drought at these locations. For both these locations, the 2015/16 drought is more severe with less rainfall than the 1990s droughts in both the Lowveld and the south-western parts of the Western Cape Province.

Figure 15 and **Figure 16** show the deviation in rainfall per year since the middle of the 20th century for specific locations in the Lowveld (semi-arid savanna) and the south-western Cape (fynbos biome), respectively.

c) *Temperature extremes during the 2015/16 Drought*

The 2015–16 drought was accompanied by extremely high near-surface temperatures across South Africa. The annual mean temperature anomalies for the period January 2015 to December 2015, as recorded by 26 climate stations, was on average 0.86 °C above the reference period (1981–2010), making 2015 the warmest year on record since 1951 (Blunden & Arndt 2016) (**Figure 17**).

A **prolonged heatwave** (at least three consecutive days with maximum temperature greater than or equal to 5 °C higher than the average maximum of the hottest month for a particular station) occurred in some areas in the cities of Pretoria and Johannesburg, and in the Limpopo, Mpumalanga and North West provinces in 2015.

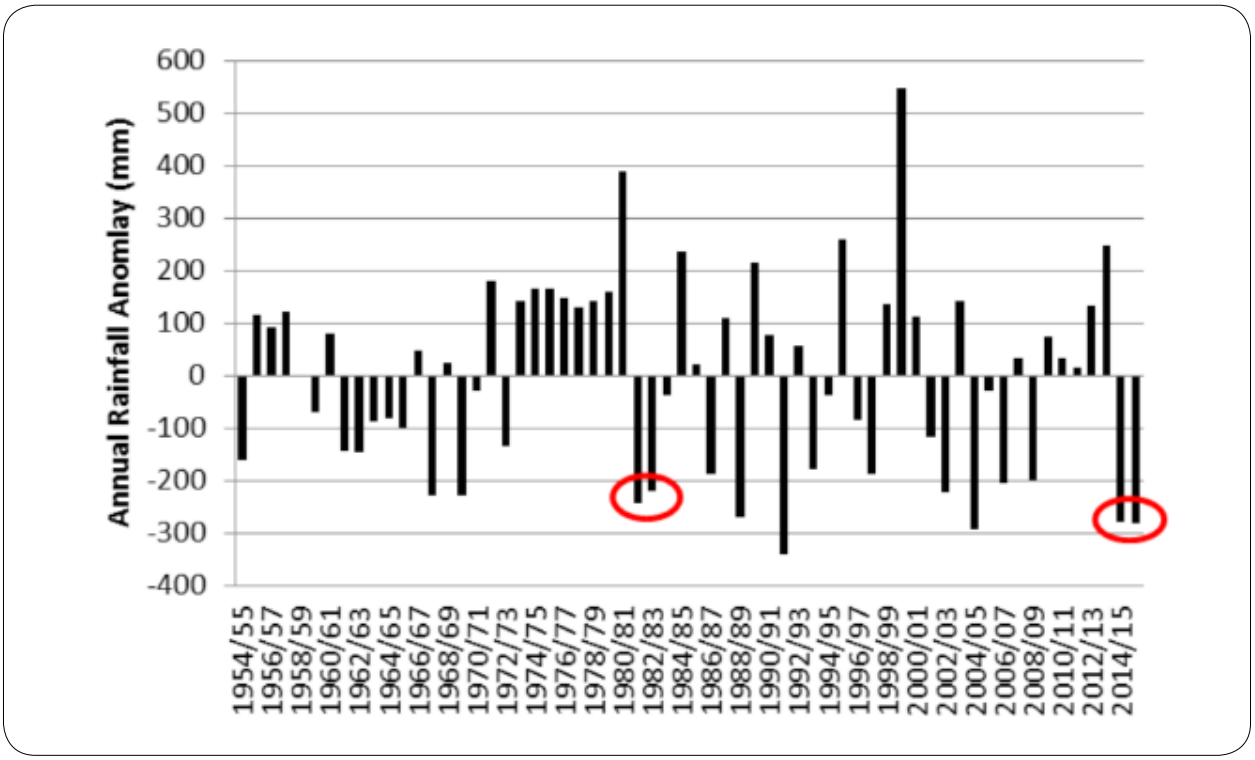


Figure 15: Deviation of annual rainfall from the long-term mean of 533 mm for Phalaborwa in the Limpopo Lowveld. The combined rainfall for 2014–15 and 2015–16 is 507 mm. Data from FOSKOR mine and SAEON. Red circles indicate the two most severe multi-year droughts on record.

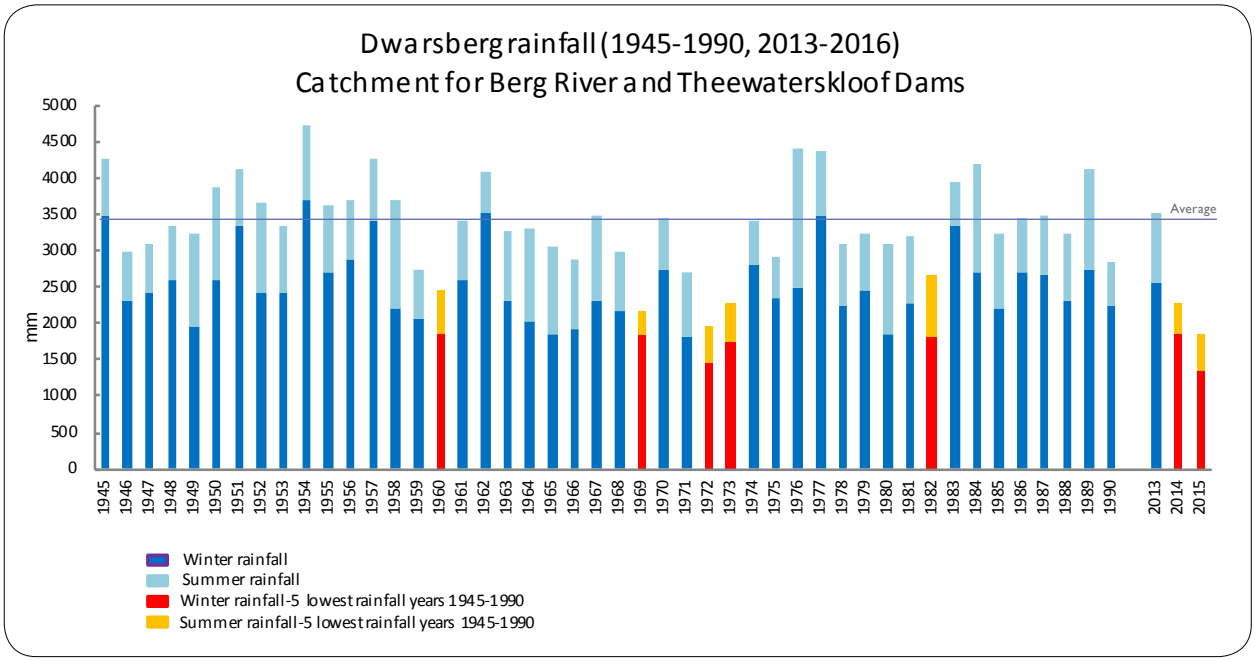


Figure 16: Annual rainfall (April to March) for Dwarsberg in the Jonkershoek mountains, south-western Cape. The station is one of the wettest in South Africa. The lower part of each bar is winter rainfall (April–September) and the upper is summer rainfall (October–March). Yellow and orange bars show the five lowest rainfall years for the period 1945–1990. The horizontal line shows the long-term average annual rainfall. The current drought has the lowest rainfall on record. *Source: SAEON*

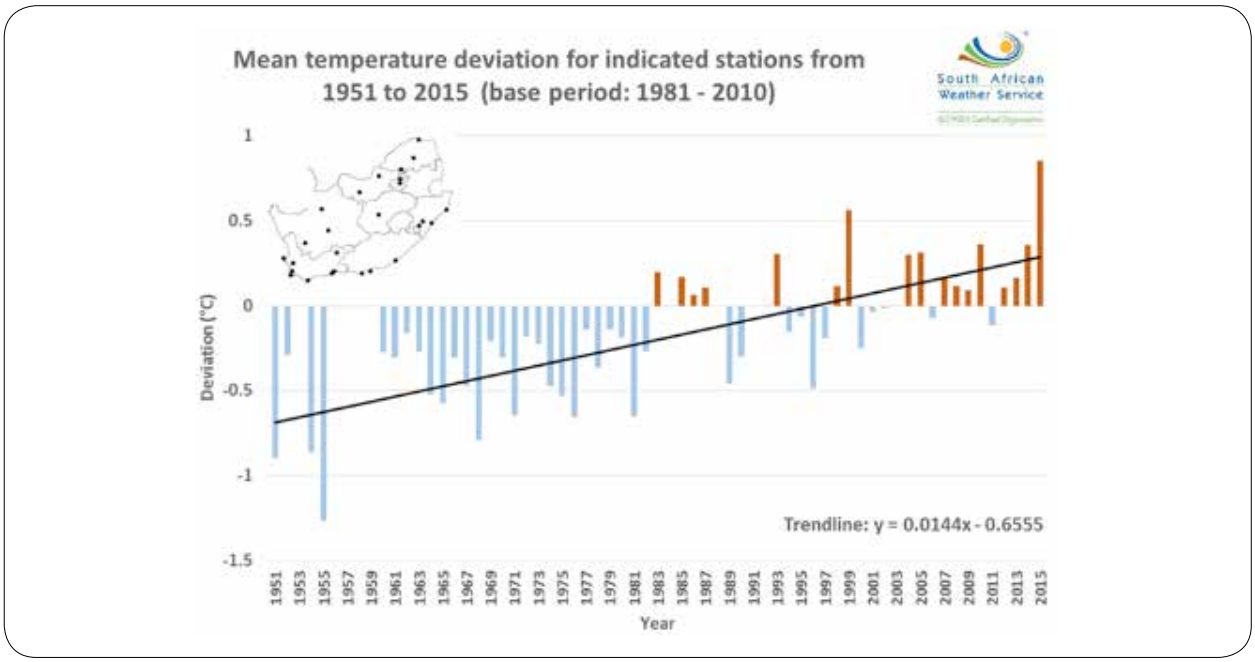


Figure 17: 1951 to 2015 annual mean near-surface temperature anomalies (°C), as calculated from the base period 1981–2010 and as recorded at 26 climate stations across South Africa (black dots on the map). The trend line indicates a warming of 0.14 °C per decade.
Source: SAWS; Blunden & Arndt 2016

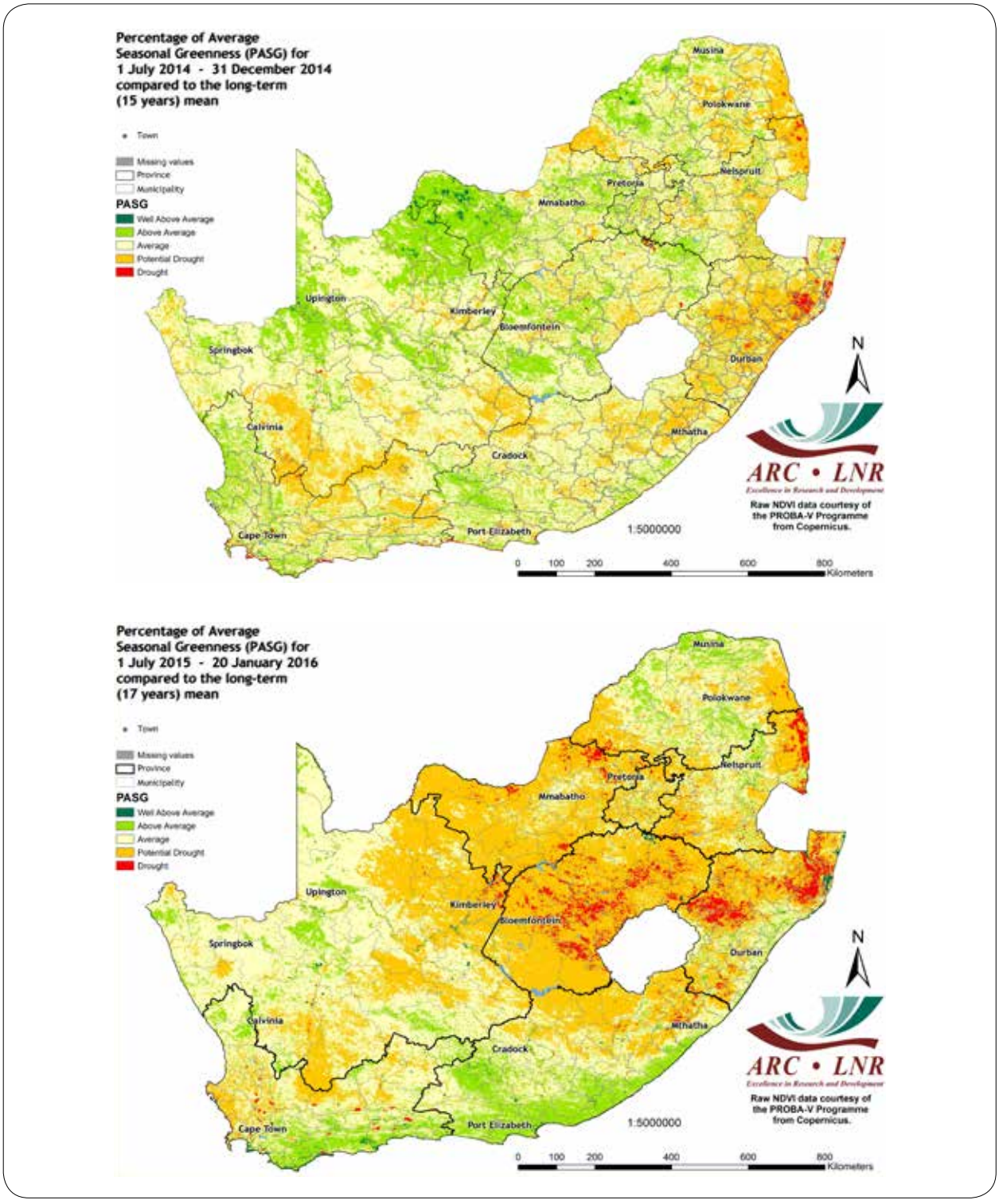


Figure 18: Percentage of Average Seasonal Greenness (PASG) by December 2014 and January 2016 respectively. *Source ARC.LNR*

d) Vegetation Condition

Drought conditions developed over the far eastern parts of the country by late 2014, while the central parts of the country were still experiencing above-normal vegetation activity due to favourable rainfall conditions. The cumulative effects of deficient rainfall over several months at the time the drought reached its maximum extent in December 2015 / January 2016, as reflected in percentages of average seasonal greenness (PASG) (**Figure 18**).

Periods of very low storage were experienced in the early 1980s, early 1990s and early 2000s, with the lowest combined levels recorded on 15 November 1983 (34% of full total capacity), 15 November 1995 (34.4% of full capacity) and 2 January 2006 (56.0% of full capacity) respectively. The periods lasted 32, 55 and 50 months respectively.

5.2.2. Research, Technological and Monitoring Tools

As can be seen throughout this report the need for data, observation networks, capacity to interpret and analyse the data and the need for effective planning are all critical when a country like South Africa has to respond to a drought. In this report we have focused mainly on national issues but clearly the links to the region and the wider sub-continent cannot be ignored and will require interrogation. In this section we focus attention on the status of operating networks.

a) South African Systems Institutions

The South African Environmental Observation Network (SAEON) has installed hydrological instruments, including cosmic ray probes for measuring soil moisture in some catchments to help understand hydrological processes. It has also installed flux towers in some catchments to determine fluxes of carbon, energy and water. SAEON is developing hydrological models supported by meteorological and hydrological observations to help determine rates of recharge in response to rainfall and to changes in vegetation cover. The combination of modelling and observation will improve future forecasting of drought (and flooding) impacts and consequences of global change in major water catchment areas.

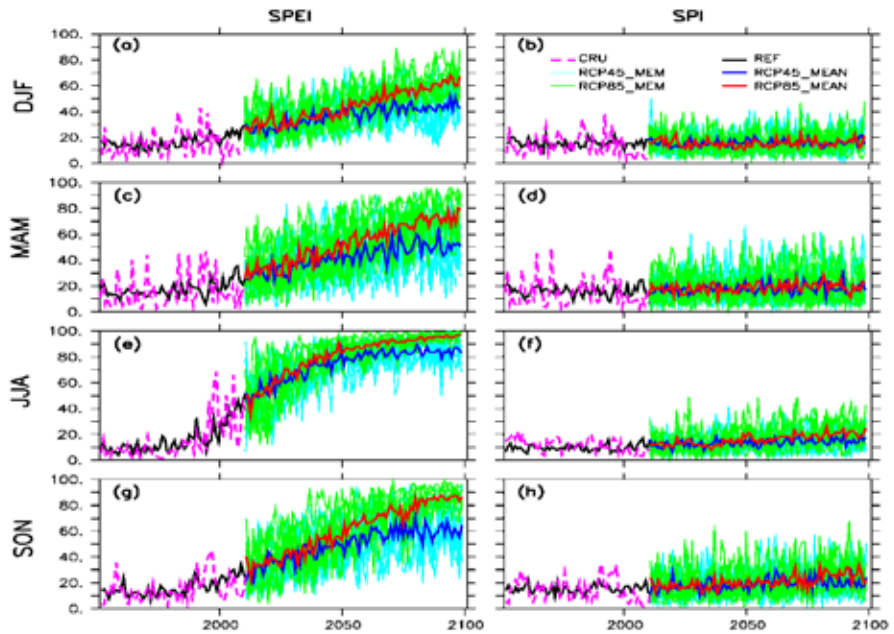
The South African Weather Service (SAWS) participates annually in the Southern African Regional Climate Outlook Forum (SARCOF) organised by the Southern African Development Community (SADC). In the late winter/spring of each year, including August 2015 SARCOF participants analyse various inputs from International centres and SADC countries, including multi-model seasonal forecasting products from SAWS, to prepare a consensus seasonal outlook for the summer season. The September 2015 SARCOF outlook indicated enhanced chances of below normal rainfall over most of southern Africa. This outlook was updated in February 2016 and in March 2016 by the SADC SARCOF secretariat with the latest information from the SADC national weather services.

The Council for Scientific and Industrial Research (CSIR) contributes to seasonal forecasting in South Africa using the Conformal Cubic Atmospheric Model. Current work includes developing a new Variable-Resolution Earth System Model (VRESM) and co-ordinating research efforts around understanding the Southern Hemisphere carbon cycle, carbon–climate feedbacks, the role of seasonality in driving ecosystem dynamics, African climate dynamics, and projecting the consequences of global change for various sectors of South African society. The fully coupled model will be the only one developed in Africa and will also be used in operational mode to issue seasonal forecasts.

Operational monitoring of weather conditions through the SAWS and ARC automatic weather station (AWS) networks enabled the continuous provision to role players of monitoring products during the 2015/16 drought. Earth observation (EO) data, collected through the Coarse Resolution Imagery Database (CRID) project have further informed decision makers regarding the intensity and extent of drought conditions. Through the UMLINDI newsletter published monthly by ARC-ISCW, as well as the SPI drought monitoring information provided on the SAWS web page (www.weathersa.co.za) drought monitoring products developed at the two institutions were disseminated throughout the period covered by this report.

b) Regional applications

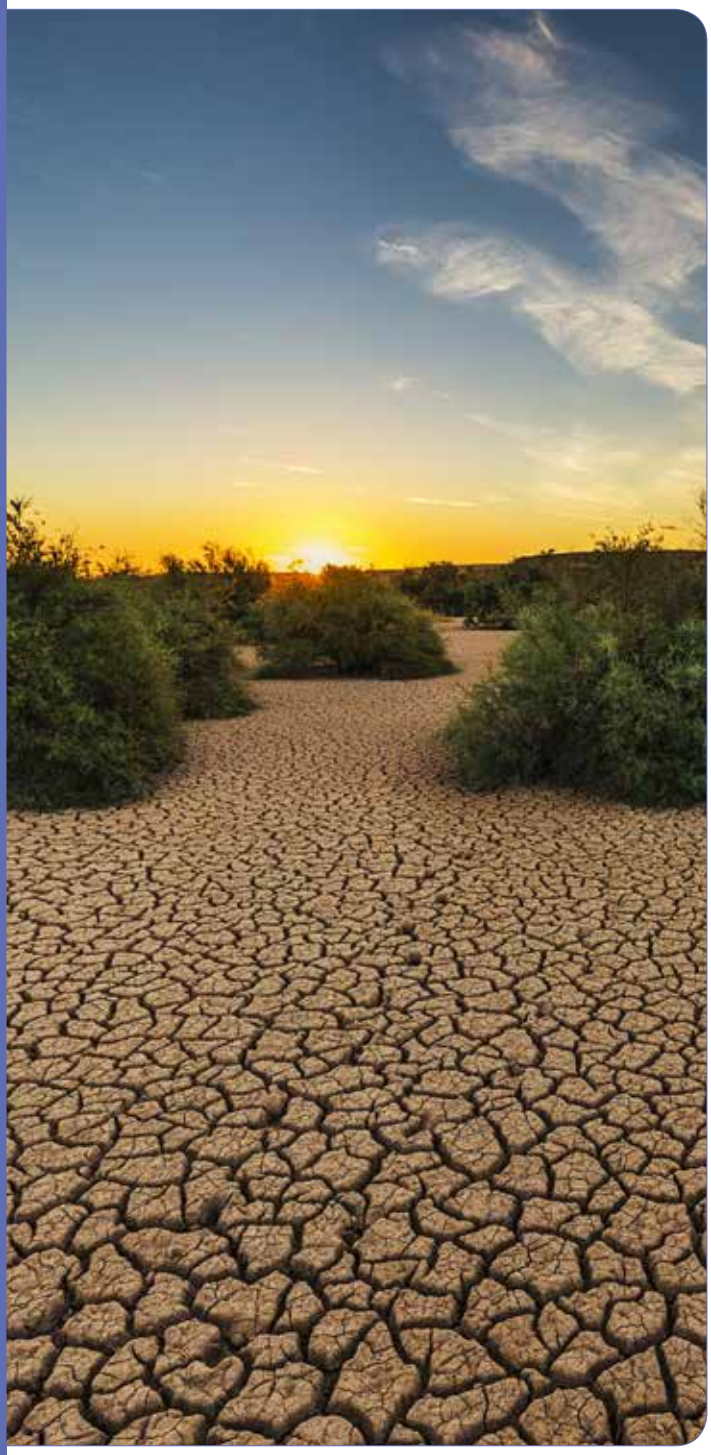
Several efforts are also made to enhance the understanding of the regional drought footprint. Analyses by the Water Research Commission (WRC), for example, were conducted to project the drought scenarios into the future. These Standardised Precipitation-Evapotranspiration Index (SPEI) scenarios project a general increase in drought coverage, and depending on the scenarios and seasons the percentage of drought area may increase up to 90% by the year 2100 (**Figure 19**).



Key

SPEI	Standardised Precipitation-Evapotranspiration Index	SPI	Standardised Precipitation Index
CRU	Climatic Research Unit, University of East Anglia	SON	September, October & November
RCP	Representative Concentration Pathways	JJA	June, July & August
MEM	Model Ensemble Mean	MAM	March, April & May
REF	Reference (Historical)	DJF	December, January & February

Figure 19: Observed and simulated percentage of Southern African landmass experiencing drought now and into the future. The Standardised Precipitation-Evapotranspiration Index (SPEI) (left) shows an increasing trend of up to 90%, while the Standardised Precipitation Index (SPI) (right column) shows a lower increase (or an under-estimation).
Source: WRC



These results, though preliminary, clearly demonstrate a pattern of increasing intensity, area coverage and frequency of Regionally Extensive Droughts (REDs) over southern Africa in the future climate.

ARC has developed a drought monitoring system for use in SADC, based on data freely available for the region. These data include earth observation data as well as rainfall data for the region. The system is free software specifically geared to guide users in the use of various standard drought monitoring indices based on rainfall and vegetation monitoring data. It was developed under the Monitoring of Environment for Security in Africa (MESA) project during 2015/16. Products are available online in near real time (http://www.mesasadc.org/drought-data-products).

5.3. DROUGHT IMPACTS

An overview of hydrological, ecological and socio-economic impacts of drought is provided in this section as indicated in **Figure 20** below.

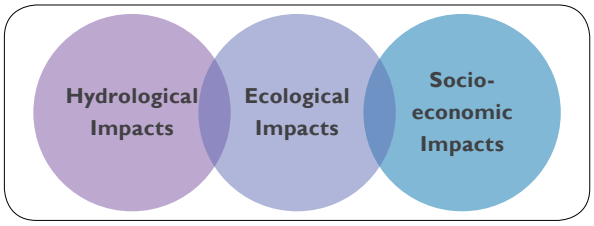


Figure 20: Dimensions of Drought impacts on South Africa

A variety of impacts, either socio-economic and or biophysical, have been recorded. Dam levels plummeted and water restrictions were introduced in several major cities. Health impacts, coupled to searing temperatures and heat waves, have begun to be understood but more research needs to be undertaken in this area. Detailed research on ecosystem health has also been undertaken in South Africa associated with drought periods. Data collected and analysed by SAEON show that consecutive years of below-normal rainfall can have negative consequences for grasses that can then impact on grazing and livestock.

Agricultural losses have been significant during this period of drought. Several reports of thousands of cattle deaths in the drier parts of the Lowveld have been observed. There have been losses of large game (hippo and buffalo) in reserves such as the Kruger National Park which generate tourist revenue for the country and critical biodiversity has also been impacted.

Commercial and small-scale agricultural producers have also been hard hit by the drought. Reports of major crop losses and delays in drought relief for farmers have been noted and should be a cause for serious concern as food prices escalate and pressure increases on poor rural households.

DAO 6

Systems, infrastructure, communities and sectors less vulnerable to climate change impacts (e.g. through effectiveness of adaptation interventions/ response measures) [G6].

a) Hydrological impacts - *National dam storage since 1980*

Periods of very low storage were experienced in the early 1980s, early 1990s and early 2000s, with the lowest combined levels recorded on 15 November 1983 (34% of full total capacity), 15 November 1995 (34.4% of full capacity) and 2 January 2006 (56.0% of full capacity) respectively. The periods lasted 32, 55 and 50 months respectively. Since 2006, the total storage percentages have been maintained for nine years above the low level of 56% recorded in that year. This has been the longest period of sustained high levels of storage since 1980. A downward trend in the levels recorded has been evident from 17 March 2014, when the average national storage was 93.3%. This downward trend accelerated during 2015, leading to a value of only 53% of storage nationally by mid-2016. Except for a few spikes (such as the ones in early 2014), a more general downward trend started after the very high levels experienced in 2010/2011 (Ntuli, 2016) (**Figure 21**).

Hydrological impacts in selected catchments

The long term historical rainfall records at Cathedral Peak indicate a general drying from 1965 to 1985 (Toucher et al. 2016). This trend appears to continue in 2013 to March 2016, but the record is too short to determine if this is

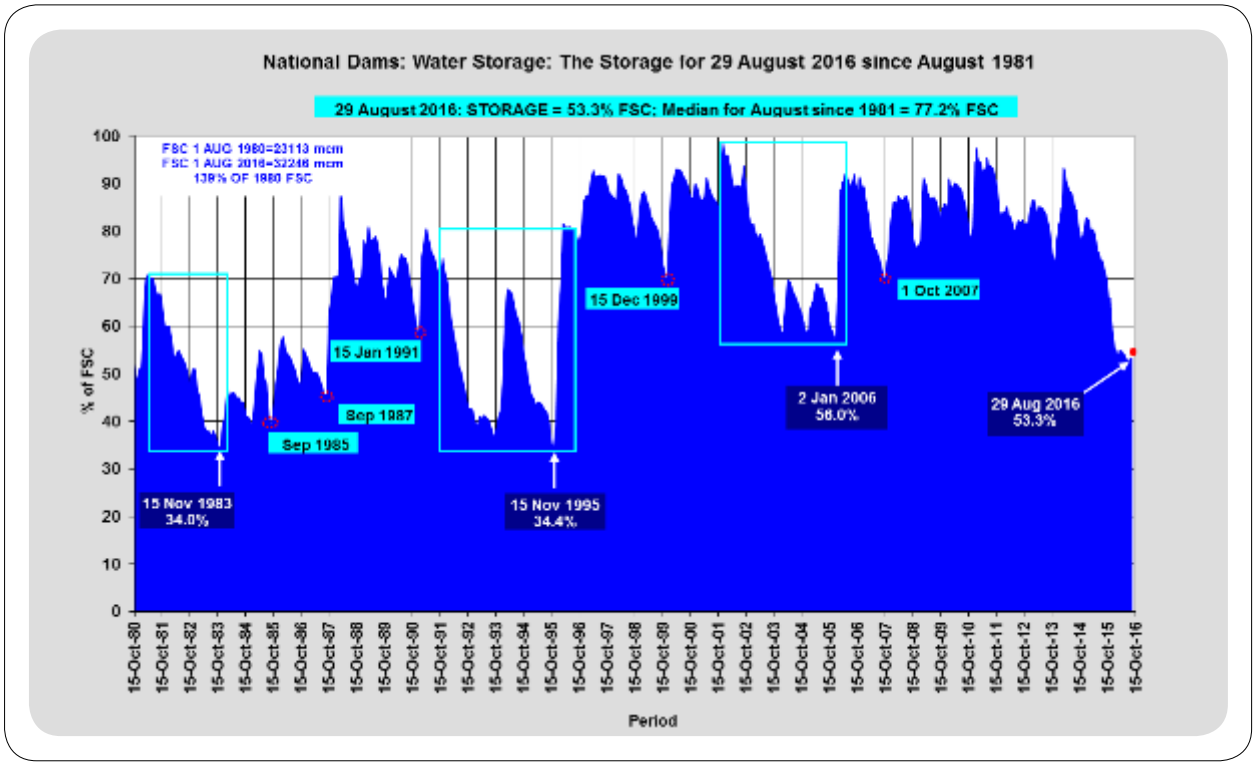


Figure 21: National dam storage status for October 1980 to 01 August 2016. *Source: DWS*

a directional trend or simply the influence of the current drought. Analyses thus far also indicate temperatures are warmer than in the early decades of records for the catchments (Toucher et al. 2016). The 2015/2016 drought is clearly apparent in the hydrological record with a much lower probability of high streamflow events in this period relative to the 20th century data (**Figure 22**). As an indication of the severity of the drought, observers noted that streamflow ceased altogether in 2015 in one of the gauged catchments (Catchment VII) for the first time since records began in the 1950s.

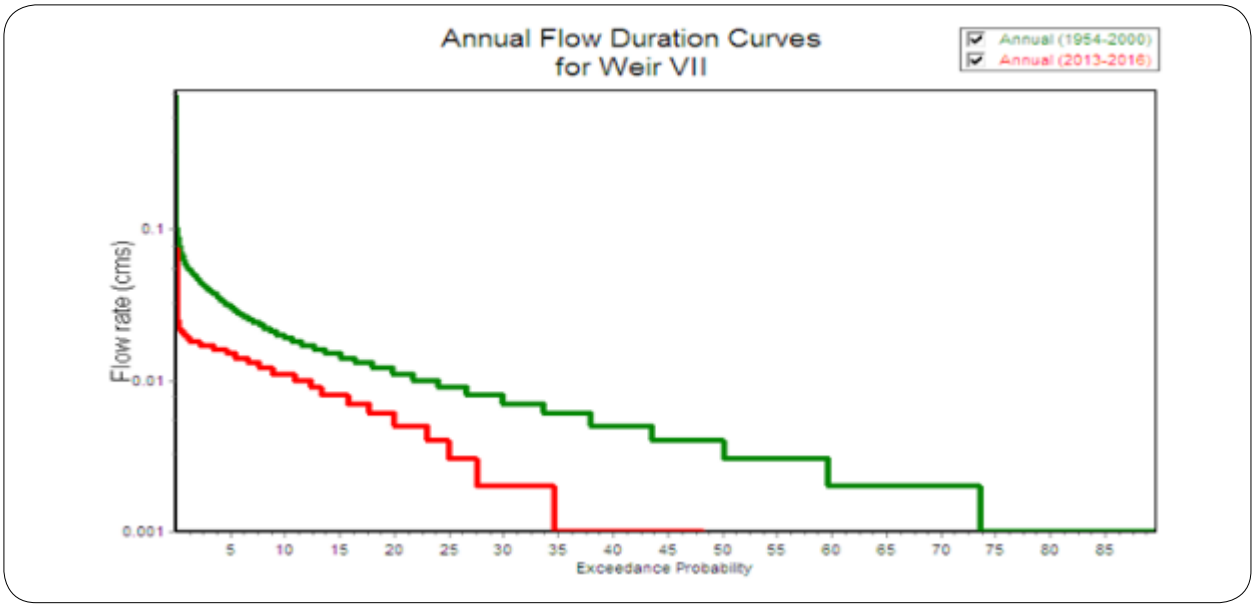


Figure 22: Annual flow duration curves for Catchment IV, Cathedral peak, showing both historical (green, 1954–2000) and recent (red, 2013-2016) data trends (Toucher et al. 2016). Note that the probability of streamflow exceeding any given flow rate is much lower in the recent period indicating drying of streams from this key region for water provision.

Groundwater impacts

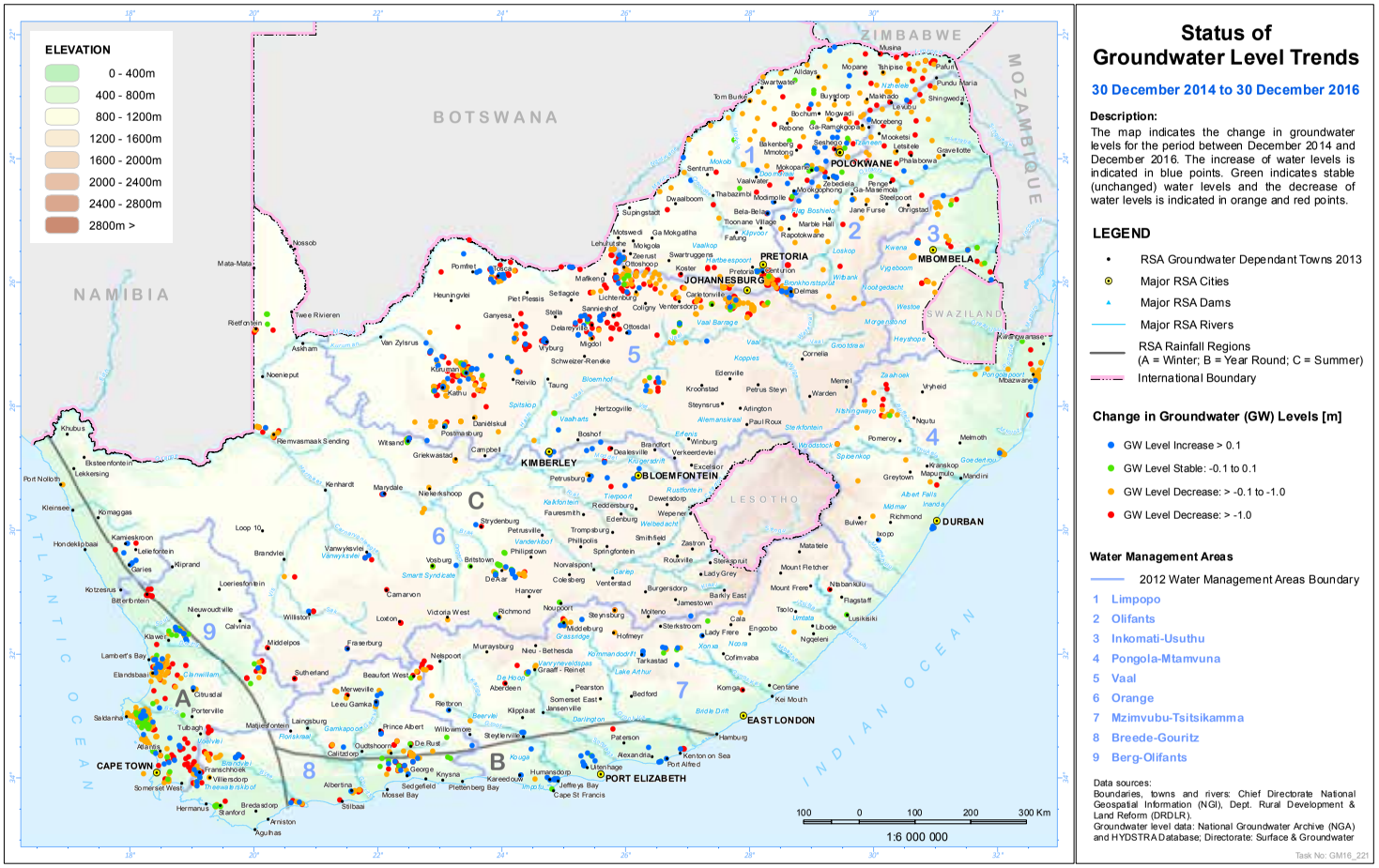
Groundwater levels for the period 30 December 2014 to 30 December 2016 decreased in Limpopo, Northwest, Northern KZN, Northern Cape and parts of the Western Cape provinces due to increased abstractions during the drought period (**Figure 23**).

b) Monitoring ecological impacts

SAEON's long-term monitoring programme is very well suited to analysing drought impacts and the degree to which they depart from the norm. SAEON has been compiling data from long-term weather stations, catchment experiments, and South Africa's remarkable legacy of ecological experiments manipulating fire and herbivores (livestock, African animals). These are invaluable for assessing long-term trends, such as global warming, and short term extreme events (such as the current drought).

Ecosystem impacts

South African ecosystems have been exposed to extreme droughts for thousands of years. Past studies show that grazing practises before, during and after a major drought can tip rangelands from resilient perennial grass cover to low productivity, unpalatable annual grasses (O'Connor 1991). Current data collected by SAEON help show drought recovery trajectories and explore conditions when droughts act as tipping points to new ecosystem states or recover to pre-drought conditions. SAEON is examining the resilience of the fynbos, savanna, grasslands, and Karoo shrub lands, each with their own trajectories of post-drought recovery. Of particular interest is how recovery varies with different land management practises (Bond 2016).



Status of Groundwater Level Trends

30 December 2014 to 30 December 2016

Description:
The map indicates the change in groundwater levels for the period between December 2014 and December 2016. The increase of water levels is indicated in blue points. Green indicates stable (unchanged) water levels and the decrease of water levels is indicated in orange and red points.

LEGEND

- RSA Groundwater Dependant Towns 2013
- Major RSA Cities
- Major RSA Dams
- Major RSA Rivers
- RSA Rainfall Regions (A = Winter; B = Year Round; C = Summer)
- International Boundary

Change in Groundwater (GW) Levels [m]

- GW Level Increase > 0.1
- GW Level Stable: -0.1 to 0.1
- GW Level Decrease: > -0.1 to -1.0
- GW Level Decrease: > -1.0

Water Management Areas

- 2012 Water Management Areas Boundary
- 1 Limpopo
- 2 Olifants
- 3 Inkomati-Usuthu
- 4 Pongola-Mtamvuna
- 5 Vaal
- 6 Orange
- 7 Mzimvubu-Tsitsikamma
- 8 Breede-Gouritz
- 9 Berg-Olifants

Data sources:
Boundaries, towns and rivers: Chief Directorate National Geospatial Information (NGI), Dept. Rural Development & Land Reform (DRDLR).
Groundwater level data: National Groundwater Archive (NGA) and HYDSTRA Database; Directorate: Surface & Groundwater

Task No: GM16_221

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Figure 23: Status of groundwater level trends for the period 30 December 2014 to 30 December 2016.

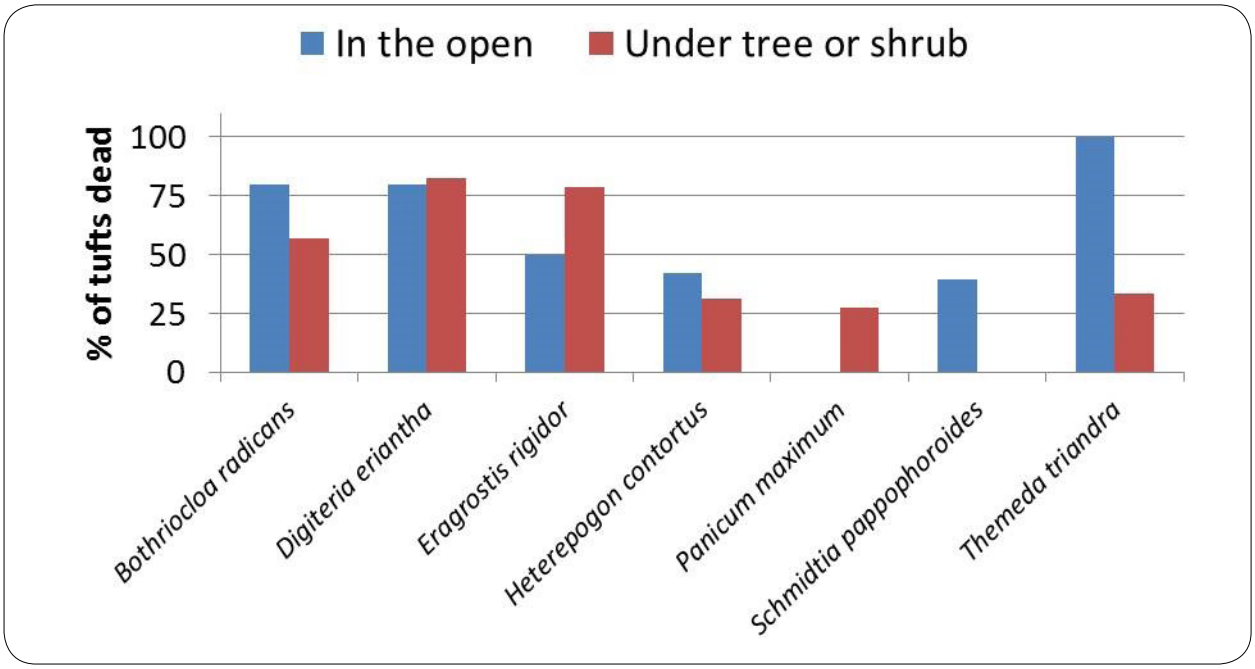


Figure 24: Estimates of the percentage of tufts of common perennial grasses that died during the 2015–16 summer at one site in the Kruger National Park near Phalaborwa. Data are grouped for tufts growing either out in the open or under tree or shrub canopies.

Impacts on semi-arid savannas

The impact of two consecutive years of below-average rainfall on the grass layer has been profound, with far greater mortality of perennial grass plants in the second year compared to the first year. **Figure 24** provides an example of the degree of mortality.

The rate of recovery to pre-drought densities is not known and depends also on grazing pressure. Heavy grazing in the recovery phase, and/or more frequent droughts, can lead to a switch from perennial to annual grasslands with large consequences for herbivore populations. This transition has already occurred in many of the communal rangelands in the arid- and semi-arid parts of the region. Forbs (non-grass herbaceous plants) show a striking increase in abundance after rains and before grasses recover. Reports from previous droughts suggest that some species only appear after rains break a severe drought suggesting adaptation of these species to drought cycles. The forb response to drought is being monitored in permanent plots by SAEON (Bond 2016).

The impact on the tree layer has not been severe thus far but previous droughts have shown lagged responses. Observations on permanent plots show very little increase in adult tree mortality thus far and a temporary absence of seedling recruitment. This suggests that there will be no significant reduction in tree cover after this drought. Indeed, the drought may result in further bush encroachment in the future, due to enhanced recruitment of trees when the drought breaks and before the grass layer recovers (February et al. 2013).

As regards herbivores, thousands of cattle deaths have been reported for the drier parts of the Lowveld. Whether deaths are higher than during previous droughts remains to be seen. In the Kruger National Park (KNP) many hippos have died, with total mortality reaching many hundreds by the end of the 2016 dry season. Buffalo

mortalities had also begun but the net effect of the drought has yet to be evaluated at the time of writing. Increased abandonment of elephant calves has also been reported. Similar mortalities have been reported for some of the neighbouring private reserves, although proactive selling of game seems to have averted this in some cases. A clear indication of the impact of the drought on wild herbivore populations will only become available after the 2017 dry season (Bond 2016). There is no indication, as yet, of loss of animal or plant species as a result of the drought but it is too early to evaluate species losses with any confidence (Bond 2016).

Impacts on fynbos

Large areas of fynbos were burnt in the last few years which will allow a comparison of drought effects on plant populations in young versus old fynbos. By March 2017, no clear indications of drought-related mortality had been observed (Bond 2016). Changes in the spread of alien invasives are being monitored by SAEON as is post-burn erosion linked to the slow recovery rate post-burn due to the drought (Bond 2016).

Impacts on coastal environments

Data analysis on coastal environmental impacts is not yet complete. However preliminary indications for the Algoa Bay instrument arrays show no discernible changes in these coastal study sites as a result of the drought / El Niño. Upwellings during the drought period also confound interpretation of the coastal temperature data. SAEON has no data on the north-eastern coastline but the drought is thought to have had major impacts on the KwaZulu-Natal coast (for example St Lucia).

Viewed collectively all of the impacts presented above usually impact more acutely on the poorest and most vulnerable. The next section profiles how the initial assessments of drought impacts described above can begin to impact communities. Remember, however, that many of these impacts are the result of both existing conditions (for example vulnerabilities due to things like poor service delivery, failed development) and the biophysical outcomes of drought (such as low rainfall). Drought therefore cannot be blamed as an Act of God! The socio-economic and development implications also require investigation as the following section illustrates.

c) Socio-economic impacts

Various organisations track the socio-economic impacts of weather and climate on a routine basis. Among these are SAWS through its monthly weather bulletins. Few detailed interrogations of the complexity of interacting causes of drought exist, however, and it is hoped that this report will prompt more actions in this area of assessment. The District Health Information System (DHIS) and District Health Barometer also have outcomes indirectly relevant to drought, and directly linked to dehydration in the event of no water supply. In addition, Statistics South Africa collects mortality data that can be considered in relation to causes of death indirectly affected by drought and its associated high temperatures and lack of drinking water.

5.4. CHALLENGES, GAPS, OPPORTUNITIES AND LESSONS LEARNED

a) Overarching Challenges

Notwithstanding the fact that South Africa is no stranger to drought, recent experience does not bode well for effective risk responses to the possibility of more frequent and greater magnitude droughts accompanying climate change (IPCC 2012). The delays in assistance and relief that have accompanied the declaration and response to drought are understandable given the complex and multi-layered nature of disaster response declaration and response in the country. This situation, however, cannot be allowed to persist and more flexible operational designs for effective drought risk reduction must be considered. In a recent assessment, Meissner and Jacobs-Mata (2016) outline some of the key needs for effective water management in a drought such as the one being experienced including that:

- South Africa should prepare and adopt a long-term, national drought adaptation policy.
- Computer-generated models for effective water restriction monitoring and operations should be considered.
- Drought risk reduction needs to continue to build on being even more proactive.

A formalised knowledge platform should be created that assesses a range of inputs required for effective drought response.

Lessons can be drawn from the National Consultative Drought Forum that was established in response to the droughts of the 1990s. This forum, via a variety of task teams, (for example water, early warning systems (EWSs), food and so on) collated and gathered critical information linked particularly to development needs in the country (Abrams et al. 1992; Task Team 1993). While the structures linked to the NDMC have been established to mimic such a forum, the delays and crisis responses experienced with this recent drought show that we seem to have forgotten the lessons and implementation designs of the past. Serious reflection and action on enhanced drought risk reduction response is thus urgently required.

Periods of dryness and drought are not unusual in South Africa. Given that such phenomena may increase, both in severity and frequency with climate change it is essential that South Africa effectively manages and reduces the risks linked to drought.

b) Integrated approach coupled with scientific and indigenous knowledge systems for smallholder farmers

Smallholder farmers remain largely affected by drought and its persistence continues to threaten food security and livelihoods. Therefore, an integrated approach coupled with scientific and indigenous knowledge systems for detecting, mitigating and adapting to drought conditions needs to be adopted. The impact of droughts on small-scale farmers cannot be underestimated. A small-scale farmer (Mahanjana 2016), who gave his views on information and assistance provided during the 2015/16 drought pointed out that:

- Information was not communicated strongly and convincingly to influence the behaviour and normal practices of small holder farmers.
- Responses in most cases only happen after the impacts have been felt (humans only change behaviour after feeling the impacts).
- Research organisations indicated that drought might be coming quite early but there were no campaigns

to sensitise farmers to change their behavioural and normal practices.

- Research and technological solutions are mainly made available through scientific journals before being repackage for normal communication platforms.
- In some cases, scientific messages conflict with indigenous knowledge which farmers have been using for a very long time to respond. Therefore, linking individual experiences with climate change becomes very critical.
- Lack of specialised skills to repackage the scientific information in a way that small holder farmers will understand (including translation into local languages).
- Access to information is also a problem as most information is available online. Small holder farmers do not have access to online platforms.
- Extension officers play an important role but sometimes do not have the technical know-how to repackage and translate science into something understandable.

c) *Systematic Observations and Modelling*

Drought still persists in many parts of South Africa and continues to directly and indirectly affect different sectors. The following key considerations can be taken into account to respond effectively to drought.

- There have been many reports on drought and policies to deal with drought in South Africa and countries with similar climates elsewhere. It would seem timely to evaluate what we have, and what we should have in place to deal with extreme droughts and their aftermath to alleviate social and economic distress while ensuring ecosystems continue to sustain us in the future.
- Enhancing communication of drought – both early warning, including effective use of social media, but also information and capacity to enhance drought risk reduction, including provision of information on extreme drought in daily media weather reports.
- Supporting more science on the understanding of atmospheric systems, science to provide early warning of El-Niño events, drought conditions and high temperatures, and for proactive planning and effective response.
- Supporting more science on impacts and understanding of the biophysical, social, economic and political dimensions of drought and extreme climate events.
- Serious attention must be given to the failing capacity to monitor rain gauges – we must build up the weather station network.
- Continued support of the NDMC and enhancing the institutional dimensions of drought risk reduction – from national to local levels.
- The need for co-engaging users in the information channels and networks.
- The need for systematic integration of products to facilitate the use of early warning information.
- Meeting the requirements for a systematic understanding of drought risks at national level.
- Rigorous assessments of losses including livelihoods, crops, livestock, economic, ecological and so on need to be undertaken.

The challenges related to forecasts and early warning systems include some of the following areas discussed in more detail on the following pages.

Modelling capability

Forecast models are generally reliable in predicting the strength and timing of El Niño events, as well as associated droughts and temperatures over southern Africa during the early to mid-summer period. These models provided early warning of the strong 2015/16 El Niño event, as well as drought conditions and high temperatures during early and mid-summer.

Seasonal forecasts are less reliable for late summer to early autumn and seem to have missed the improved rainfall conditions that occurred then. Forecasts should be tailored to suit the specific needs of users, but these tailored products should be co-produced by forecast modellers and forecast users.

Data capacity and development needs

Noticeably, observation sites have a short time series to establish trends and this requires sustained effort and funding to develop the necessary data for analysing trends. Australia, with a similar drought-prone climate to South Africa, had a policy providing support for rural industries based on the frequency of extreme droughts (only 1 in 20 to 25 year events) (White & O'Meagher 1995). They recommend a record of at least 70 years and preferably 100+ years to detect such events. Such long climate records are very rare in South Africa. It is essential that the existing network of weather stations is maintained, coordinated, and made more accessible to researchers and the public. Ideally, information on extreme droughts should form part of daily media weather reports. Maps of Normalised Difference Vegetation Index (NDVI) departures from the norm, or drought indices based on weather data, are effective methods for public communication.

Effective understanding of drought

There is clearly a need for a more effective and systemic understanding of drought (both biophysical and socio-economic causes and responses to drought). The recent national efforts undertaken by the DEA (for example, the National Adaptation Plans being prepared; the National Framework on Climate Services and the South African Risk and Vulnerability Atlas (SARVA) can all play an instrumental role in enabling a better co-ordinated response to drought going forward. The lack of an integrated early warning system to mitigate against the impacts of hydrological droughts, for example, was highlighted as requiring immediate action. In response, the WRC made a call for proposals to develop such an early warning system.

Declining rainfall networks and data

Rainfall is measured by various entities and institutions. For national drought monitoring purposes, the networks maintained by SAWS and ARC are arguably the most important. In recent history, however, there has been a marked decline in the number of rainfall measurements taken on a regular basis, especially from manual stations where the measurements are taken on a voluntary basis. There are several reasons for the decline, the most important being the historical increase in farm size to improve the financial viability of commercial farming, leading to a decline in the number of farmers available to do measurements. In recent years, there has also been an increasing unwillingness to do measurements without financial incentive, particularly from government institutions such as police stations and prisons. **There has been a decline** of stations from SAWS and ARC reporting rainfall on a daily basis from 1950 to 2016, from a high of almost 3 500 stations in 1950 to 1 976 stations in 2016. In fact, this decline in rainfall measurements commenced about a decade earlier. The most important causes of the decline in measurements are the quality of

measurements from manual stations, a decrease in the enthusiasm to do voluntary measurements and budgetary constraints on expanding the automatic observation network. It is imperative that the trend of declining rainfall measurements, which has accelerated since the mid-1990s, be reversed, as it lessens the effectiveness of climate monitoring and the reliability of relevant products. The importance of an operational network of weather stations that measure conditions accurately cannot be overstated. Without sufficient recordings, it will be impossible to place drought conditions into context with normal climate variability in order to quantify the extent, severity and duration of drought conditions. There are serious concerns about the decline in monitoring of rainfall, stream flows, groundwater levels, water quality, and so on. Rainfall is an important variable through which the efficient assessment of the availability of water resources is gauged. However, rainfall observation in South Africa has declined to such an extent that the current number of useful rainfall stations is far less than the number of stations in 1920 (**Figure 25**).

The key to drought preparedness and readiness is about knowing the what, how and when of the drought. To achieve this goal the scientific expertise to monitor and predict, the capability of the observation networks, and information systems for drought early warning have to be improved.

Enhanced integrated reporting of drought indicators

Various institutions monitor rainfall conditions, the most noteworthy probably being SAWS and ARC. The applications of different indices, methodologies of calculation and thresholds to define the severity of drought all have a bearing on trying to ensure that a uniform message on drought conditions is communicated to various users and interested stakeholders. One example is the reporting of the SPI by SAWS and ARC: SAWS endeavours to update the SPI drought report monthly by the 7th of the following month and ARC on the 3rd. SAWS uses a different threshold scale to distinguish between

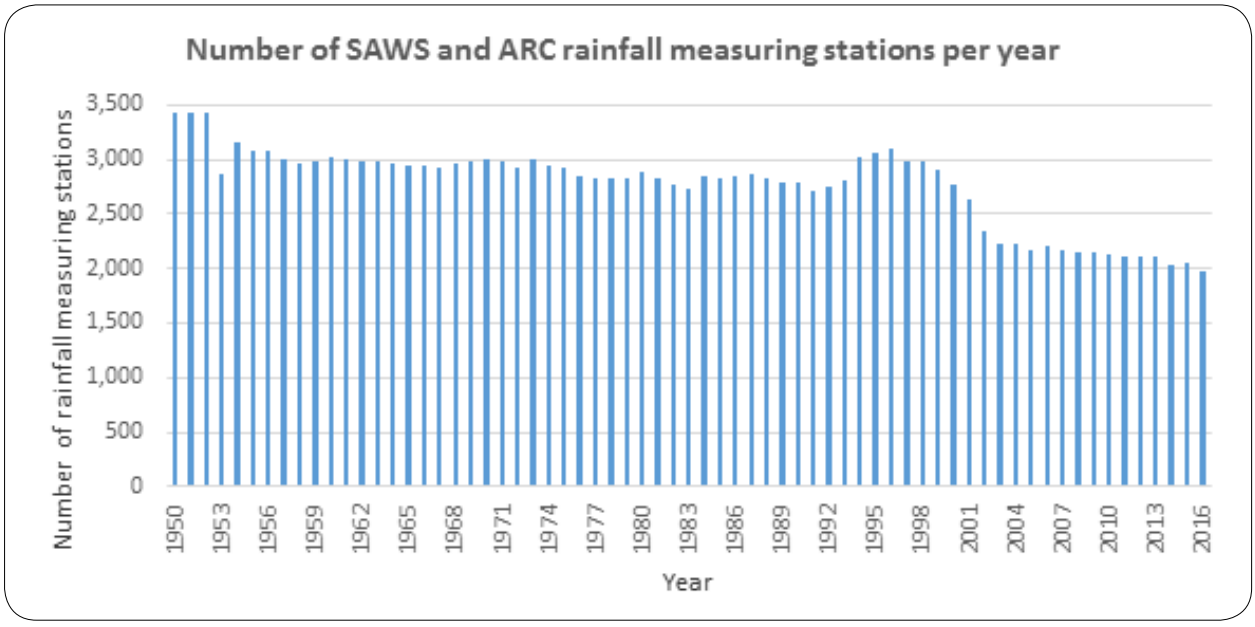


Figure 25: Number of SAWS and ARC rainfall measuring stations per year

drought severity, for example between moderate and severe drought, to ARC. In addition, the two institutions use different data sets and interpolation methods. While in most cases there are commonalities between the drought affected regions identified on some occasions there are marked differences between the extents of the severities in drought conditions reported. ARC and SAWS already share rainfall data in reporting on rainfall conditions and, in light of the above challenges, it will probably be useful, primarily to minimise confusion by users of the information, to cooperate more widely in reporting on other rainfall related conditions as well.

Information needs and partnerships

A major factor in drought risk reduction is the issue of information. Several questions require attention. For example, when should information be provided, who authorises such information, how credible and valid is the information provided, in what formats is the information provided and can a variety of users (citizens, business, small- and large-scale farmers) easily access and make use of such information?

Several studies of both the access and use of information in times of drought have been undertaken. More recently a more systematic assessment of the role of information has begun through the establishment of a National Framework on Climate Services and deliberations on an effective climate service are underway.

However, greater attention to engaging users in the information chain and network, something that social media and citizen science make more feasible, is still required and should be enhanced. The recent crisis developing in the Western Cape over water supply is a case in point. One cannot wait for a crisis to begin an intervention. More efforts on social learning for droughts are needed in a variety of areas, for example in schools, in the tourism industry, and in large- and small-scale industry and business: drought is not just a farmers' issue. The National Disaster Management Centre (NDMC) together with various actors (including the DEA, local government and non-governmental organisations (NGOs) can greatly enhance the ability of the nation to effectively prepare and respond to droughts.

Integration with open data platforms, specifically SARVA

SAEON is also in the process of publishing data and integrating data sources for the purposes of SARVA. The following actions are of interest from a drought management and mitigation perspective:

Collaboration with SAWS and the CSIR to publish seasonal and long-term weather and climate forecasts:

- Detailed publication of profiles of the human and natural capital that may be impacted by drought: this includes the extent, value, and nature of agriculture and forestry, of human settlement and dwellings, economic activity, ecosystem services, and infrastructure (stocks or capital). These may be used for better future impact assessment and resilience estimates given proper drought warning systems.
- Development of a framework for risk and vulnerability assessment, aligned with the Climate Change Response and M&E frameworks developed by the DEA, and with the National Disaster Management Act and National Disaster Management Framework. In respect of drought, this report will serve as a valuable input in determining a data and decision support framework for drought early warning and impact assessment.
- The data resources mentioned and referenced in this report will be used as a starting point for a portfolio of drivers and pressures, stock or capital profiling, and impact assessment presented via SARVA.

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Note: *In person interviews only are cited. Numerous interviews took place telephonically and information was also exchanged via email correspondence.*

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ABBREVIATIONS

ARC	Agricultural Research Council
ARC–ISCW	Agricultural Research Council Institute for Soil, Climate and Water
ARC.LNR	Agricultural Research Council. Landbou Navorsings Raad
AWS	automatic weather station
CRID	Coarse Resolution Imagery Database
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DAO	Desired Adaptation Outcome(s)
DCoG	Department of Cooperative Governance and Traditional Affairs
DHIS	District Health Information System
DWS	Department of Water Affairs and Sanitation
EO	Earth Observation
EWS	early warning system
KNP	Kruger National Park
MESA	Monitoring of Environment for Security in Africa
NDMC	National Disaster Management Centre
NDVI	Normalised Difference Vegetation Index
PASG	percentage of average seasonal greenness
RED	Regionally Extensive Drought
SADC	Southern African Development Community
SAEON	South African Environmental Observation Network
SARCOF	Southern African Regional Climate Outlook Forum
SARVA	South African Risk and Vulnerability Atlas
SAWS	South Africa Weather Service
SPEI	Standardised Precipitation-Evapotranspiration Index
SPI	Standardised Precipitation Index
VRESM	Variable-Resolution Earth System Model
WRC	Water Research Commission

CHAPTER 6

MITIGATION

SOUTH AFRICA'S TRANSITION TO A LOW CARBON ECONOMY AND SOCIETY

CHAPTER 6: MITIGATION - South Africa's Transition to a Low Carbon Economy and Society

PREPARED BY: Letete T. (Department of Environmental Affairs) & Thangavhuelelo M. (Department of Environmental Affairs)

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6.1. INTRODUCTION

Both domestically and internationally, South Africa has committed itself to a lower-carbon development trajectory. The National Climate Change Response M&E system is the primary tool through which South Africa's Nationally Determined Contribution (NDC) under the Paris Agreement will be monitored and evaluated.

This chapter presents the results of tracking the country's transition towards this envisaged lower-carbon economy and society, updating the information that was provided in the first Climate Change Annual Report (DEA 2016a). It also expands the scope of that information by providing more details where possible. In particular, this chapter focuses on the following key areas:

- The extent to which South Africa is making the transition to a lower-carbon economy: This is addressed at three levels:
  - national indicators
  - sectoral indicators
  - indicators that assess the impact of individual response measures and policies

This includes tracking the progress towards achieving domestic and international targets.

- Tracking South Africa's progress in achieving the mitigation component of its Nationally Determined Contribution (NDC) under the UNFCCC. In this report, we cover both the approach to doing this tracking on an annual basis as well as tracking the progress since 2012.
- Showcasing some innovative lower-carbon programmes or projects in the country in order to motivate for innovations and to enhance learning.

Text Box 1 provides an overview of the structure of the mitigation chapter of the Annual Climate Change Reports.

Text Box 2
Framework structure of the mitigation chapter of the Annual Climate Change Reports

This chapter, in this and in subsequent reports, will always seek to respond to information needs for both domestic policy formulation and implementation on mitigation. It will also respond to South Africa's international reporting obligations under the UNFCCC. The following framework is required to meet these objectives:

1. NATIONAL INDICATORS

This section will cover the following:

The National Greenhouse Gas (GHG) Inventory

- Domestic targets graphs: GHG inventory vs. the Peak Plateau and Decline (PPD) trajectory vs. the business-as-usual trajectories.

Text box 2 continued:

- Decoupling graphs: GHG inventory vs. GDP growth vs. primary energy supply vs. population growth.
- Other national indicators: These may include percentage of renewables and carbon-free sources in the primary energy supply, number of green jobs created, number of green enterprises created, and so on. These indicators should seek to respond to current information needs, as appropriate, on an annual basis.

2. SECTORAL INDICATORS

This section will cover the following:

- Sectoral decoupling: Sectoral GHG emissions in relation to sectoral GDP contributions.
- Emissions intensity: Sectoral GHG emissions intensity per unit of service or product.
- Other sectoral indictors: These may include sectoral green jobs, green enterprises and so on.

3. MAJOR MITIGATION RESPONSE MEASURES

This section will include:

- Mitigation assessments: Assessing the achieved and envisaged GHG emissions reductions of individual or groups of response measures, and carefully estimating the cumulative impact.
- Sustainable development indicators: Assessing the achieved and envisaged sustainable development indicators resulting from the mitigation response measures, and carefully estimating the cumulative impact.

4. PROGRESS ON THE MITIGATION NDC OF SOUTH AFRICA

This section can cover:

- Ex-post tracking of the emissions in relation to the 2025 and 2030 targets: This is primarily a comparison of the GHG inventory with the targets.
- Ex-ante modelling of the GHG emission growth rates: Modelling the emission growth rates and reductions required to achieve the 2025 and 2030 targets.
- Ex-post tracking of the mitigation instruments cited in the NDC: Implementation progress and mitigation assessment of the carbon tax, desired emission reduction objectives (DEROs), carbon budgets and so on.
- Ex-ante tracking of the key mitigation instruments to be used in achieving the NDC: Primarily the instruments cited in the NDC but may include other instruments.

5. SPECIAL CHAPTER

This chapter can present and showcase successful lower-carbon programmes being undertaken by particular sector(s), subsector(s), local municipality(ies), provinces, NGOs or even individuals, highlighting the successes, challenges and lessons learnt.

ANNEXURES - Summaries of each individual and groups of mitigation measures.

6.2. NATIONAL-LEVEL TARGETS, PROGRESS AND TRENDS

6.2.1 Targets and Commitments

The South African Government has made two major commitments to a lower-carbon economy trajectory, which can be summarised as follows:

a. **Domestic Target:** In 2008 Cabinet committed the country to a Peak Plateau and Decline (PPD) target, which was reiterated in the 2011 National Climate Change Response Policy (NCCRP) (DEA 2011a). In the National Development Plan (NDP) (NPC 2011) this commitment covers the following areas:

   - Reduced dependency on carbon, natural resources and energy.
   - Carbon emissions reduced to sustainable levels through mitigation policies.
   - Economic activity decoupled from environmental degradation and carbon intensive energy.
   - Expanding economic activity, while simultaneously decreasing consumption of non-renewable natural resources (NPC 2011).

b. **International Target:** Under the Paris Agreement (United Nations 2015) South Africa committed to a nationally determined mitigation contribution (M-NDC) that will see the country's emissions in the range between 398 and 614 $MtCO_2e$ by 2025 and 2030, as defined in the NCCRP, ensuring that the international target is identical to the national target for the period 2025–2030 (RSA 2015). The international commitment is subject to the provision of support.

Figure 26 shows the levels and relationship between the national PPD target and the international NDC target, and how they compare with the business-as-usual (BAU) trajectory range, including the the Long-Term Mitigation Scenarios (LTMS) Growth Without Constraint (GWC) baseline trajectory (DEA 2007) and the two baseline scenarios of the Mitigation Potential Analysis (MPA) study: Without Measures (WoM) and With Existing Measures (WEM) (DEA 2014).

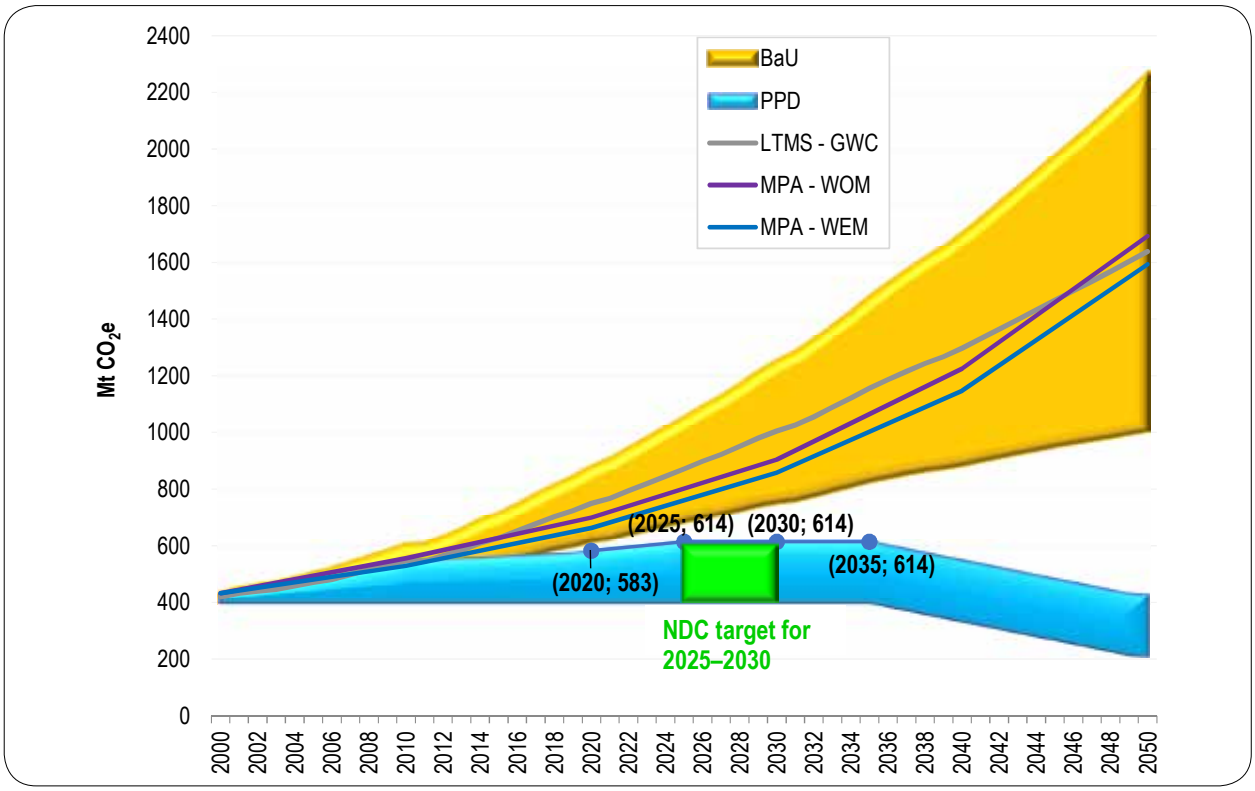


Figure 26: Peak, Plateau and Decline and Nationally Determined Contribution targets of South Africa

6.3. PROGRESS AND TRENDS – GHG EMISSIONS

South Africa's latest GHG inventory covers the period 2000–2012, and shows that GHG emissions during this period have been growing at an average annual rate of about 7 $MtCO_2e$, from 434 $MtCO_2e$ in 2000 to 518 $MtCO_2e$ in 2012 (DEA 2016c).

Figure 27 gives the GHG inventory time series between 2000 and 2012. The country's GHG emissions peaked at 529 $MtCO_2e$ in 2010, after which emissions decreased to 518 $MtCO_2e$ in 2012. The peaking can be attributed to the hosting of the 2010 FIFA World Cup in the country, which saw manufacturing industry booming in the years up to 2010, followed by a significant decline.

The energy sector is the largest contributor to total GHG emissions in the country, amounting to 78.9% in 2000 and increasing to 82.6% in 2012. The Industrial Processes and Product Use (IPPU) sector, the Agriculture, Forestry and other Land use sector (AFOLU) and the Waste sector contributed 7.2%, 6.0% and 4.2% respectively to total GHG emissions in 2012. The AFOLU and IPPU sectors decreased from 10.6% and 7.7% respectively from 2000 emissions levels .

South Africa's GHG emissions in 2012 were dominated by CO_2 (83. 5%), followed by CH_4 (10.8 %) and N_2O (5.0%). F-gases contributed less than 0.7% (**Figure28**). CO_2 and CH4 emissions increased by 21.2% and 14.6% between 2000 and 2012 respectively, while N_2O emissions showed a decline of 5.6%. PFC emissions doubled over the 12-year period, while HFCs (only included from 2005) increased by 65.8% between 2005 and 2012.

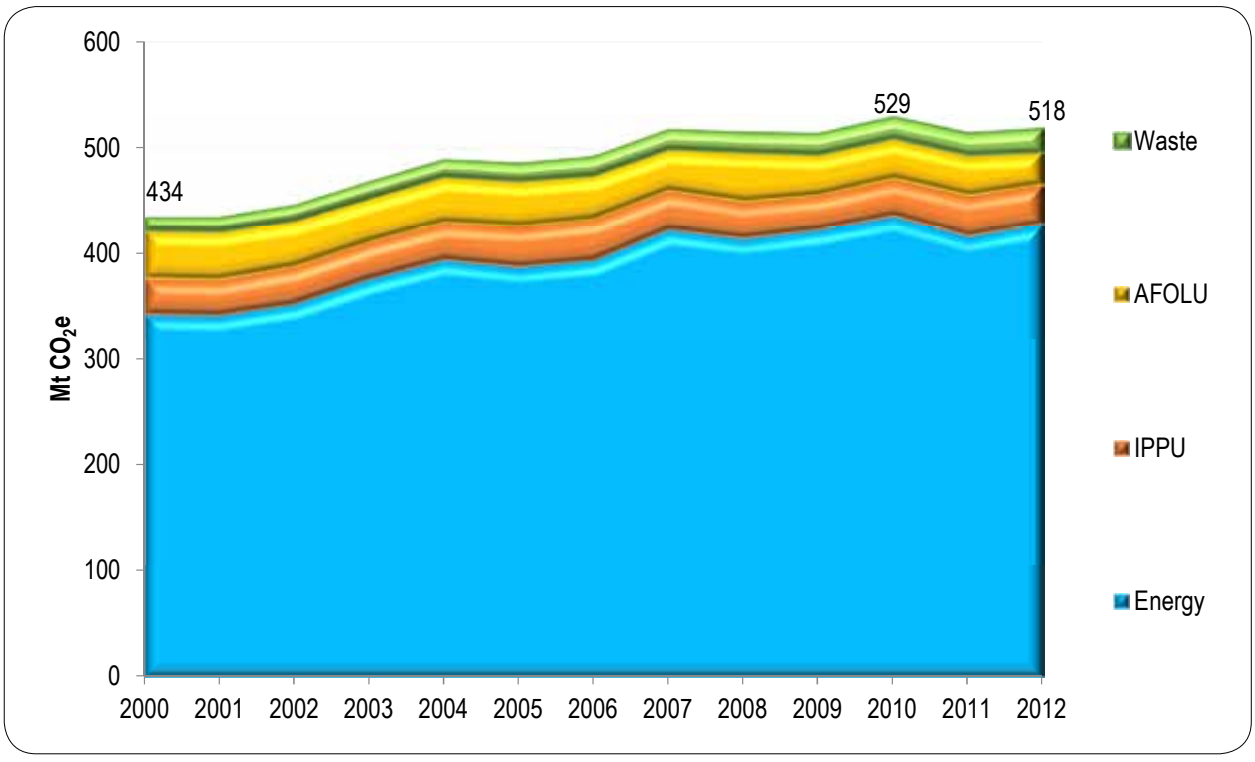


Figure 27: South Africa`s GHG inventory 2000–2012

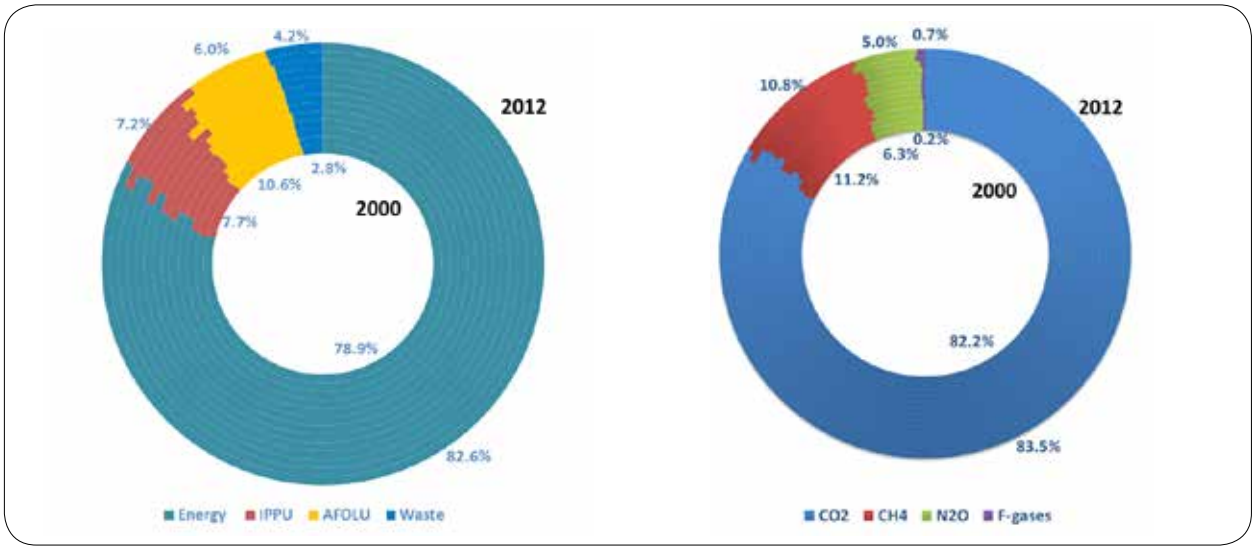


Figure 28: Trends in sector and gas contributions in the GHG inventory between 2000 and 2012

Figure 28 shows the percentages of GHG contributions for different sectors and the overall percentage contributions of different GHGs to the inventory.

Figure 29 below shows the GHG inventory trajectory compared to the PPD trajectory and the mitigation NDC target of the country.

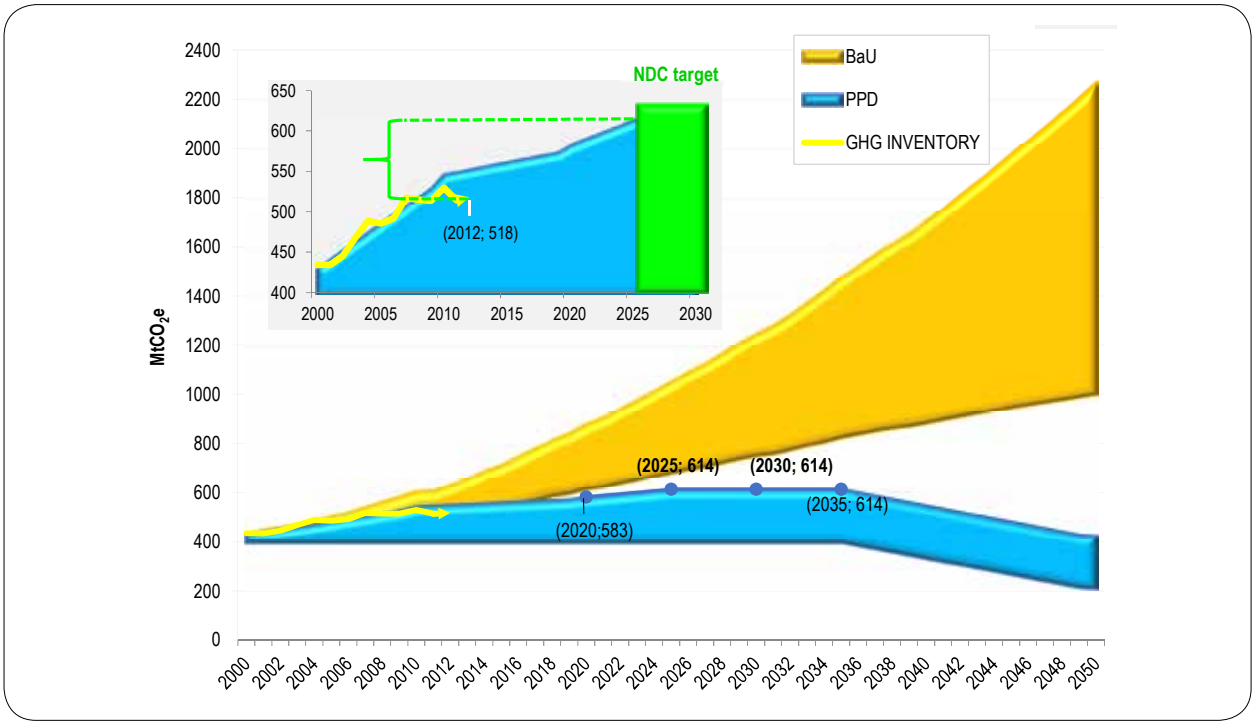


Figure 29: Comparing South Africa's GHG inventory with PPD and NDC targets

By 2012 an implied carbon budget of 96 $MtCO_2e$ between the GHG inventory levels and the upper limit of the PPD and NDC targets can be observed from the figure. This means that between 2012 and 2025 the country's emissions should not grow faster than 7.4 $MtCO_2e$ per year on average if the PPD and NDC targets for 2025 are to be achieved. With an estimated 2016 economic growth of 0.4% year-on-year and a projected 2017 economic growth of no more than 1.5% year-on-year, an average emissions growth rate of 7.4 $MtCO_2e$ per year does not seem likely (Quantec, 2017).

It is worth noting, however, that programmes currently underway will significantly affect national GHG emissions in the near future, regardless of the economic growth rate. The most prominent are the Kusile and Medupi coal-fired power plants, each with a gross generating capacity of 4,800 MW. The two power plants combined will contribute between 55 and 60 $MtCO_2e$ per annum to the national GHG inventory.

Significant GHG mitigation has been undertaken within the economy between 2000 and 2012, with at least 106 $MtCO_2e$ mitigated in 2012 alone. This is shown in **Figure 30** below. If the same rate of increase of mitigation is maintained to 2025 the GHG emissions impacts of Kusile and Medupi are likely to be absorbed without exceeding the 7.4 $MtCO_2e$ per year average increase.

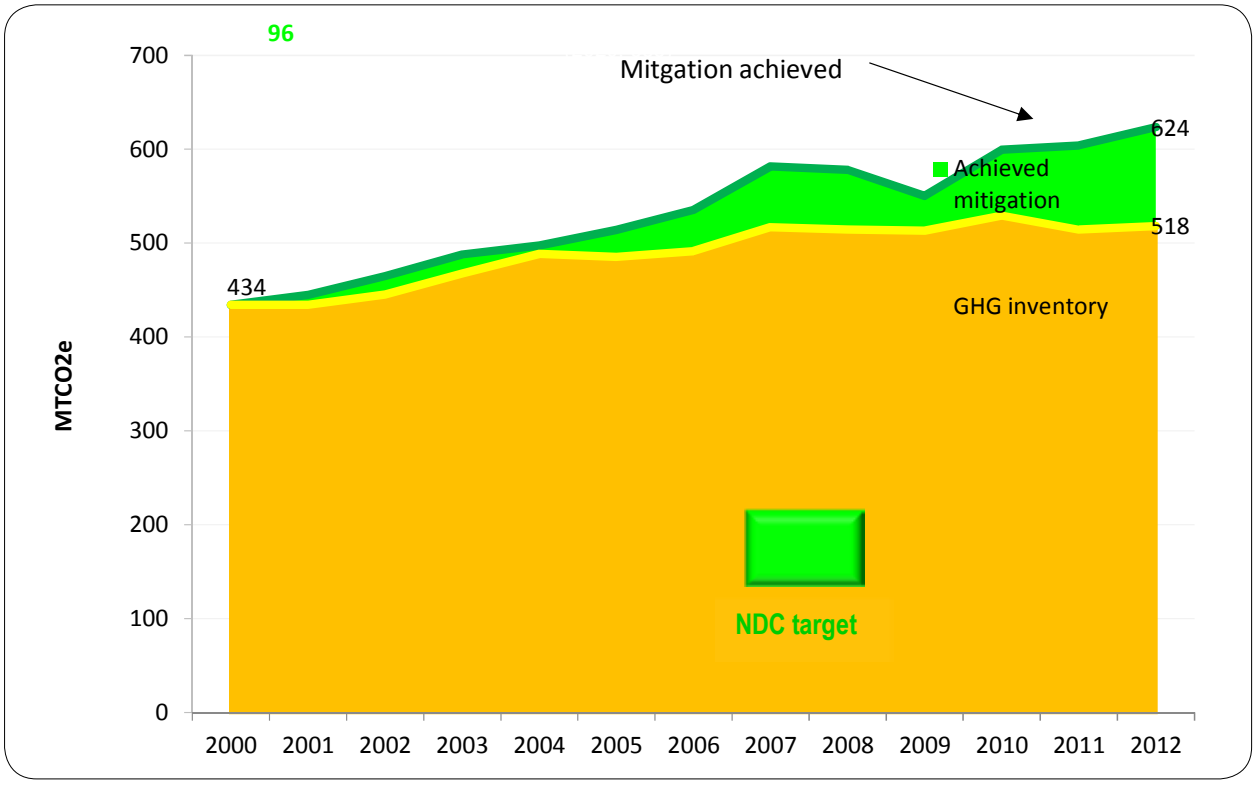


Figure 30: Overall GHG mitigation achieved within the economy between 2000 and 2012

6.4. PROGRESS AND TRENDS – DECOUPLING INDICATORS

This section presents and discusses the overall progress made in decoupling economic and population growth from climate degradation and carbon-intensive non-renewable energy.

Lower carbon consumption

The level of per capita GHG emissions increased from 9.94 $MtCO_2e$ in 2000 to 10.64 $MtCO_2e$ in 2007, after which it declined to levels similar to those of 2000 at 9.90 $MtCO_2e$ in 2012 (**Figure 31**). The decline is likely to be due to a combination of factors including the 2008 economic decline.

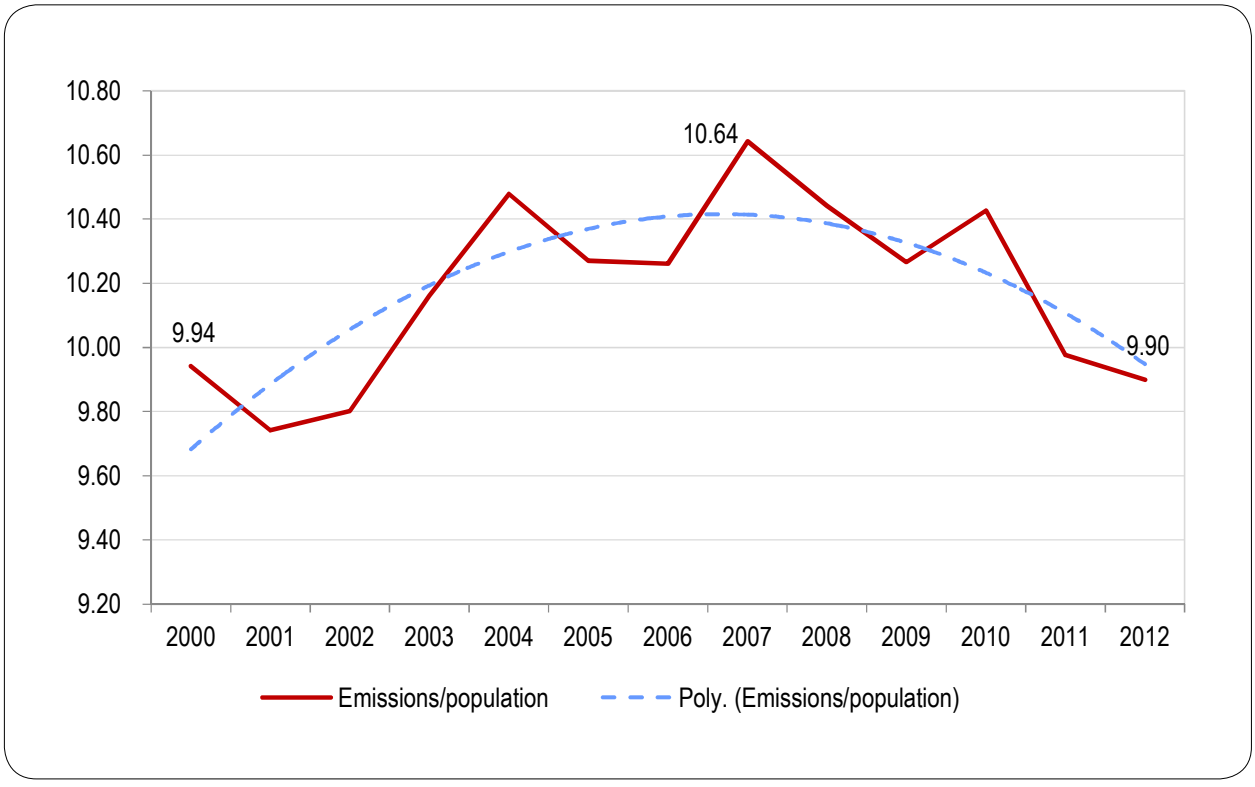


Figure 31: Per capita GHG emissions

Carbon and energy intensities of the economy

Figure 32 assesses the extent to which economic growth (GDP) has been decoupling from energy resources (total primary energy supply (TPES)) and climate degradation in the form of GHG emissions. The figure shows that the economy has been growing marginally faster than both the national GHG emissions at an average of 3.46% year-on-year compared to an average of 1.51% for the GHG emissions and 2.85% for the TPES.

This means that there has been a marginal decoupling of economic growth from both GHG emissions and energy consumption. This is likely due to a continuous decrease in the operations of energy-intensive sectors like mining and heavy industries over the past 11 years, compared to the less energy-intensive commercial sector.

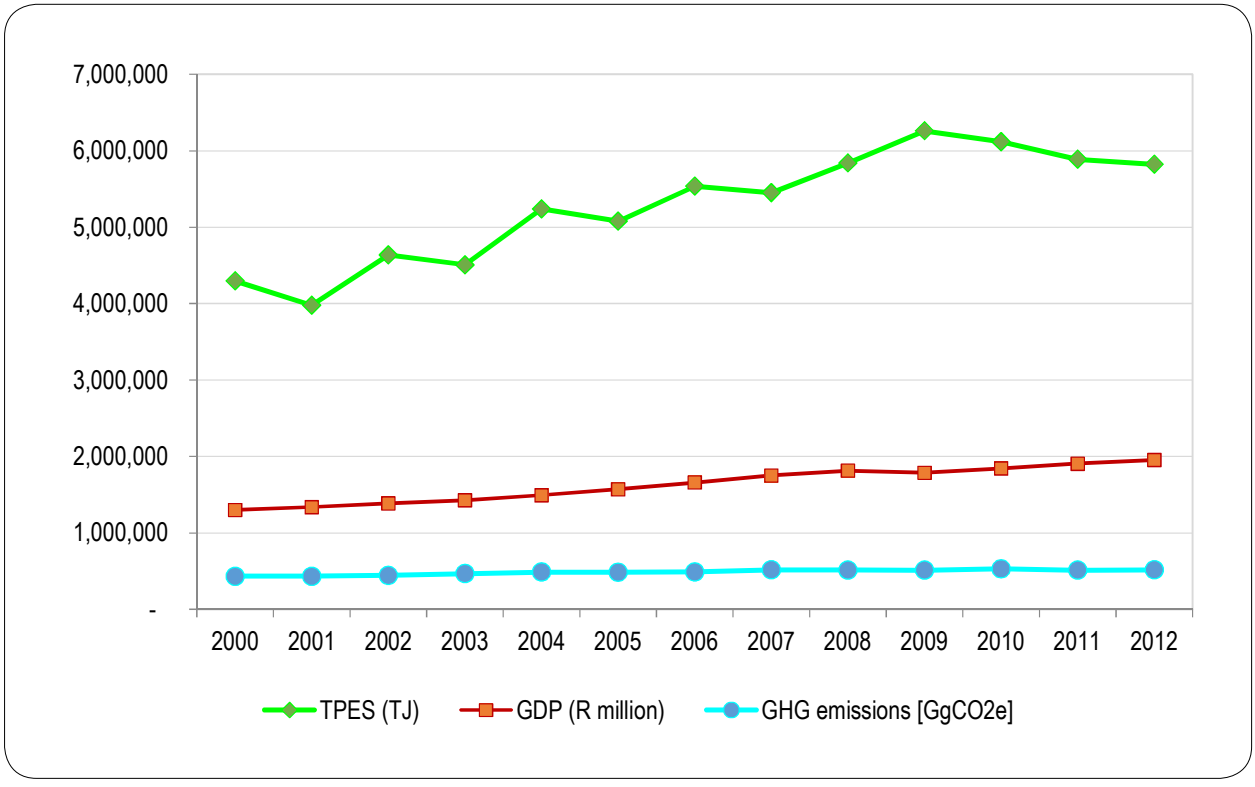


Figure 32: GHG Emissions vs. economic growth (GDP) vs. total primary energy supply (TPES)

6.5. LOWER CARBON RESOURCING

Proportion of renewables or zero-carbon energy to total primary energy

Renewable energy and nuclear energy are the two energy sources in South Africa's energy systems that do not contribute to the national GHG inventory. An increase in their contribution to the energy system results in a decrease in the carbon intensity of the national energy system. **Figure 33** presents the percentage contribution of renewables and nuclear and the absolute contribution of renewable energy, in terajoules, to the country's energy mix for the period 2000–2012.

Due the country's mitigation policies, the use of renewable energy has been increasing over the years.

The renewable energy contribution throughout this period has been primarily from hydro-power, use of indigenous biomass in households, waste and solar (DoE, 2015). The curve shows a significant increase in the absolute contribution of renewable energy from 244 800 TJ in 2001 to about 435 000 TJ in 2002 due to a doubling in the monitored consumption of biomass and waste (DoE, 2009). A further significant increase in the consumption of renewables is observed in 2010 and constantly increasing until 2012, primarily due to an increase in solar installations and bio-energy.

While the TPES of the country kept increasing between 2002 and 2009, **Figure 33** shows that the consumption of renewables virtually remained constant during that period.

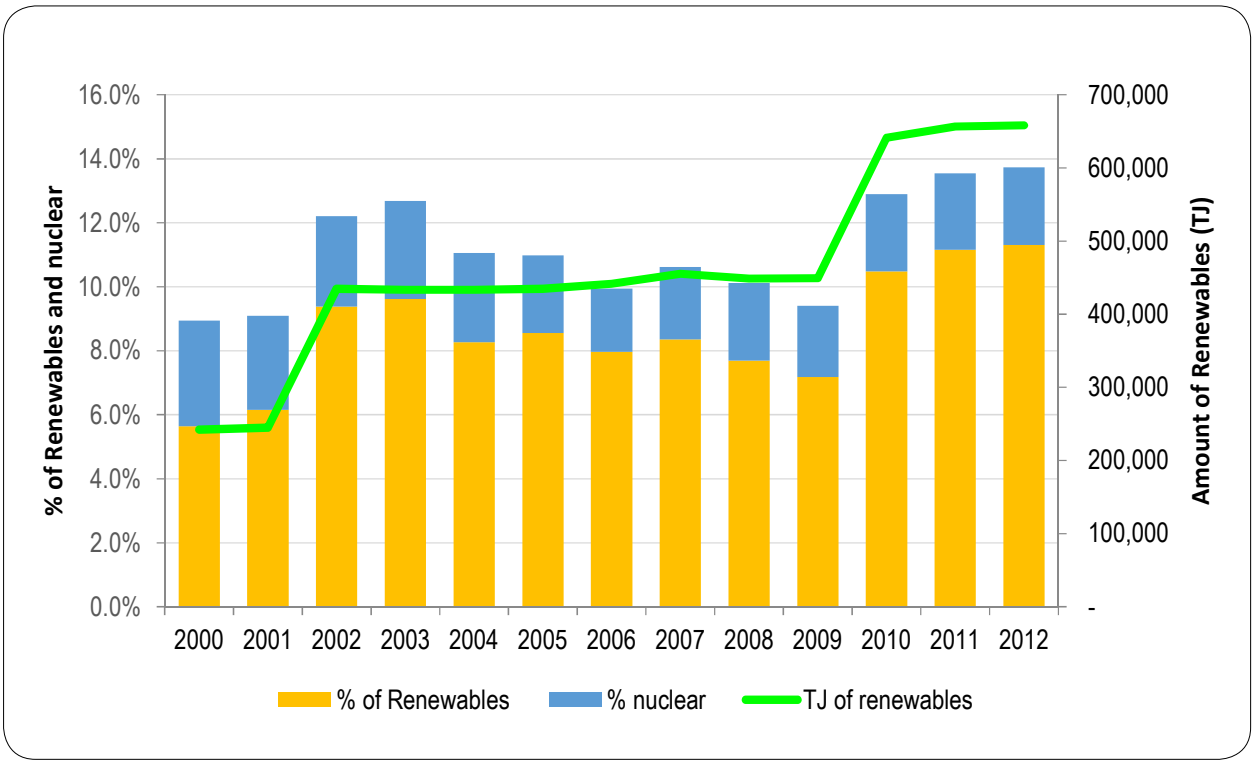


Figure 33: Lower Carbon Resourcing

There were no new installations of nuclear plants in the country between 2000 and 2012, hence no significant changes in the contribution of nuclear power to the electricity grid, apart from fluctuations resulting from downtime and availability of the existing Koeberg power plant.

Carbon intensity of the national energy system

The carbon intensity of the national energy system is closely related to the contribution of renewables and nuclear energy to the total energy supply discussed in the previous sub-section. **Figure 34** shows that the carbon intensity of the energy system has remained fairly constant over the period 2000–2012, and this can be attributed to the fact that there has not been a significant increase in carbon neutral resources like renewables or nuclear energy in the energy system.

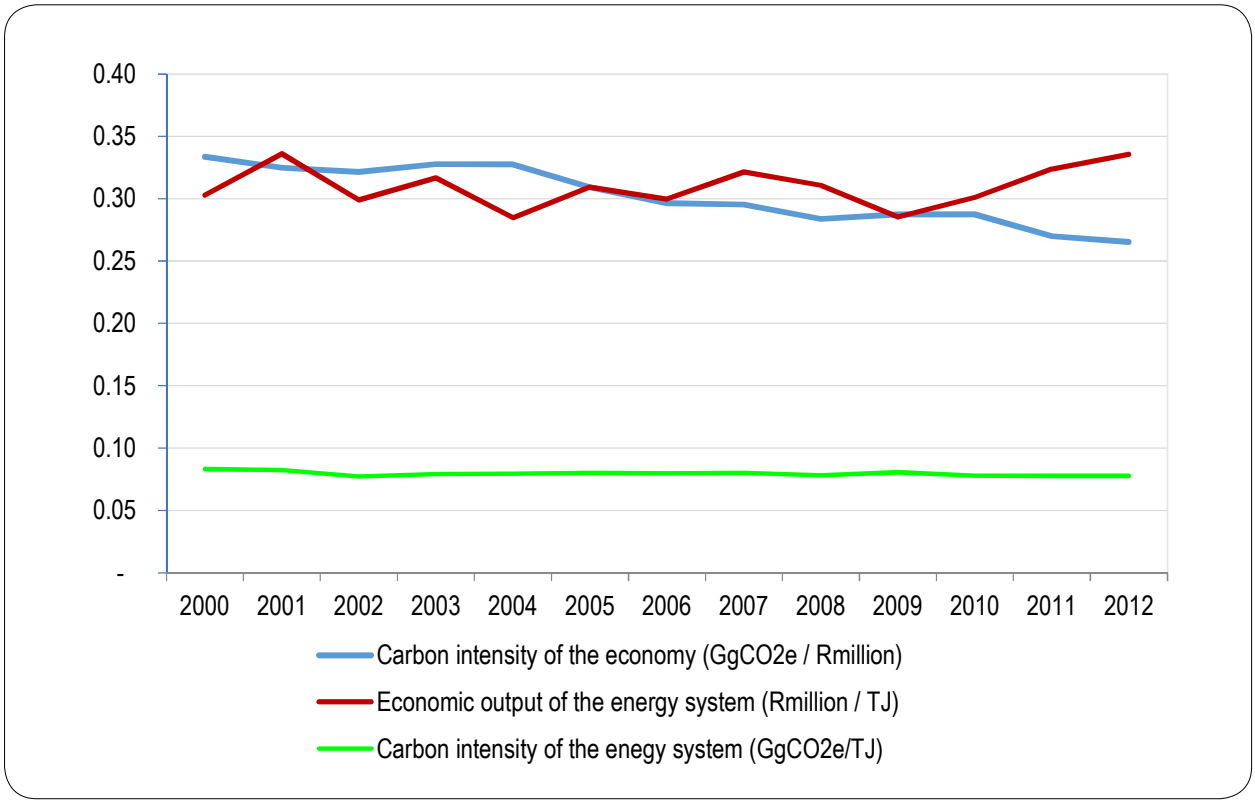


Figure 34: Summary of the key intensity indicators

6.6. SUMMARY OF KEY GOVERNMENT AND INDUSTRY MITIGATION RESPONSE MEASURES

This section looks at the individual or group mitigation response measures that have contributed to the achieved mitigation presented in **Figure 30**. The section assesses the impact of the major response measures in the country, including the Climate Change Near-term Priority Flagship Programmes discussed in more detail in **Chapter 7** of this report.

The analysis in this section focuses on the following core indicators identified in the Climate Change Response Monitoring and Evaluation System (DEA 2015, 15) and builds on the information presented in the 1st Annual Climate Change Report of 2016 (DEA 2016a, 11–21):

- **Progress indicators:** Stages, phases, steps taken to implement the response measure.
- **Impact Indicators:**
    - impact on climate change: the mitigation impact
    - impact on job-creation: number and type of jobs directly created
    - impact on other sustainable development Indicators
- **Effectiveness indicators:** Cost effectiveness and job-creation effectiveness.

While the primary focus is on tracking these indicators in the period 2000–2012, assessment up to 2014 is also undertaken where information is available. The overall results are different from those presented in the 1st Annual Climate Change report of 2016 due to two major factors:

- **Updates:** The 2012 National Energy Efficiency Target Monitoring System (EETMS) report was used to assess the national energy efficiency mitigation results in the current report while the 1st Annual Climate Change Report (DEA, 2016a) used the 2011 EETMS report. The 2012 EETMS report presents different and updated values from the 2011 EETMS report. The assessment of the biofuels programme has also been updated as actual information from biofuels producers became available.
- **Scope:** There are new and additional response measures that have been included and assessed in the current report which were not part of the 1st Annual Climate Change Report. Specifically, the following response measures have been included for the first time:

i. Department of Environmental Affairs green building, included under the Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme

ii. Energy efficiency tax incentive, Section 12 L of the Income Tax Act, 1962 (Act No. 58 of 1962), included in the Energy Efficiency and Energy Demand Management Flagship Programme

iii. Tongaat-Hulett co-generation programme

iv. The Public Transport Strategy (DoT 2007) (BRT systems, Gautrain, luxury commuter rail and taxi recapitalisation programme) included under the Transport Flagship Programme

v. The National Waste Management Strategy (DEA 2011b) biogas projects, composting projects, landfill gas programmes and material recovery facilities) included in the Waste Management Flagship Programme

The Climate Change Flagship Programmes mentioned above are described in more detail in **Chapter 7** of this report.

6.6.1. Mitigation Impact Achieved

Table 6 and **Figure 35** together present a summary of the key mitigation assessment for individual or groups of response measures undertaken in the country between 2000 and 2012 or 2014.

From 2000 to 2012 about of 561.2 $MtCO_2e$ emissions were mitigated by key government and industry programmes in the country. The achieved GHG reductions have generally been growing over time as more programmes that mitigate climate change are implemented. In 2011, 2012, 2013 and 2014 the annual emission reductions from these mitigation programmes were estimated at 90.0 $MtCO_2e$/yr, 105.5 $MtCO_2e$/yr, 107.0 $MtCO_2e$/yr and 111.0 $MtCO_2e$/yr respectively, bringing the total cumulative emission reductions achieved since 2000 to 779.4 $MtCO_2e$ by 2014.

Table 6: Cumulative mitigation achieved by major response measures since 2000

Sector / Thematic Area		Response measures	Climate Change Flagship Programmes	Cumulative mitigation, in $MtCO_2e$, from 2000	
				to 2012	to 2014
Energy	Energy Efficiency	Industrial Policy Action Plan (IPAP) – National Cleaner Production Centre (NCPC)	Energy Efficiency and Energy Demand Management Flagship Programme	0.4	1.3
		Eskom – Integrated Demand Management (IDM) Programme	Energy Efficiency and Energy Demand Management Flagship Programme	38.6	62.6
		Section12L – Income Tax Act	Energy Efficiency and Energy Demand Management Flagship Programme	0.0	5.7
		SASOL energy efficiency projects	No	3.3	5.9
		Municipal energy efficiency (EE) programme	Energy Efficiency and Energy Demand Management Flagship Programme	0.2	0.5
		DEA Green building	Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme	N/A	0.00005
		Energy Efficiency Target Monitoring System (EETMS) – EE Achieved nationally	Energy Efficiency and Energy Demand Management Flagship Programme	428.1	577.3

Sector / Thematic Area		Response measures	Climate Change Flagship Programmes	Cumulative mitigation, in $MtCO_2e$, from 2000	
				to 2012	to 2014
Transport	Electricity generation	Rea Vaya bus rapid transport (BRT) system	Transport Flagship Programme	0.03	0.03
		MyCity BRT system	Transport Flagship Programme	0.05	0.1
		Gautrain high-speed rail	Transport Flagship Programme	0	0
		Luxury commuter rail	Transport Flagship Programme	0	0
		Taxi Recapitalisation	Transport Flagship Programme	0.7	1.2
	Green vehicles	DEA Green vehicles	Transport Flagship Programme	0.0000004	0.000003
	Other Transport programmes	Compressed natural gas (CNG) vehicle fuel switch	Transport Flagship Programme		0.003
		Transnet Road-to-rail	Transport Flagship Programme	0.4	1.7
		Biofuels (biodiesel and bioethanol)	Transport Flagship Programme	0.0002	0.0003
AFOLU	Expanded Public Works Programmes	Working for Ecosystems, Land & Energy	The Climate Change Response Public Works Flagship Programme	Not estimated	0.04
Waste	Waste Management Strategy	Biogas projects	Waste Management Flagship Programme	0.4	0.5
		Composting projects	Waste Management Flagship Programme	0.5	0.9
		Landfill gas projects	Waste Management Flagship Programme	2.1	3.4
		Material recovery facilities	Waste Management Flagship Programme	0.02	0.04
		SASOL coal-to-gas switch	No	66.2	80.9

Sector / Thematic Area		Response measures	Climate Change Flagship Programmes	Cumulative mitigation, in $MtCO_2e$, from 2000	
				to 2012	to 2014
Cross-cutters	Industrial feed & fuel switch	CNG industry fuel switch	No	N/A	0.008
	CDM	Clean Development Mechanism (CDM) (excl. EE)	No	16.5	26.2
	Green Fund	Green Fund	No	N/A	0.02
TOTAL				561.2	779.4

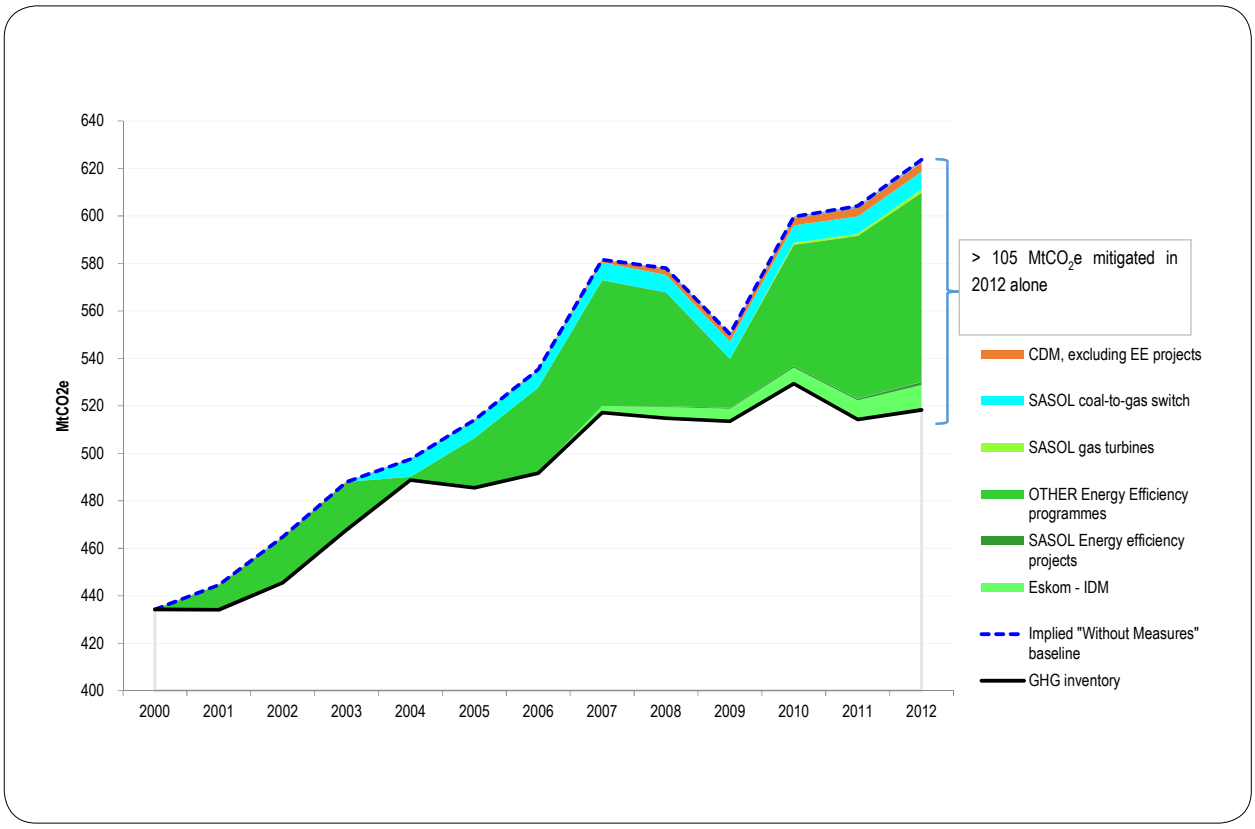


Figure 35: Annual mitigation achieved by major mitigation measures in the country

Energy efficiency has been the largest contributor responsible for between 82% and 85% of reductions per year between 2010 and 2014 (see **Figure 36** and **Figure 37**). The second highest contributor has been the cross-cutting measures at about 12% average contribution per annum. In terms of individual contributions to mitigation, the Sasol coal-to-gas switch has achieved the highest mitigation at a cumulative total of 80.9 $MtCO_2e$ by 2014, followed by the Eskom Integrated Demand Management (IDM) Programme at 62.6 $MtCO_2e$, then the Clean Development Mechanism (CDM) programme at 26.2 $MtCO_2e$. The Gautrain and luxury commuter rail are the lowest achievers both resulting in no mitigation at all.

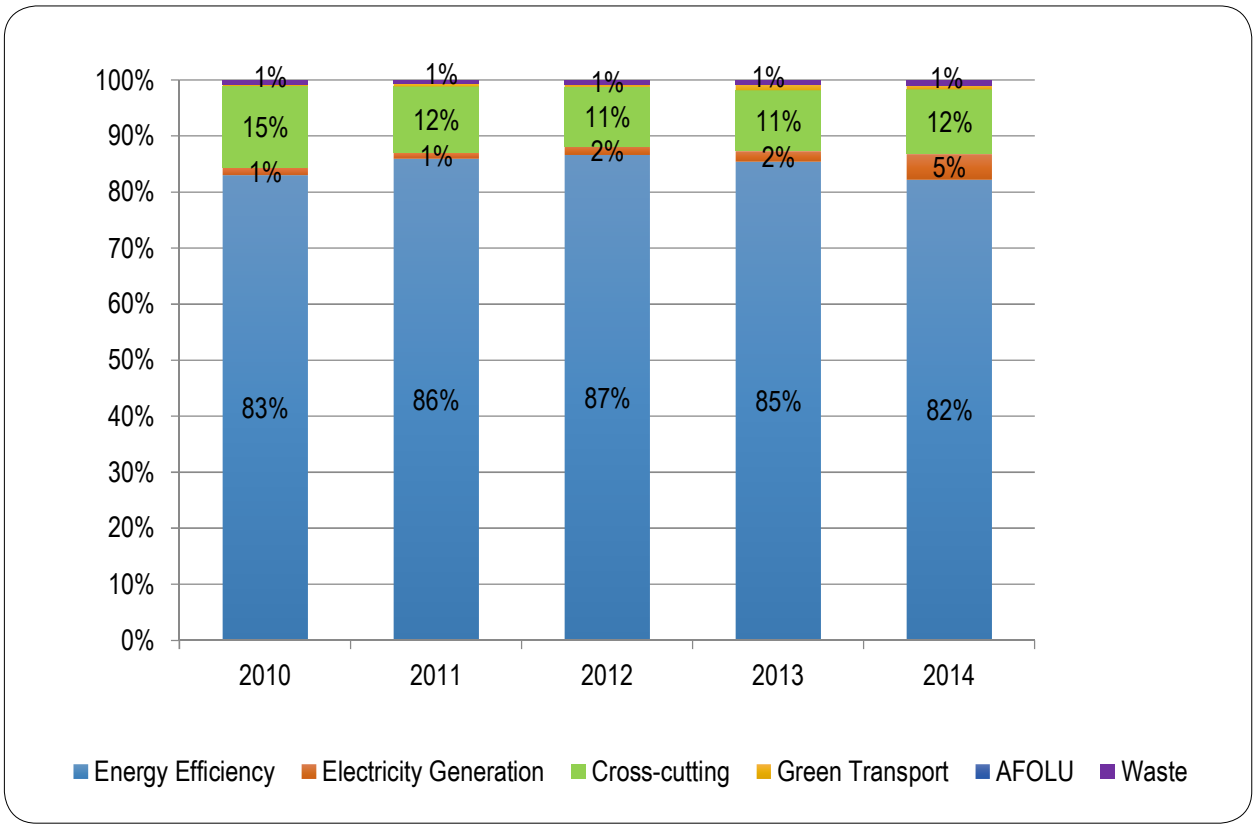


Figure 36: The achieved mitigation disaggregated by type of mitigation measure between 2010 and 2014

6.7. IMPACT ON SUSTAINABLE DEVELOPMENT INDICATORS

This section presents the sustainable development (SD) benefits achieved through the implementation of the mitigation response measures presented in the previous section. The values presented are cumulative from 2000 to 2014. As in the previous annual report, data to estimate the SD indicators for most response measures was not available. This section presents a summary of the assessments that were possible. The following notations are used in the sections below:

- N/E = not estimated
- N/A = not applicable

In total, it is estimated that the following sustainable development benefits have been achieved:

Socio-economic	**Jobs**	**Electricity saved (GWh)**	**Local investment value (R million)**	**SMME projects**
	>94 660	>67 837	>212 874	>181

Environ-mental	**Avoided SO_2 (t)**	**Avoided NOx (t)**	**Avoided partic-ulate matter (t)**	**Avoided Ash (kt)**	**Avoided CO_2 (t)**	**Avoided VOC (t)**	**Avoided NH_3 (t)**	**Waste diverted from landfill (t)**
	>819 417	>486 303	>31 782	>15 113	>196 434	>12	>43	>580 666

Resource minimisa-tion	**Water saved (Ml)**	**Coal saved (kt)**	**Oil saved (t)**	**Virgin material saved (t)**
	>136 502	>51 735	>2 645	>81 564

Response measure		Socio-economic			Environmental			Resource		
		No of Jobs	Electricity saved (GWh)	Local investment value (R million)	Avoided SO_2 (t)	Avoided NOx (t)	Avoided particulate matter (t)	Avoided Ash (kt)	Water saved (Ml)	Coal saved (kt)
NCPC industry energy efficiency	Energy Efficiency and Energy Demand Management Flagship Programme	N/E	1 342	N/E	11 304	5 901	448	208	1 878	711
Eskom IDM	Energy Efficiency and Energy Demand Management Flagship Programme	N/E	6 586	6 664	527 340	275 263	20 876	9 701	87 621	33 171
Section 12L - Income Tax Act	Energy Efficiency and Energy Demand Management Flagship Programme	N/E	3 079	N/E	48 267	25 195	1 911	888	8 020	3 036
REIPPPP	Renewable Energy Flagship Programme	19 050		192 600	27 550	14 381	1 091	507	4 578	1 733
ESKOM OCGTs	Energy Efficiency and Energy Demand Management Flagship Programme				63 888	31 977	1 876	1 213	10 958	4 149
SASOL gas turbines	N/A				135 409	69 878	5 361	2 491	22 499	8 517
Tongaat Hulett co-generation	N/A				1 491	778	59	27	248	94

6.9. TRANSPORT SECTOR RESPONSE MEASURES

Response measure	Socio-economic	Environmental		
	No of Jobs	Avoided CO (t)	Avoided VOC (t)	Avoided NH_3 (t)
Rea Vaya BRT system	15 698	168.11	1.84	18.38
Mycity BRT system	N/E	263.96	10.04	24.74
Gautrain	35 743	0	0	0
Taxi recapitalisation	N/E	196 002	N/A	N/A

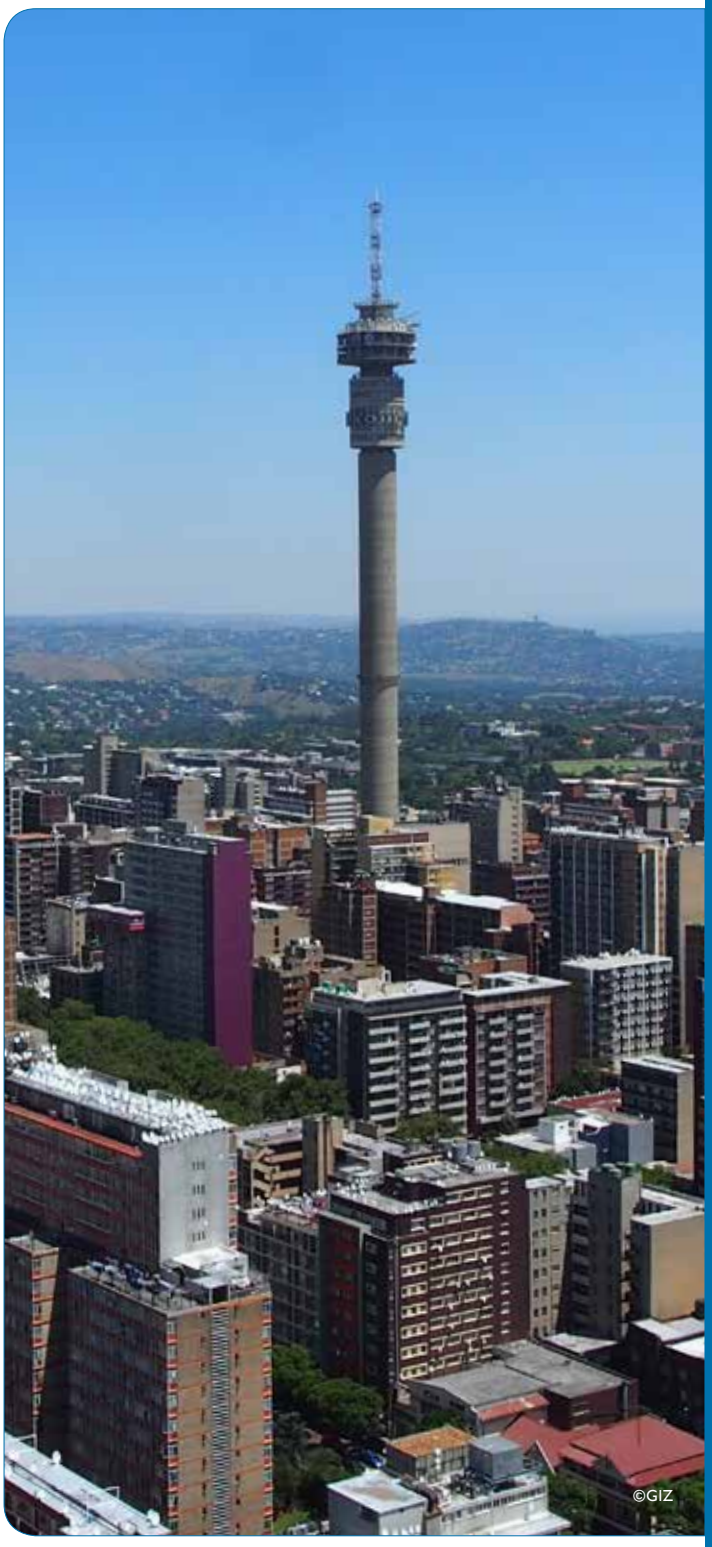
6.10. WASTE SECTOR RESPONSE MEASURES

Response measure	Socio-economic			Environmental	Resource
	No of Jobs	Electricity generated (GWh)	SMME projects initiated	Waste diverted from landfill (t)	Coal Saved (kt)
Biogas projects	409	46	N/E	4 380	7
Composting projects	N/E	N/A	N/E	506 668	N/A
Landfill gas projects	48	285	N/E	N/A	41
Material recovery facilities	337	N/A	3	35 403	N/E

6.11 PRIVATE SECTOR'S TRANSITION TO A LOWER CARBON ECONOMY

The rising costs of climate impacts and the cost effectiveness of adapting to climate change make a compelling case for business to take early action to seize opportunities and adapt. In South Africa the private sector through the Carbon Disclosure Project (CDP), has been a forerunner in responding to climate change for credibility, reducing risks and saving costs with a co-benefit of reducing emissions. This section will therefore focus on the following:

- The private sector Carbon Disclosure Project as a response measure;
- Its history and rationale;
- Annual GHG profiles of CDP projects;
- Collective response measures and
- Monetary savings due to CDPs.



6.12 THE BUSINESS OF CLIMATE CHANGE

The transition to a low-carbon economy is underway, urged on by the 2015 Paris Agreement and the adoption by the UN of the Sustainable Development Goals (SDGs). Climate change will impact every area of commercial and industrial business. In the new climate reality businesses that can innovate and take advantage of lower carbon transition will be the ones that secure a sustainable future. This reality makes climate change and sustainability two sides of the same coin. Proactive businesses have begun taking advantage of opportunities brought by climate change – they are using renewable energy, deploying innovative low-carbon technologies, sustainably sourcing resources, working on innovative and transformative solutions and more. The business community of South Africa is not immune to climate change and they have been influential in responding to climate change spurred by existing local and global policies. The Carbon Disclosure Project (CDP, https://www.cdp.net/en) is one of the drivers for businesses to transition to a lower carbon economy.

6.13 THE PRIVATE SECTOR CARBON DISCLOSURE PROJECT AS A RESPONSE MEASURE

The CDP is a not-for-profit that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts. In South Africa, the National Business Initiative (NBI, http://www.nbi.org.za/) has been a local partner to the CDP since 2007. From its inception, the CDP has managed to mainstream climate change into business thinking. Consequently, the CDP remains the global standard for measurement and reporting of climate change information and the biggest repository of greenhouse gas emission information from the business sector.

The CDP requests information on climate change risks, opportunities and integration from the Johannesburg Stock Exchange (JSE) 100 companies on behalf of 827 institutional investors representing more than $100 trillion in assets (CDP 2016). The CDP helps companies to manage their carbon emissions and protect themselves from climate risks. It also helps investors to understand the climate change risks associated with their portfolios. The CDP in South Africa continues to help companies integrate climate change into their overall strategy and governance structures. Recently there has been a progressive shift towards focusing on companies' performance in terms of their climate change actions over and above their transparency around these issues.

Even if a company does not receive an information request from CDP on behalf of investors it can still contact CDP to better understand climate change risks and opportunities.

Rationale for CDP companies

For the initial tracking of company level information CDP information is used. The CDP data is somewhat easier to obtain compared to approaching individual companies and, furthermore, the data is credible. The CDP requests information on climate change risks, opportunities and integration from JSE 100 companies. It encourages companies to identify their direct and indirect climate change risks and opportunities and to integrate this into their risk management process. This enables mitigation and adaptation to climate change impacts. In addition, information from individual companies may be used to get more detail. For the purposes of this report, assessment of Scope 1 (direct) emissions focused on 45 companies that report on emissions in South Africa but did not look into their international emissions. Collective response measures and savings information was obtained from the NBI annual report.

Annual GHG profiles

In terms of GHG profile or emission trends for the 45 companies, given a robust increase in market capitalisation and reasonable GDP growth, a total sample reduction of 6.6% from 2009–2015 is significant. From 2008–2015 South African companies were exposed to many external factors that could potentially influence their GHG emissions. Eskom's load shedding disrupted business in 2008 and the global financial crisis impacted the economy from late 2008 to 2009.

A like-for-like comparison of 45 companies reporting their GHG emissions since 2009 reveals that gross scope 1 direct emissions and scope 2 indirect emissions from electricity purchases have declined by 11.5% from 221.8 million tCO_2e in 2009 to 196.3 million tCO_2e in 2015 (CDP 2015).

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Collective mitigation impact of responses by companies setting targets illustrates a commitment by businesses to respond to climate change. There has been a significant increase in companies setting targets and implementing a range of response measures to reduce emissions. Energy efficiency continues to provide the largest emission reductions, followed by renewable energy. Total CO_2e emission savings equal 16.8 million tonnes for the period 2012–2015.

Collective monetary savings due to mitigation impact of responses in companies

The results from **Figure 37** show that responding to climate change makes good business sense due to cost saving opportunities. Energy efficiency provides the largest cost savings and emission reductions for the least investment.

Figure 37: Collective monetary savings due to response measures

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ABBREVIATIONS

AFOLU	Agriculture Forestry and Land Use
BAU	Business as Usual
BRT	bus rapid transport
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CH_4	Methane
CNG	Compressed Natural Gas
CO	carbon monoxide
CO_2	Carbon Dioxide
DEA	Department of Environmental Affairs
DEROs	Desired Emissions Reductions Outcomes
DoE	Department of Energy
EE	energy efficiency
EETMS	Energy Efficiency Target Monitoring System
F-gases	Fluorinated Gases
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWC	Growth Without Constraints
GWH	Giga Watt Hour
HFCs	Hydro Fluoro Carbons
IDM	integrated demand management
IPAP	Industrial Policy Action Plan
IPPU	Industrial Processes and Product Use
JSE	Johannesburg Stock Exchange
LTMS	Long-term Mitigation Scenario
M&E	Monitoring and Evaluation

M-NDC	Mitigation Nationally Determined Contribution
MPA	Mitigation Potential Analysis
$MtCO_2e$	Metric Tonnes of Carbon Dioxide Equivalent
MW	Mega Watts
NBI	National Business Initiative
NCCRP	National Climate Change Response Policy
NCCRWP	National Climate Change Response White Paper
NDC	Nationally Determined Contribution
NDP	National Development Plan
NCPC	National Cleaner Production Centre South Africa
NGOs	Non-Governmental Organizations
NH_3	ammonia
NO_X	Nitrogen Oxide
NPC	National Planning Commission
N_2O	Nitrous Oxide
OCGT	open cycle gas turbine
PFC	Perfluorocarbons
PPD	Peak Plateau and Decline
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
RSA	Republic of South Africa
SD	sustainable development
SDGs	Sustainable Development Goals
SO_2	Sulfur Dioxide
TJ	terajoule
TPES	total primary energy supply
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VOC	volatile organic compound
WoM	Without Measures
WoM	Without Measures

CHAPTER 7

NATIONAL CLIMATE CHANGE FLAGSHIPS PROGRAMMES

CHAPTER 7: NATIONAL CLIMATE CHANGE FLAGSHIPS PROGRAMMES

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7.1. OVERVIEW

The Climate Change Flagship Programmes are strategic measures implemented by the South African Government intended to serve as a rallying point to trigger a large-scale transition to a lower carbon economy and a more climate resilient South Africa. They are government led programmes and they provide the certainty needed to stimulate the investment required for these transitions. The programmes place government at the forefront of increasing the use, visibility and recognition of climate change response technologies and services, facilitating their rapid diffusion.

The strategic approach for the implementation of South Africa's National Climate Change Response Policy (NCCRP) rests on six pillars (**Figure 38**). The NCCRP distinctly identifies eight Flagship Programmes as the champions of its 'dynamic and evidence-based' approach. The programmes respond to the action-focused aspect of the NCCRP and constitute the major climate change action response by government.

There are currently ten Climate Change Flagship Programmes, building on the initial set of eight programmes, described in Section 8 of the NCCRP they are:

1. The Climate Change Response Public Works Flagship Programme
2. The Water Conservation and Demand Management Flagship Programme

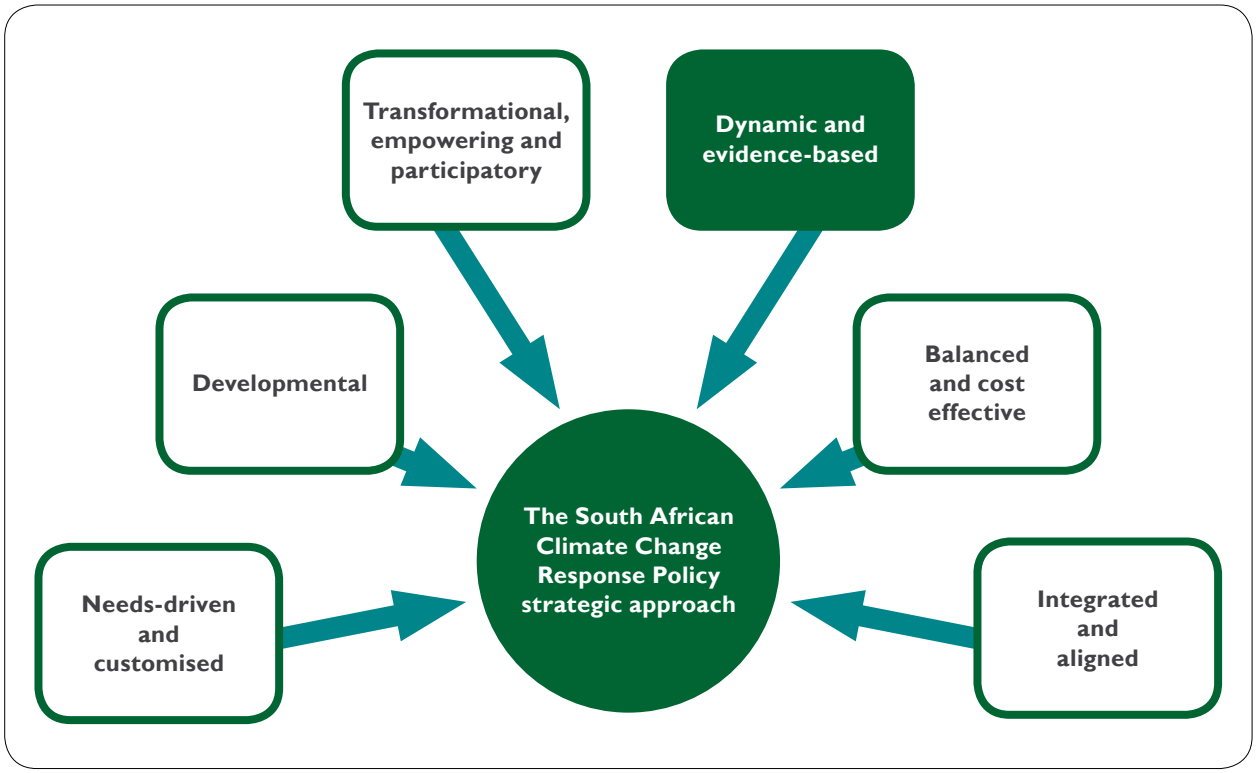

Figure 38: The six pillars of the NCCRWP strategic approach, highlighting that the Flagship Programmes are the champion of the 'dynamic and evidence-based' approach pillar.

3. The Renewable Energy Flagship Programme
4. The Energy Efficiency and Energy Demand Management Flagship Programme
5. The Transport Flagship Programme (renamed Low Carbon, Climate Resilient Transport Systems Flagship Programme)
6. The Waste Management Flagship Programme
7. The Carbon Capture and Storage Flagship Programme
8. The Adaptation Research Flagship Programme
9. The Agriculture, Food Systems and Food Security Flagship Programme
10. The Low Carbon, Climate Resilient Built Environment, Communities and Settlements Flagship Programme

The 1st Climate Change Annual Report (CCAR-1) (DEA 2016) profiles and explains these Near-term Priority Flagship Programmes in detail, and articulates their value and benefits to South Africa's climate change response. It further explains that government has been continually working to identify new Flagship Programmes, as well as refining the existing activities and funding streams. This 2nd Climate Change Annual Report (CCAR-2) aims to provide an update on the progress of development and implementation of the Climate Change Flagship Programmes, and planned steps forward.

As indicated in CCAR-1, the priority areas for the scaled-up implementation of Near-term Priority Flagship Programmes include an expanded list of adaptation and mitigation focused measures. These have a greater emphasis on cross-cutting measures which leverage both the mitigation and adaptation benefits arising from implementing a set of actions and further adopt a systems approach, incorporating multiple focus areas for greater impact, to facilitate coordination and implementation of actions by provincial and local government.

Figure 39 shows the updated list of South Africa's Climate Change Flagship Programmes and investment priority areas. The blocks in bold indicate new Flagship Programmes included in the 2016 priority work packages.

In partnership with the relevant lead departments and implementers, the Department of Environmental Affairs (DEA) is currently working on the development and implementation of the two new Flagship Programmes and the expansion of several existing Climate Change Flagship Programmes.

Figure 39: South Africa's Climate Change Priority Investment Areas and Corresponding Expanded Climate Change Flagship Programmes (2016)

7.2 THE FLAGSHIP PROGRAMMES JOURNEY

The Climate Change Flagship Programmes tell the story of how South Africa's climate change response continues to mature and deepen over time: from the first tentative steps in responding to climate change, to what is now a progressively bold and ambitious national climate change response. South Africa's implementation capability has grown tremendously, characterised by more effective systems and processes, and a more capable workforce that is better able to achieve strong, well-coordinated progress in responding to climate change.

Over the past five years, extensive work has been done to translate the NCCRP into practical action. In the first phase of the implementation of the Near-term Priority Flagship Programmes, efforts focused on defining the scope and boundaries of individual Flagship Programmes at operational level, and on consolidating existing climate action already being implemented. The initial set of Flagship Programmes, as at December 2015, had thirty-nine distinct components. Each of these Programmes was disaggregated into sub-programmes and distinct projects that were typically implemented at provincial and municipal levels. **Figure 40** gives an overview of the initial set of eight Near-Term Priority Flagship Programmes, and the associated sub-programmes and projects.

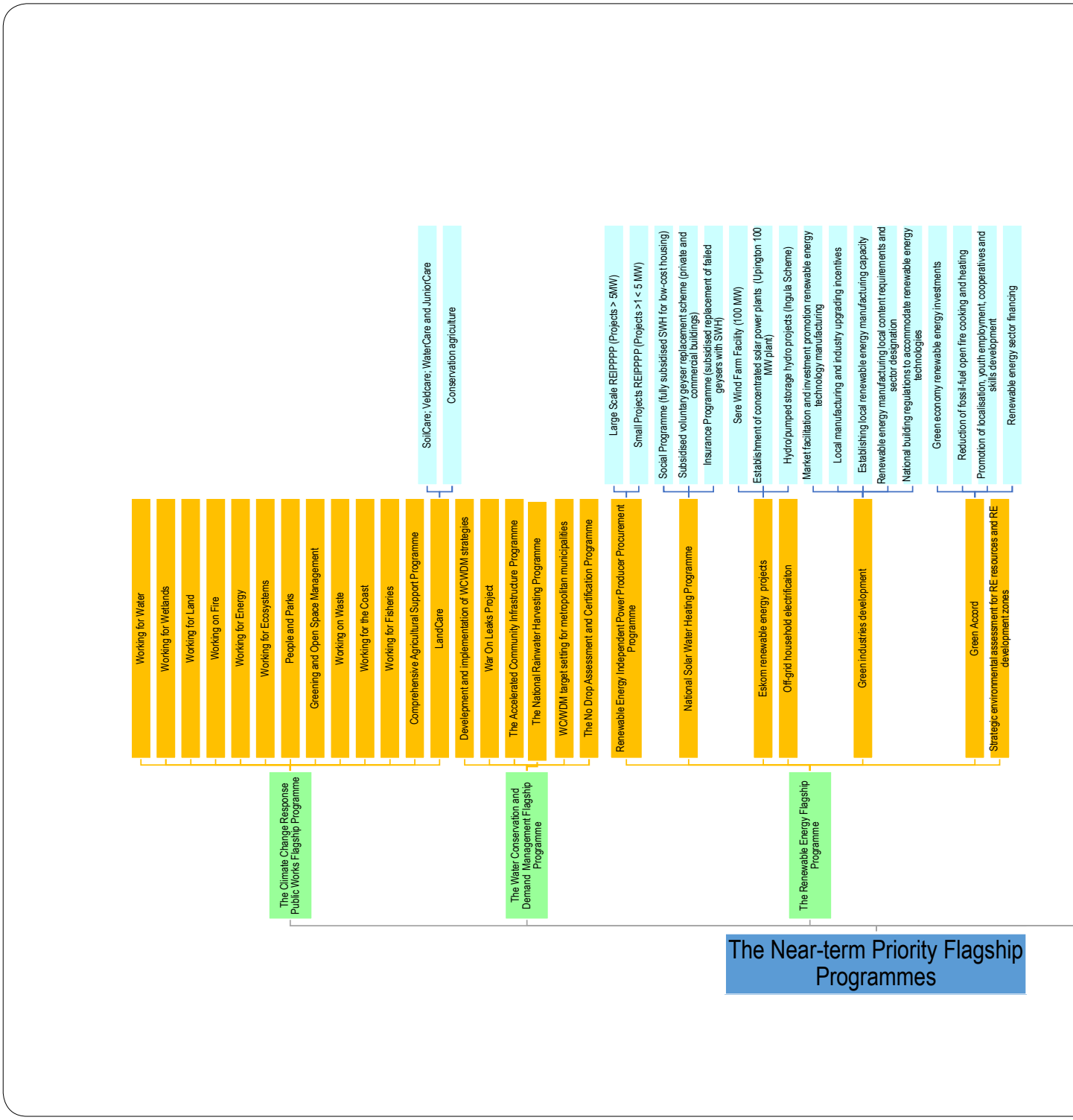

Figure 40: Overview of the initial set of Near-term Priority Flagship Programmes (2011)

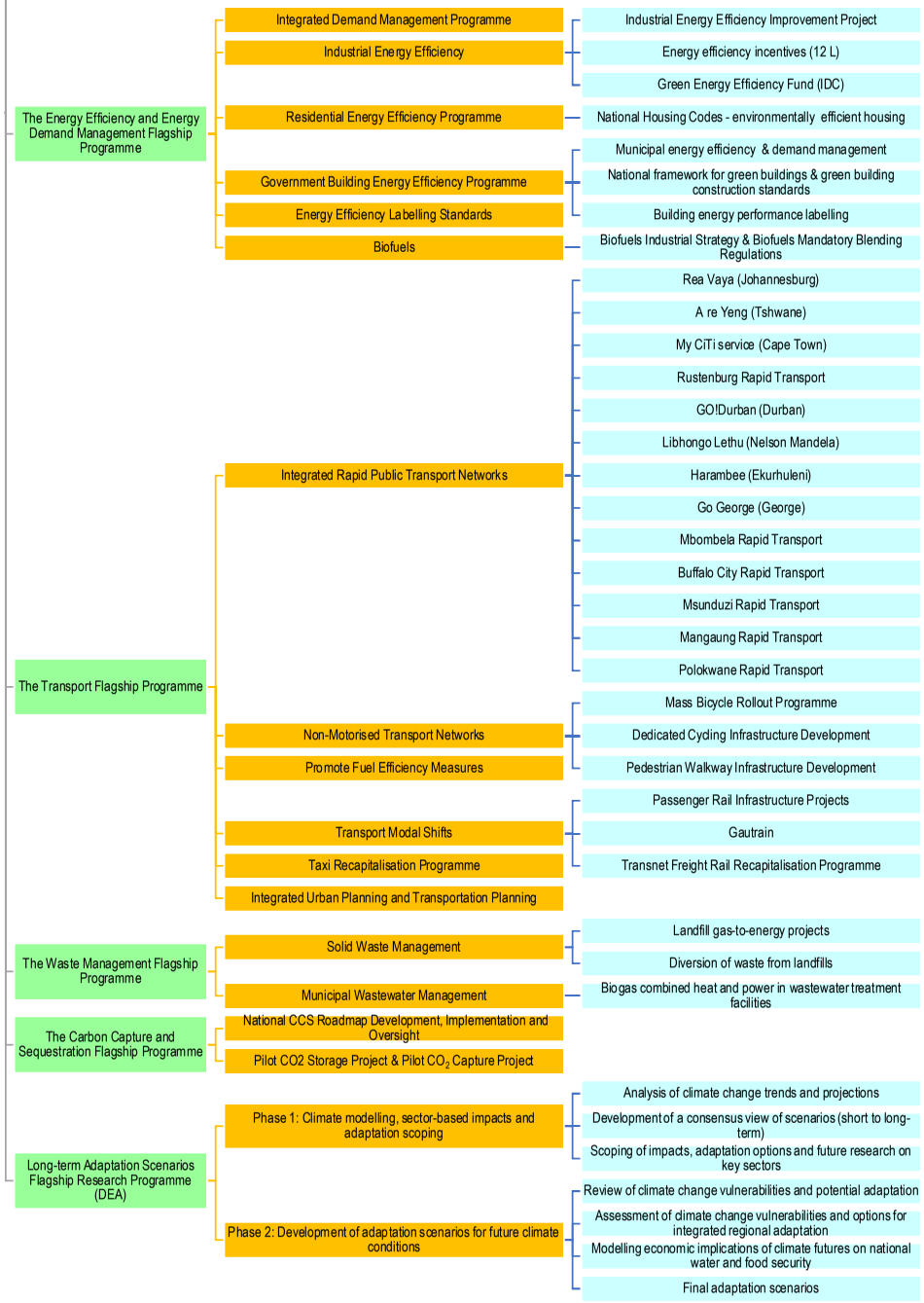
The Energy Efficiency and Energy Demand Management Flagship Programme
Integrated Demand Management Programme
Industrial Energy Efficiency Improvement Project
Industrial Energy Efficiency
Energy efficiency incentives (12 L)
Green Energy Efficiency Fund (IDC)
Residential Energy Efficiency Programme
National Housing Codes - environmentally efficient housing
Government Building Energy Efficiency Programme
Municipal energy efficiency & demand management
National framework for green buildings & green building construction standards
Energy Efficiency Labelling Standards
Building energy performance labelling
Biofuels
Biofuels Industrial Strategy & Biofuels Mandatory Blending Regulations
The Transport Flagship Programme
Integrated Rapid Public Transport Networks
Rea Vaya (Johannesburg)
A re Yeng (Tshwane)
My CiTi service (Cape Town)
Rustenburg Rapid Transport
GO!Durban (Durban)
Libhongo Lethu (Nelson Mandela)
Harambee (Ekurhuleni)
Go George (George)
Mbombela Rapid Transport
Buffalo City Rapid Transport
Msunduzi Rapid Transport
Mangaung Rapid Transport
Polokwane Rapid Transport
Non-Motorised Transport Networks
Mass Bicycle Rollout Programme
Dedicated Cycling Infrastructure Development
Pedestrian Walkway Infrastructure Development
Promote Fuel Efficiency Measures
Transport Modal Shifts
Passenger Rail Infrastructure Projects
Gautrain
Transnet Freight Rail Recapitalisation Programme
Taxi Recapitalisation Programme
Integrated Urban Planning and Transportation Planning
The Waste Management Flagship Programme
Solid Waste Management
Landfill gas-to-energy projects
Diversion of waste from landfills
Municipal Wastewater Management
Biogas combined heat and power in wastewater treatment facilities
The Carbon Capture and Sequestration Flagship Programme
National CCS Roadmap Development, Implementation and Oversight
Pilot CO2 Storage Project & Pilot CO_2 Capture Project
Long-term Adaptation Scenarios Flagship Research Programme (DEA)
Phase 1: Climate modelling, sector-based impacts and adaptation scoping
Analysis of climate change trends and projections
Development of a consensus view of scenarios (short to long-term)
Scoping of impacts, adaptation options and future research on key sectors
Phase 2: Development of adaptation scenarios for future climate conditions
Review of climate change vulnerabilities and potential adaptation
Assessment of climate change vulnerabilities and options for integrated regional adaptation
Modelling economic implications of climate futures on national water and food security
Final adaptation scenarios

Figure 41 shows the phases and key milestones in the journey of the Climate Change Flagship Programmes since inception in 2011. The second phase of the Climate Change Flagship Programmes, which began in 2012, has focused on (i) deepening the impact of existing programmes; (ii) expanding the initial set of Flagship Programme activities to incorporate increasingly ambitious and innovative elements; and (iii) introducing new Flagship Programmes to anchor climate action leadership and reflect the importance of both adaptation and mitigation action as part of a holistic national climate change response.

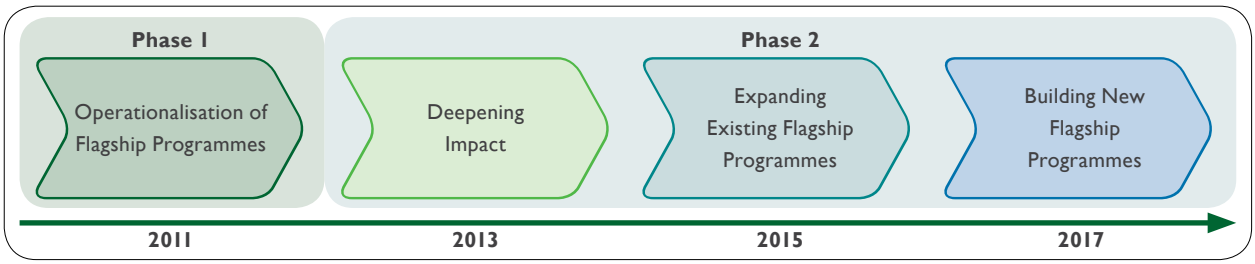

Figure 41: Milestones in implementing the Climate Change Flagship Programmes since publishing the NCCRWP in 2011

Table 7: Approaches to scaling-up the Climate Change Flagship Programmes

Approach	Description	Mechanism for Scaling-up
Quantitative	Growth or expansion and/or replication of existing measures.	• Replication • Adaptation
Deepening/ Functional	Increasing the coherence and comprehensive coverage of the programme components to increase the depth of impact.	• New dimensions/types of activities and programme areas • Adding incentives or tools to reinforce existing components
Idea or innovation	Spreading an idea among individuals or organisations within a certain area or system (geographic, organisational, professional); ideas can be adapted to fit different purposes or contexts.	• Communication • Marketing • Dissemination
Technology or skill	Increasing the number of people or places that use or apply a technology, practice or approach.	• Marketing • Distribution • Training
Policy	Moving towards institutional and structural changes – institutionalisation (mainstreaming). Ensuring that ideas expressed as policy are transformed into behaviour throughout a place.	• Implementation

2016 marked a year of momentous acceleration and maturation in implementing and scaling-up the Near-term Priority Flagship Programmes. This was largely due to the increased dynamism of the national climate change response landscape following the December 2015 Paris COP21 event.

Scaling-up the Climate Change Flagship Programmes has taken many forms, based on the maturity and complexity of the targeted work packages as shown in **Table 7**. In all cases, the acceleration of climate action has meant expanding, adapting and sustaining the successful projects, programmes, or policies in different ways over time (Hartmann & Linn 2007).

The DEA, other national government departments and key implementation partners intensified their efforts towards the development, implementation and scaling-up of climate action in their respective sectors. **Figure 42** shows the Flagship Programmes priority work packages that have been the focus of intensive collaboration and development, particularly during 2016. These include existing work packages in which the DEA has been involved in partnership with the lead implementing partners, as well as a series of new initiatives begun in 2016.

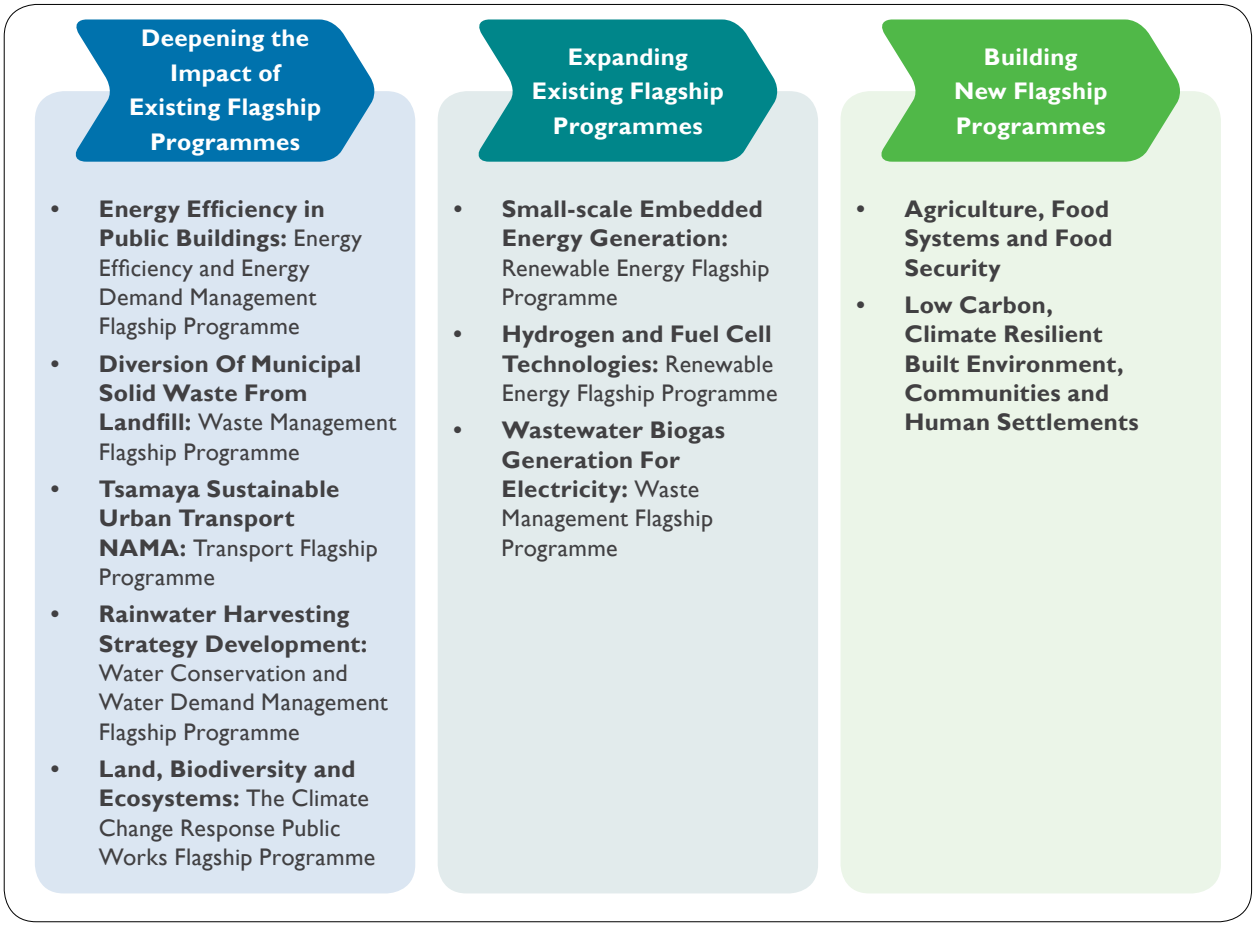

Figure 42: Climate Change Flagship Programmes priority work packages during 2016

The 2016 priority work packages included pre-existing Climate Change Flagship Programmes (first described in 2011), as well as new Flagship Programmes established since the publication of the NCCRP. **Table 8** provides an overview of the primary focus areas for the 2016 priority work packages.

Table 8: Core focus areas of the Climate Change Flagship Programmes priority work packages

Climate Change Flagship Programmes 2016 Priority Work Package		Climate Change Flagship Programmes	Envisaged Climate Change Outcome
Work Package	**Core Focus**		
Energy Efficiency in Public Buildings Programme	• Market development and expansion • Leveraging private sector investment	Energy Efficiency and Energy Demand Management Flagship Programme	Urgent, comprehensive and coordinated large-scale implementation of energy efficiency measures and technologies, across all sectors of South Africa's economy and society anchoring and stimulating the establishment of inclusive and localised energy services and technologies.
Diversion of Municipal Solid Waste from Landfill	• Demonstration scale implementation and development of implementation blueprints • Strengthening the regulatory framework	Waste Management Flagship Programme	Accelerated investment in, and implementation of large scale waste minimisation; recycling and composting of organic waste; using waste-to-energy opportunities available within the solid-, semi-solid- and liquid-waste management sectors; and establishing appropriate infrastructure and value chains to enable widespread uptake of low carbon waste management approaches.
Wastewater Biogas Generation for Electricity			
Tsamaya Sustainable Urban Transport NAMA	• Strengthening the regulatory framework • Dedicated implementation support	Transport Flagship Programme	Accessible and integrated transport systems that prioritise the use of more efficient spatial design, transport networks and operations; low emissions transport modes, vehicles, fuels, technology; non-motorised transport; and climate-resilient infrastructure to enhance social mobility; access to economic opportunities and levels of rural access and connectedness.

Climate Change Flagship Programmes 2016 Priority Work Package		Climate Change Flagship Programmes	Envisaged Climate Change Outcome
Work Package	**Core Focus**		
Rainwater Harvesting Strategy Development	• Strengthening of the regulatory framework • Development and piloting of implementation blueprints	Water Conservation and Demand Management Flagship Programme	Urgent and large-scale implementation of efficient water systems, water storage and infrastructure coupled with prudent resource and demand management, and informed behavioural change
Small-scale Embedded Energy Generation	• Strengthening the regulatory framework • Supporting systematic implementation	Renewable Energy Flagship Programme	Widespread development, integration and use of, and affordable access to, South Africa's abundant renewable energy (RE) resources through the large-scale deployment of appropriate technologies at all scales driving innovation; localisation of RE goods, services and technologies; energy security and economic
Hydrogen and Fuel Cell Technologies	• Market development • Demonstration scale implementation and development of implementation blueprints		
Agriculture, Food Systems and Food Security Flagship Programme	• Strengthening the regulatory framework • Demonstration scale implementation of integrated approaches and new systems	Agriculture, Food Systems and Food Security Flagship Programme	Widespread and urgent establishment of climate-smart agriculture, agro-processing and food production systems to enhance productivity and climate resilience at all scales of production, and successfully integrating agro-ecological practices and resource efficient approaches to drive the growth and competitiveness of South Africa's agricultural sector.

Climate Change Flagship Programmes 2016 Priority Work Package		Climate Change Flagship Programmes	Envisaged Climate Change Outcome
Work Package	**Core Focus**		
Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements	• Strengthening the regulatory framework • Demonstration scale implementation of integrated approaches and new systems	Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme	Resilient, low emissions and spatially efficient, rural, urban and coastal communities, settlements and infrastructure incorporating a high-performance green built environment, green building practices, green retrofits of existing buildings, protecting and enhancing natural ecosystems and extensive green infrastructure networks.
Land, Biodiversity and Ecosystems	• Strengthening the regulatory framework • Demonstration scale implementation of integrated approaches to rehabilitation and management of grasslands, sub-tropical thicket, forests and woodlands	The Climate Change Response Public Works Flagship Programme	Large-scale investment in, and expansion of, the restoration and rehabilitation of South Africa's natural resource base including management of invasive species, enhancing ecosystem integrity and resilience, creating and enhancing carbon sinks, ecosystem-based adaptation approaches and better management of marine resources, fisheries and ecosystems.

As the priority work packages were at different levels of implementation readiness, each Flagship Programme required bolstering in a different area to enable scaling-up. Programmes ranking highest in a set of pre-defined implementation and scaling-up success factors listed below presented an opportunity for the lead department, in collaboration with the DEA and other technical partners, to focus on refining the implementation model and finalising the institutional support arrangements.

Implementation and success factors:

- A well-defined and established regulatory framework.
- The core activity(ies) and indicators in the regulatory framework readily translate into a quantifiable climate change impact.
- An existing funding stream drawn from fiscal allocations is already in place.
- Tested private sector investment models exist and are well understood.
- Uses a range of finance instruments beyond grants.
- Main technologies and/or practices are mature and well established.

- An established implementation base is in place at demonstration scale.
- A designated champion leading the work within the relevant national department.

Figure 43 shows the relative readiness for scaling-up of the ten priority work packages during 2016, two of which are new full-scale Flagship Programmes. Regulatory and policy barriers tend to have a significant impact on scaling-up readiness, and those work packages that require an enhanced regulatory framework take longer to mobilise.

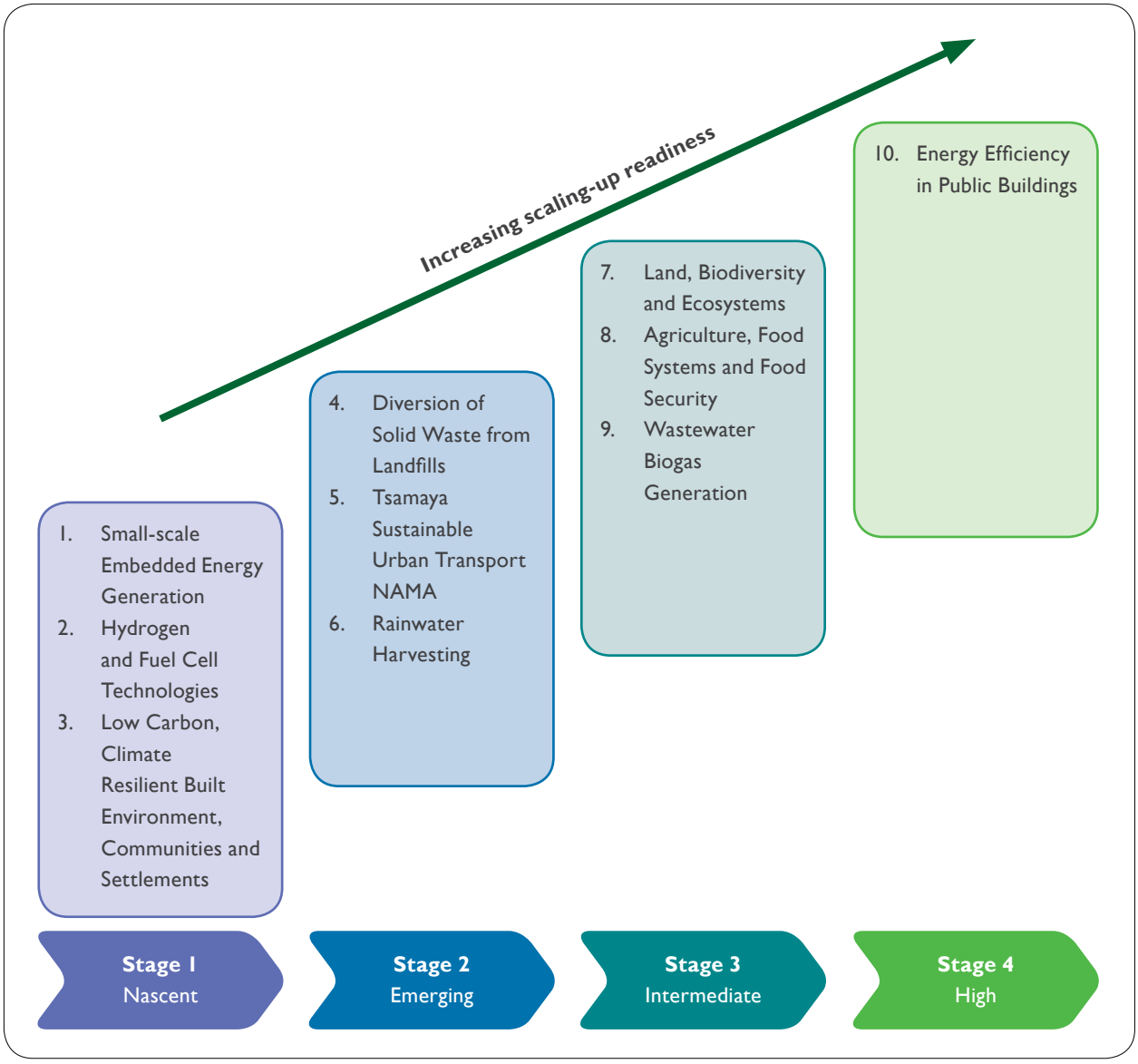

Figure 43: Maturity model for the 2016 Flagship Programmes priority work packages

7.3 PROGRESS IN IMPLEMENTING THE PRIORITY WORK PACKAGES

7.3.1 The Energy Efficiency and Energy Demand Management (EEEDM) Flagship Programme: Energy Efficiency in Public Infrastructure and Buildings

The Energy Efficiency in Public Infrastructure and Buildings work package (EEPIBP) is an example of one of the more mature work packages implemented as part of the Climate Change Flagship Programmes, with the highest level of scaling-up readiness. The EEPIBP work package has continuously been refined over the past four years. The EEPIBP forms part of an overarching sector-wide Nationally Appropriate Mitigation Action (NAMA) that aims to integrate energy efficiency measures in the public-sector buildings portfolio across all three spheres of government. The EEPIBP was first introduced as a key component of the EEEDM Flagship Programme in CCAR-1. Given the strategic importance of this work in the public sector built environment, the EEPIBP is discussed in some detail here.

The EEPIBP consolidates and extends work undertaken by a range of implementers and organises these various measures into a cohesive programme within a single integrated national energy efficiency and climate change framework (**Figure 44**).

The EEPIBP, developed under the EEEDM Flagship Programme, is one of the most well-established Flagship Programmes and is supported by a mature policy framework. The programme is informed by the National Energy Efficiency Strategy (DME 2005) which was first published in 2005 and has since undergone several revisions.

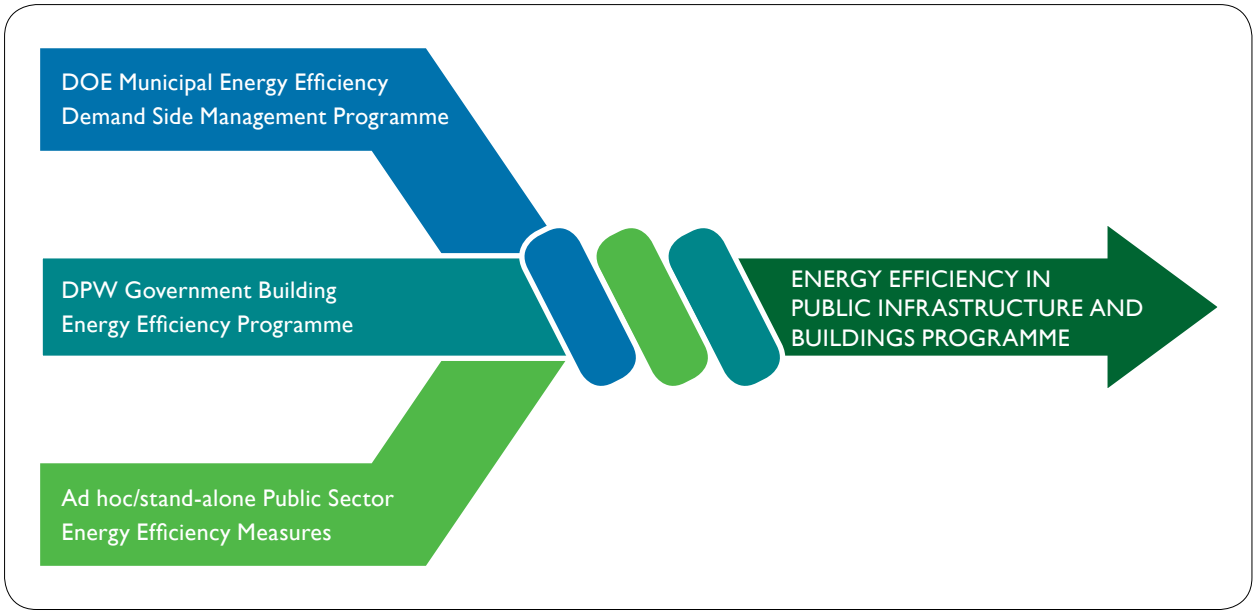

Figure 44: Consolidation and extension of energy efficiency and demand-side management measures through the EEPIBP

The EEPIBP is developed by the National Departments of Energy (DOE), Public Works (DPW) Environmental Affairs, the National Business Initiative (NBI), the Carbon Trust and the Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).[3]

The DOE is the lead national government authority for the EEPIBP. The lead departments and implementation partners have actively steered the development and preparation of the EEPIBP over the past four years, building on the extensive national investment and experience in energy efficiency garnered over more than a decade.

The EEPIBP focuses explicitly on stimulating the Energy Service Company (ESCo) market by providing access to the vast public sector building portfolio, facilitating access to private sector finance for energy efficiency initiatives and providing risk reduction measures that encourage private sector investment.

In July 2015, South Africa submitted a funding proposal for implementation of the EEPIBP to the NAMA Facility[4] in response to the third call for NAMA support project outlines. In April 2016, the NAMA Facility Board granted pre-approval of the EEPIBP funding proposal. The proposal is subject to a detailed appraisal by the NAMA Facility Technical Support Unit as part of the second stage of the selection process. The EEPIBP proposal was completed detailing the implementation modalities, institutional arrangements, finance models and transformational impacts and submitted in March 2017. The work package will be implemented once final approval has been granted by the NAMA Facility Board in 2017.

7.3.2 Waste Management Flagship Programme: Diversion of Municipal Solid Waste from Landfill and Wastewater Biogas Generation for Electricity

Great strides have also been made in the, 'Diversion of Municipal Solid Waste from Landfills' work package under the Waste Management Flagship Programme, mainly pertaining to the diversion and beneficiation of the organic waste stream comprising food and garden waste. A set of alternative solid waste treatment technologies have been assessed for suitability for implementation in a range of South African municipalities, edging ever closer to the possibility of full-scale implementation.

In September 2015, the GIZ in partnership with the DEA commissioned the development of strategies for the diversion of solid waste from landfills in six Local Municipalities (LM) and one Metropolitan Municipality (MM) namely: Rustenburg LM; Emfuleni LM; uMhlathuze LM; Msunduzi LM; Mbombela LM; and Mangaung MM, which were selected based on their level of readiness

3 The EEPIBP is supported by the BMUB International Climate Initiative (IKI) through the Vertically Integrated Nationally Appropriate Mitigation Actions (V-NAMA) Programme and the Climate Support Programme. Both programmes are implemented by GIZ on behalf of the German Federal Government.

4 The NAMA Facility was jointly established by the BMUB and the UK Department of Energy and Climate Change to support partner countries in implementing the most ambitious and transformative parts of NAMAs. The donor partners supporting the NAMA Facility have since expanded to include the European Commission and the Danish Ministry of Foreign Affairs on behalf of the Danish Ministry of Energy, Utilities and Climate.

to implement alternative waste treatment interventions. These strategies are to be incorporated into the respective municipal Integrated Waste Management Plans (IWMPs) and are intended to contribute to integrated waste management systems. Five suitable alternative waste treatment technologies were identified (**Figure 45**).

The pre-feasibility studies, strategy, business and implementation plan development were completed for the six municipalities in August 2016. Furthermore, the development of a climate finance proposal is underway for piloting the five, alternative waste treatment technology options in six municipalities and for implementation in 24 additional municipalities on the basis of the lessons learnt from the initial six. Programme development will include the compilation of technical blueprints, standardised procurement documents and financial model development at the programme level amongst other activities. A programme of 30 municipalities implementing the five technologies will reduce 572 $MtCO_2e$ per annum as a result of fuel switch to renewable energy and waste diversion.

If a total of two hundred municipalities were to implement these technologies, this would divert about 3.1 million tonnes of waste per year, with the associated benefit of reducing GHG emissions by 4 million tCO_2e per year. The programmatic approach increases the efficiency of climate change mitigation gains, because it reduces individual project preparation efforts through a streamlined, replication process.

A second phase of the flagship programme will include strategy development for a further six municipalities. Inclusive of the development of zero waste strategy in a Metropolitan Municipality.

A second important work package included under the Waste Management Flagship Programme focuses on the generation of electricity from biogas in municipal wastewater treatment works (WWTW). Wastewater management is overseen by the Department of Water and Sanitation (DWS), but implementation at local level is led by individual municipalities. Biogas produced from anaerobic digestion of wastewater sludge can be used in combined heat and power engines to generate heat (for digester heating) and electricity for on-site consumption. Anaerobic digestion has been implemented in South African WWTW for sludge treatment purposes since the 1960s, however most of the biogas (mostly

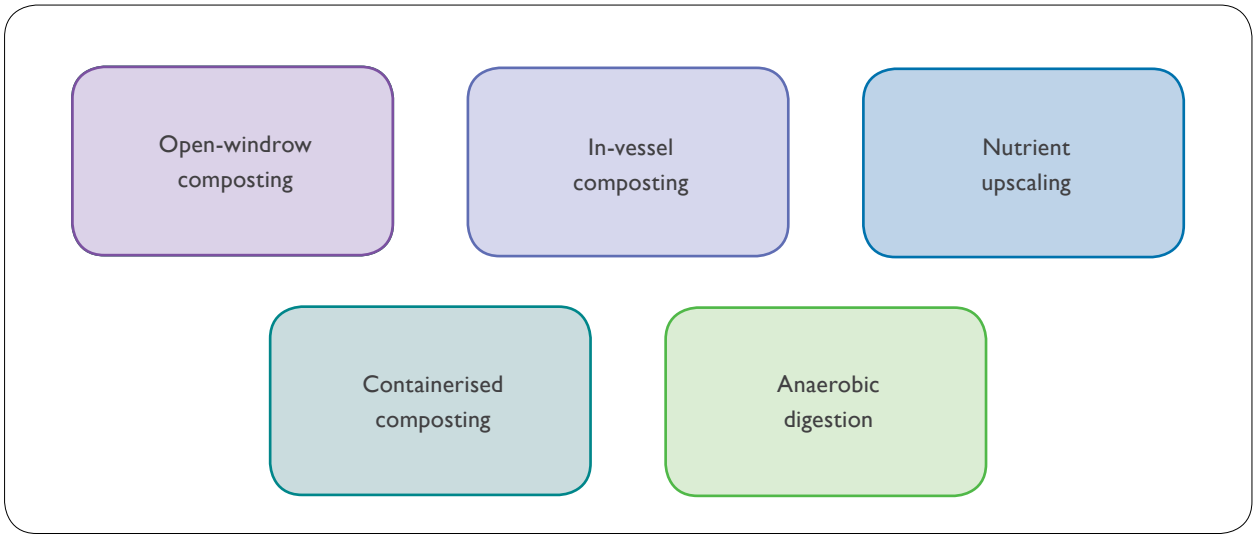

Figure 45: Technology-based approaches used for diverting food and green/garden waste from municipal landfills

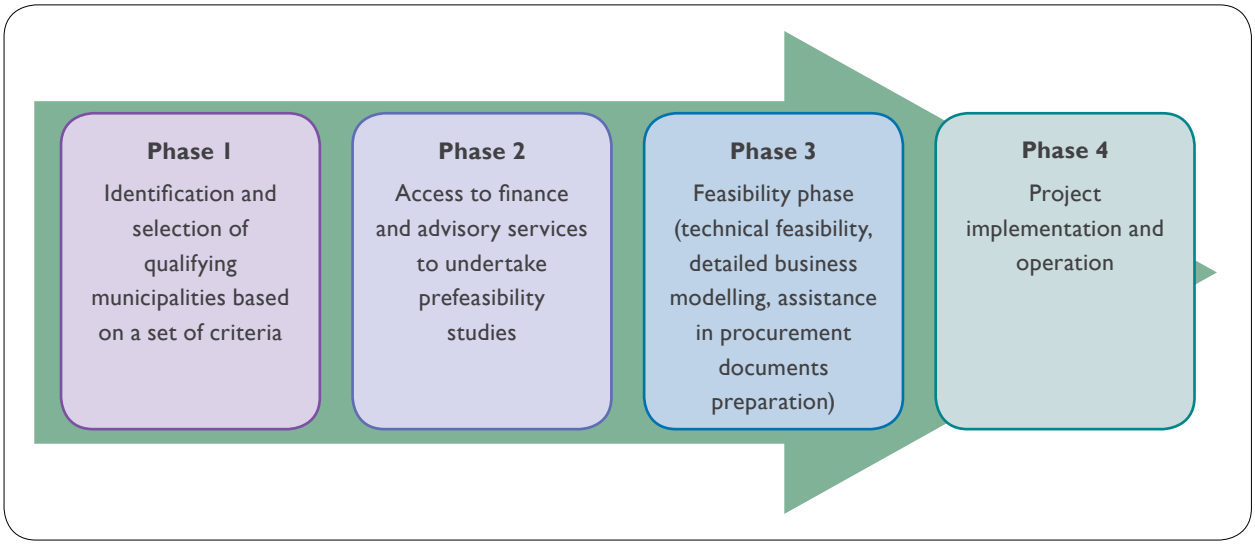

Figure 46: Phasing of the Diversion of Municipal Solid Waste from Landfill and Wastewater Biogas Generation for Electricity programme

methane) generated is flared rather than converted into usable energy. Approximately 30% of the total costs of all municipal WWTW can be attributed to energy consumption due to the requirement for continuous operation of equipment. The use of WWTW biogas as an energy source both reduces the cost of operating these facilities and reduces GHG emissions.

The objectives of the Wastewater Biogas to Generate Electricity work package are to undertake feasibility studies and to support the implementation of the project in selected WWTW (only WWTW with a daily inflow larger than 10 megalitres are currently being considered). There is currently only one biogas WWTW project operating in South Africa, but there are nine hundred and sixty-eight municipal WWTW in South Africa and one hundred and thirty-one of these would qualify to participate in the programme, pointing to significant benefits in terms of enhancing the financial efficiency of municipal wastewater treatment and reducing GHG emissions.

These work packages will be implemented in four phases (**Figure 46**).

7.3.3 Transport Flagship Programme: Tsamaya Sustainable Urban Mobility NAMA

The Transport Flagship Programme has a well-established policy base in the White Paper on National Transport Policy (1996) and the Public Transport Strategy (2007) (Department of Transport 1996; 2007). Although implementation of the Public Transport Strategy is advanced, there has been limited uptake of public and non-motorised transport, which are needed to accelerate the transformation of the sector and contribute to South Africa's climate change mitigation commitments.

The Department of Transport (DOT), the DEA and the GIZ, in collaboration with a range of key programme implementers drawn from local government, research institutions and international partners, have actively worked towards the development of a sustainable urban mobility (SUM) NAMA. This SUM NAMA, since renamed the Tsamaya SUM NAMA, is set to fast-track a new phase of accelerated climate action within the Transport Flagship Programme.

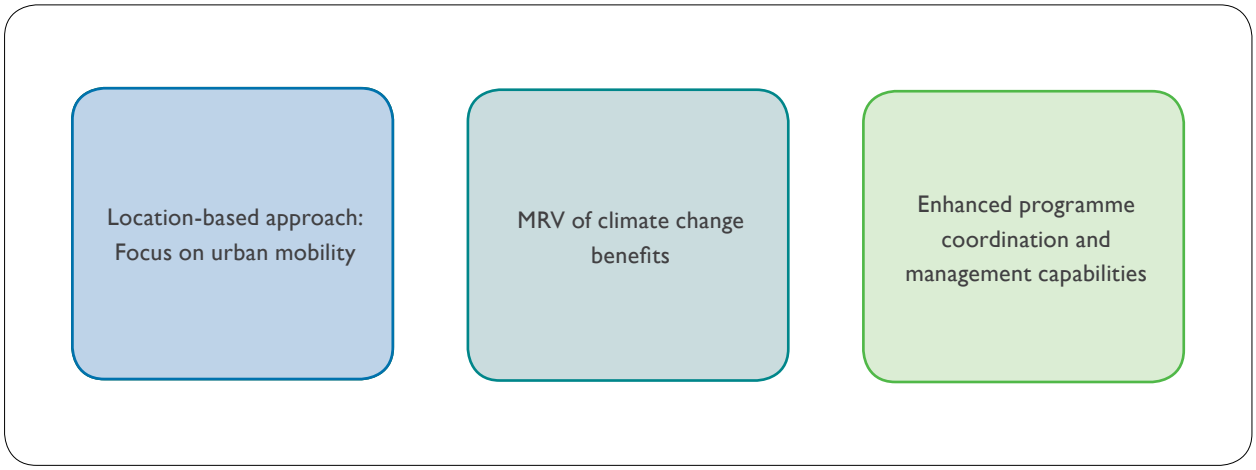

Figure 47: Key elements of the Tsamaya Sustainable Urban Mobility (SUM) NAMA implementation approach

The Tsamaya SUM NAMA focuses on providing dedicated advisory and technical support to municipalities in the implementation of a variety of low carbon transport options and technologies, and on enhancing the level of integration and collaboration between the different spheres of government responsible for different aspects of transport systems and infrastructure throughout South Africa. **Figure 47** presents the main elements envisaged to catalyse sector-wide implementation of low carbon transport measures.

Over the past four years, the focus has included intensive stakeholder consultations and the establishment of governance structures to coordinate the development and implementation of the Transport Flagship Programme. A Transport Steering Committee has been established to coordinate and oversee implementation of the Tsamaya SUM NAMA.

In keeping with the focus on the technical aspects of programme management, there has been a concerted effort to develop and test approaches for measuring the GHG emission reductions and other benefits of low carbon mobility. The third focus area of the Tsamaya SUM NAMA is enhancing policy frameworks to better enable the large-scale uptake of low carbon transport technologies, approaches and practices.

Figure 48 provides a detailed overview of the Tsamaya SUM NAMA work package.

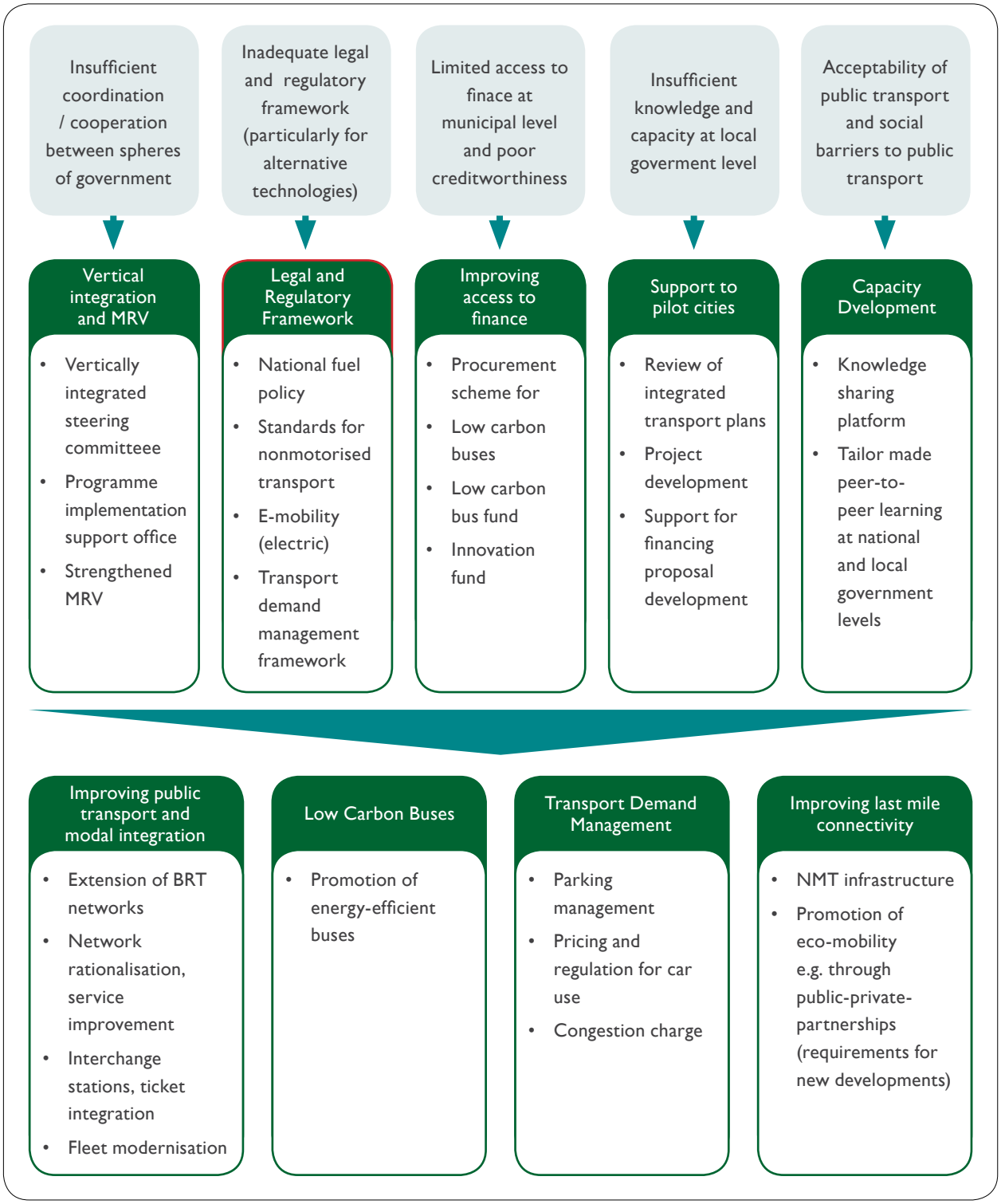

Figure 48: Summary of the Tsamaya Sustainable Urban Mobility NAMA

7.3.4 Renewable Energy (RE) Flagship Programme: Small-scale Embedded Energy Generation and Hydrogen and Fuel Cell Technologies

South Africa's location, geography and size all play a role in providing the country with multiple renewable energy resources. South Africa has some of the best solar resources in the world: the annual 24-hour global solar radiation average is about 220 W/m^2, compared to about 150 W/m^2 for parts of the USA, and about 100 W/m^2 for Europe and the United Kingdom (DoE no date). A coastline of approximately 3 000 km provides favourable conditions for wind power throughout the country. The East coast is tropical with large wood and sugar plantations, creating biomass to energy opportunities.

The Renewable Energy (RE) Flagship Programme includes some of the most potent game changers of South Africa's climate change response. The Renewable Energy Independent Power Producers Procurement Programme (REI4P) is a trailblazer in South Africa's renewable energy journey. The renewable energy portfolio currently under REI4P at full operation will displace an estimated 45 million tCO_2e emissions per year, and has already realised 7 million tCO_2e reductions from programme inception. Over the next 20 years, this is expected to amount to a total of 902 million tCO_2e in GHG emissions reductions. The wind and solar power capacity operational during 2015 generated R800 million net benefit to the South African economy, helping to save more than an additional R4 billion in costs to the economy. The REI4P has attracted over R53 billion in foreign investment and financing to date, and has committed more than R19 billion towards socio-economic development initiatives in the country (Luthuli 2016).

The RE Flagship Programme includes two additional game changers in the form of hydrogen and fuel cell technologies and small-scale embedded generation. Emphasis has traditionally been placed on the supply side of the energy system, as acknowledged by the White Paper on the Energy Policy of the Republic of South Africa as far back as 1998 (DME 1998). The hydrogen value chain is an emerging source of safe, clean and reliable decentralised energy. Fuel cell technology is more efficient, reliable, quieter and compact. The emphasis in South Africa is on developing hydrogen from renewable energy sources, thereby maximising the contribution of these technologies to national efforts to mitigate GHG emissions in the national energy system.

Hydrogen can be used in fuel cells supplying homes, businesses and industries that could be linked to a national power grid allowing surplus power at one location to be transferred to areas experiencing power shortages, thus facilitating energy access. Smaller (1–20 kW) fuel cell systems can be used in residential and commercial buildings as backup power or in energy efficiency and demand-side management initiatives to shift load and reduce pressure on generating capacity. Opportunities also exist in the electrification of municipalities and operations that are too far from the nearest grid connection point to be included in the national power utility's short- and medium-term grid expansion plans.

The roll-out of hydrogen and fuel cell technologies is supported by the Department of Science and Technology's National Hydrogen and Fuel Cell Technologies Research, Development and Innovation strategy (HySA) published in 2008, as well as institutionalised technical expertise (Pollet et al. 2014). Three centres of competence have been established by the Department of Science and Technology (DST) to implement the HySA strategy, and these are charged with attaining the goal of supplying 25% of the global demand for platinum group metals-based catalyst by 2020.

The DEA has partnered with the DST to accelerate the integration of hydrogen and fuel cell technologies into South Africa's energy system. The climate change mitigation potential of these technologies has previously

not been fully recognised as a major opportunity, with only limited reference being made to these technologies in South Africa's Greenhouse Gas Mitigation Potential Analysis (DEA 2014), and focusing only on transport applications. The DEA's role in this partnership is to identify and support the DST in accessing climate finance and related resources to expand the market share of hydrogen-based technologies beyond a few localised pilot projects, and to promote uptake of these technologies in transport, the built environment and other applications.

A second priority work package of the RE Flagship Programme is scaling-up small-scale embedded renewable energy. Embedded generation is the next significant transformational shift after the large-scale REI4P, with significant climate change benefits and broader socio-economic benefits. This form of energy generation is growing in prominence in South Africa. Municipalities and the national power utility are increasingly inundated with applications from all types of customers to install some form of grid-connected embedded generation (Association of Municipal Electricity Utilities 2013). Approximately 60% of electricity distribution and reticulation is undertaken by local government, with the remaining 40% undertaken by the national power utility. With electricity distribution being dominated by local government, it is important that the approach feeds into national objectives.

The DEA is working with several key partners including the DOE, the National Energy Regulator of South Africa (NERSA), the South African Photovoltaic Industry Association, and international partners, towards achieving the joint vision of energy systems that are efficient, low carbon, modern and intelligent.

The embedded generation work package of the RE Flagship Programme seeks to achieve the following objectives over the 2017–2020 period:

- **Objective 1: To support institutional strengthening and coordination for scaling-up embedded generation:** While the increased uptake of renewable energy is a recurrent theme in various national policies, support for small-scale renewable energy uptake is generally not well articulated or structured. The DEA, with key partners, will facilitate the structured involvement of key actors across the embedded generation value chain with clear institutional arrangements.

- **Objective 2: To actively promote and facilitate large-scale uptake of the net-consumer approach to embedded generation through advocacy:** The DEA, with key partners, will support municipal energy and finance system readiness to better respond to and capitalise on the proliferation of rooftop solar photovoltaic systems, without putting municipalities' financial stability at risk. Instead, the use of increased energy generation capacity will be promoted to enhance national energy security and realise low carbon resilient growth at local level.
- **Objective 3: To scale-up embedded generation and realise the mitigation impact of renewable energy:** Privately installed small-scale, grid-connected rooftop solar is growing in South Africa. In response to the wide-scale appeal of small-scale RE technologies, the DEA with key partners will actively identify opportunities with interested municipalities and develop implementation plans.

In its initial stages, the work is focusing on developing a coherent approach to scaling-up over the next five years.

7.3.5 Water Conservation and Water Demand Management (WCWDM) Flagship Programme: Rainwater Harvesting Strategy Development

Water security has once again come to the fore amid a serious drought which struck South Africa and the surrounding region from 2014 onwards. While the water conservation and water demand management (WCWDM) component of the WCWDM Flagship Programme is well-established, the rainwater harvesting component of this Flagship Programme has yet to realise its full potential.

Rainwater harvesting is currently implemented by three different departments: the DWS, the Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Rural Development and Land Reform (DRDLR). Efforts towards a national rollout of rainwater harvesting would benefit from a more coherent approach. Unlike the other WCWDM components, rainwater harvesting is not supported by a strong regulatory framework. The DEA has therefore worked with the DWS to develop a national rainwater harvesting strategy to consolidate and support the scaled-up implementation of the WCWDM Flagship Programme.

The work on rainwater harvesting, which was led by the DWS in partnership with the DEA and other key implementers, is in its initial stages, and will be featured in more depth in future CCARs.

7.3.6 Agriculture, Food Systems and Food Security Flagship Programme

Agriculture is identified in the National Development Plan (NDP) (NPC 2011) and several agriculture sector policies as one of the most important drivers of employment and job creation in South Africa. The sector is envisioned to provide opportunities for 300 000 households in smallholder schemes by 2020; create 145 000 agro-processing jobs; and enhance employment on commercial farms by 2020 (NPC 2011). The location of agriculture primarily within rural areas implies that this sector can also play a key role in driving rural development, livelihood improvements and infrastructure development. Agriculture is positioned to stimulate sustainable rural enterprises, investment in agro-processing, and opportunities for broader economic participation.

Changing climate has already significantly impacted the agricultural sector in South Africa and caused food shortages and increases in the price of agricultural produce. The extent of these impacts will depend not only on the intensity and timing (periodicity) of the changes, but also on their combination. Given the finite availability of water and suitable land, agriculture is under growing

pressure to increase output per unit of land (Lipper et al. 2014).

The Agriculture, Food Systems and Food Security Flagship Programme, led by DAFF, aims to enhance agricultural productivity and climate resilience in agriculture at all scales of production, decoupling agricultural growth from GHG emissions growth, and driving enhanced growth and competitiveness of the sector. The primary programme objective is the simultaneous implementation of a comprehensive, cohesive and integrated set of climate change mitigation and adaptation measures to build climate-smart agricultural and food production systems.

The programme proposes the following interventions:

- infrastructure investment and technology
- agricultural/production inputs
- enhanced access to finance and technology
- skills and capacity building
- education and awareness

Figure 49 presents the main programme activities envisaged, informed by the principles of climate smart agriculture (CSA) and relevant national policies and strategies.

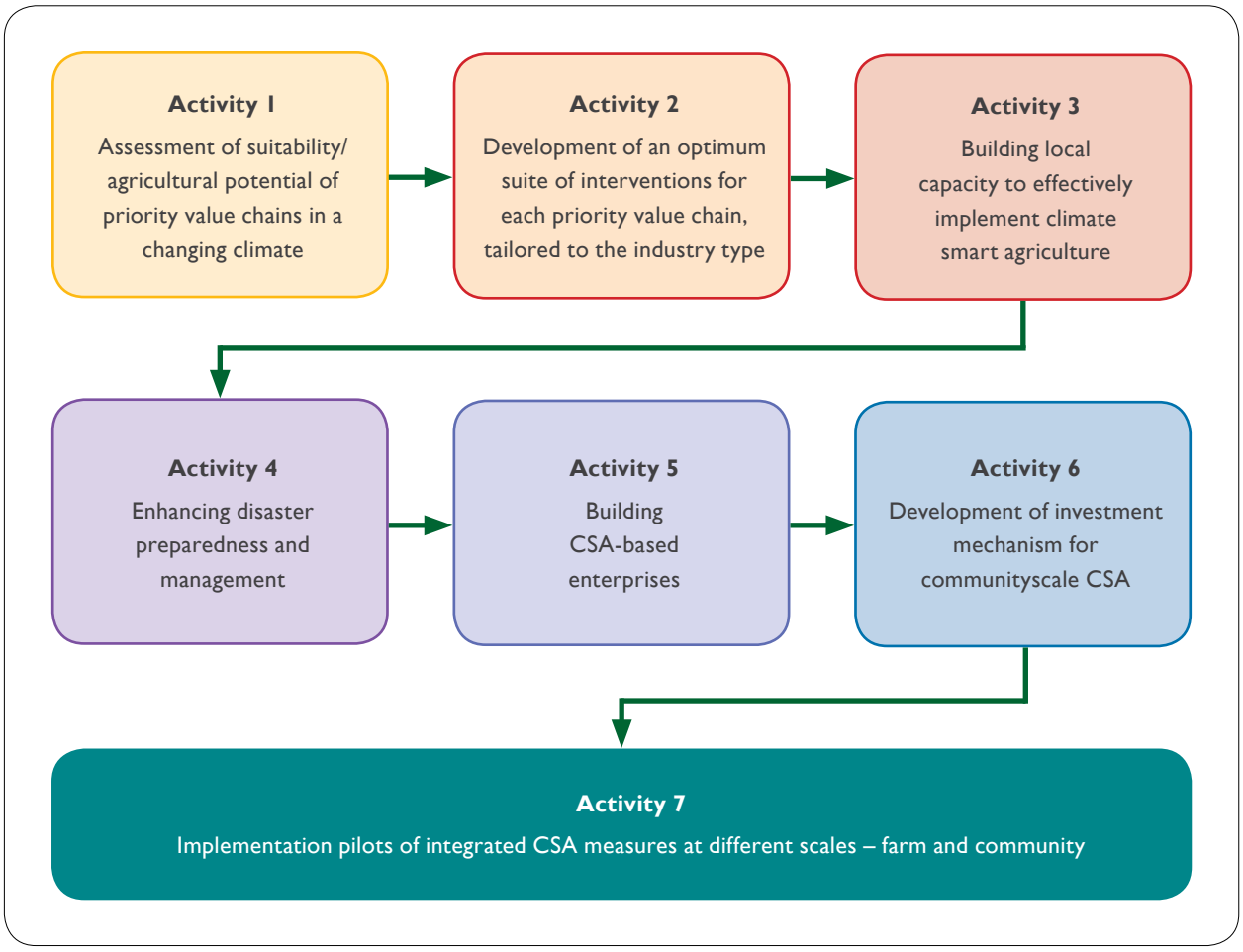

Figure 49: Overview of the Agriculture, Food Systems and Food Security Flagship Programme activities

Figure 50: Priority Work Packages included in the Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme

7.3.7 Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme

The Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme is a complex programme consisting of three work packages targeting institutional and residential buildings and academia (**Figure 50**).

Much of the work included under this Flagship Programme is still at an early phase and will be discussed in more detail in future CCARs.

7.3.8 Land, Biodiversity and Ecosystems Work Package

The Land, Biodiversity and Ecosystems Work Package aims to develop a cohesive national implementation programme on land rehabilitation and sustainable maintenance, building on the various 'Working For' programmes and land management programmes included in the Climate Change Response Public Works Flagship Programme. This work package will focus on scaling up opportunities to enhance the rehabilitation and management of grasslands, sub-tropical thicket, forests and woodlands. The aim is to demonstrate the mitigation–adaptation nexus characteristic of land-based climate change response measures. This work package will develop mechanisms to support a sustainable land management regime that enhances ecological infrastructure and resilience, and reduces GHG emissions from the land sector

7.4 MOBILISING FINANCE FOR SOUTH AFRICA'S NATIONALLY DETERMINED CONTRIBUTION (NDC) THROUGH THE CLIMATE CHANGE FLAGSHIP PROGRAMMES

7.4.1 Overview

A key challenge highlighted in South Africa's Nationally Determined Contribution (NDC) is the limited ability to catalyse finance and investment at an economy wide scale for the transition to a low carbon and climate resilient economy and society (RSA 2015, 10–11). The support component of the NDC (S-NDC) identifies the major climate change adaptation and mitigation programmes that could be scaled-up to achieve these outcomes, and provides an initial assessment of the level of finance and investment required to achieve economy-wide implementation.

Figure 51 provides an overview of the role of the Climate Change Flagship Programmes in South Africa's Climate Change Response.

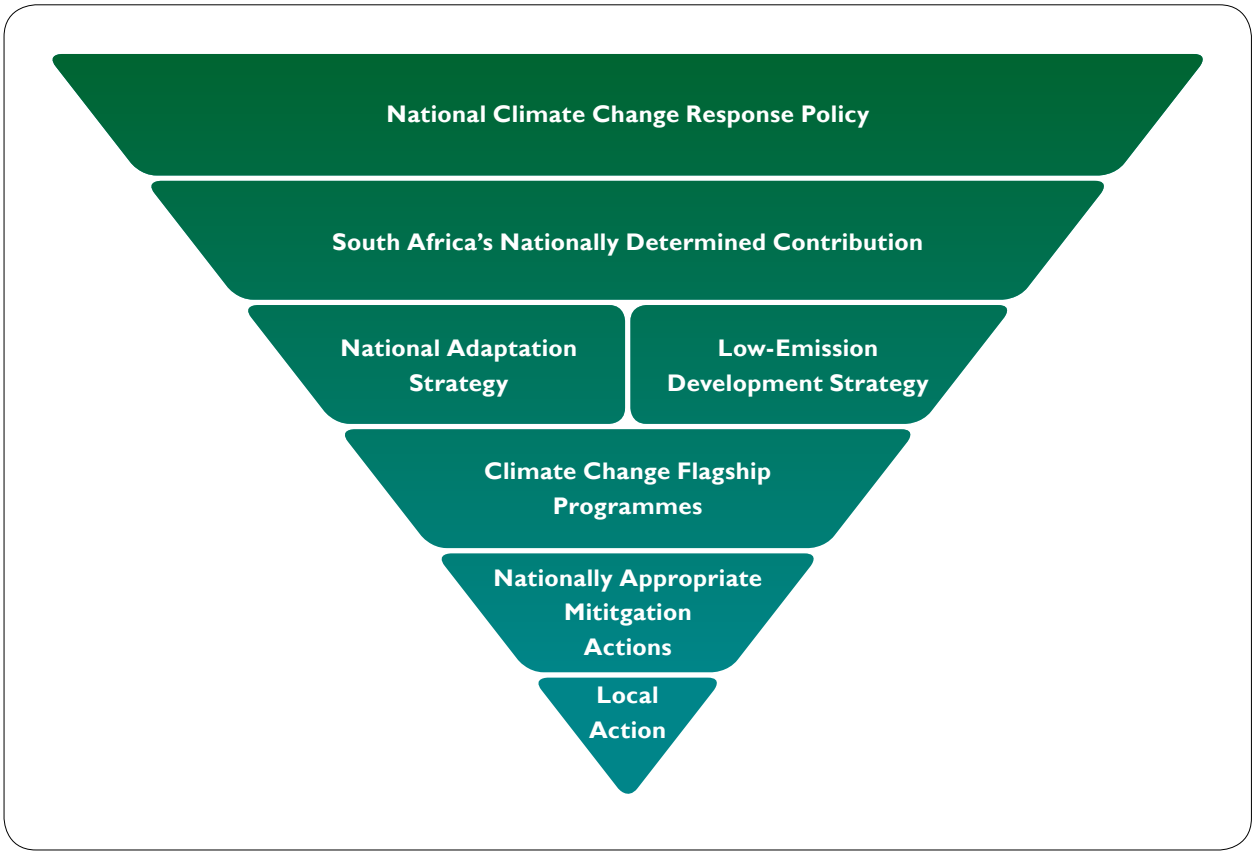

Figure 51: The Role of the Climate Change Flagship Programmes in South Africa's Climate Change Response

The Climate Change Flagship Programmes respond to key challenges facing South Africa and other countries as global efforts to address climate change intensify, through:

- **Igniting national-scale action at the speed required to respond to climate change**, namely limiting GHG emissions and/or enabling adaptation to the impacts of unavoidable climate change with the necessary urgency.
- **Demonstrating that the course of actions needed to respond to climate change effectively and efficiently** is not only possible, but highly beneficial unlocking and realising significant social, economic and environmental benefits.
- **Attracting resources at the scale required to enable meaningful transformation**, namely transformation at the scale that effectively limits atmospheric GHG emissions and/or enables adaptation to the impacts of unavoidable climate change.

The key programmes identified as part of South Africa's S-NDC include several which correspond with the Climate Change Flagship Programmes (**Table 9**). In this way, the Climate Change Flagship Programmes consolidate and extend existing national climate action towards achieving South Africa's NDC.

Table 9: A selection of key programmes and climate change response measures for scaling-up the 'Support' component of South Africa's NDC

Component	Key Programmes and Measures to be Scaled Up as per the NDC	Corresponding Climate Change Near-Term Priority Flagship Programme
Adaptation	• Working for Water, • Working on Wetlands • Land restoration • Water conservation and demand management	• The WCWDM Flagship Programme • Social Protection Systems and Public Works Programmes
Mitigation	• Renewable Energy Independent Power Producer Procurement Programme • Solar photovoltaics, solar water heaters and wind • Decarbonised electricity by 2050 • Carbon capture and storage • Energy efficiency and advanced bio-energy • Investment in public transport infrastructure and electric vehicles • Working on Fire	• The RE Flagship programme • The EEEDM Flagship Programme • The Carbon Capture and Sequestration Flagship Programme • The Low Carbon, Climate Resilient Transport Systems Flagship Programme • Low Carbon, Climate Resilient Built Environment, Communities and Human Settlements Flagship Programme

Just as the ability to achieve South Africa's NDC is premised on accessing adequate finance, technology and capacity building support; the required support needs to be directed by a clearly articulated set of investment priorities. In addition, this needs to be led by an identifiable champion, governance structure and implementation approach. The Climate Change Flagship Programmes fulfil this specific function.

The Climate Change Flagship Programmes provide a focal point for attracting and leveraging investment from both the private and public sectors at the scale required to enable meaningful climate action. Additionally, the Flagship Programmes direct investment to priority areas through clearly articulating the expected outcomes of climate action in these areas, the associated investment needs and value. The Flagship Programmes also provide for robust climate action monitoring and evaluation mechanisms and a well-defined governance structure through which the envisaged climate benefits will be achieved.

The following sections detail the various ways in which Flagship Programmes are mobilising climate finance and how the Flagship Programmes are South Africa's main link to the primary climate finance mechanism of the UNFCCC, the Green Climate Fund (GCF) and other funding opportunities.

7.5 LESSONS LEARNT THROUGH THE CLIMATE CHANGE FLAGSHIP PROGRAMMES

Over the past year, the Climate Change Flagship Programmes have successfully leveraged resources and finance, and built the partnerships necessary to enable the scaling-up of national climate action. The Flagship Programmes have built on existing resources to progressively unlock additional resources and so begin to fundamentally transform South Africa's society and economy. This is a key area of importance in South Africa's climate change response, highlighted in Section 11 of the NCCRWP, and in the S-NDC.

The Energy Efficiency in Public Infrastructure and Buildings work package (EEPIBP) work programme encapsulates many of the elements that not only make for a successful transition to a low carbon, climate resilient economy (**Figure 52**), but also contribute to fully realising the benefits of this transition by unlocking new economic opportunities.

The EEPIBP uses the procurement potential of the public sector to stimulate the growth of the Energy Service Company (ESCo) market, by enhancing financial services and creating a critical mass of project opportunities. **Figure 53** highlights the main catalytic elements of the EEPIBP that can be applied to other climate change response programmes to achieve wide-scale transformation and contribute to economic growth and development.

The EEPIBP demonstrates how the Climate Change Flagship Programmes can act to accelerate action towards achieving low-carbon and climate resilient economic growth and a new economic and social paradigm characterised by new jobs, new industries, and new economic opportunities (Figueres, 2013). Through the EEPIBP, different funding opportunities have been leveraged and consolidated to progressively develop and test increasingly ambitious climate action, with far-reaching implications for South Africa's transition towards a lower carbon future. The EEPIBP has received support from several related initiatives implemented by various national and international organisations (**Figure 54**).

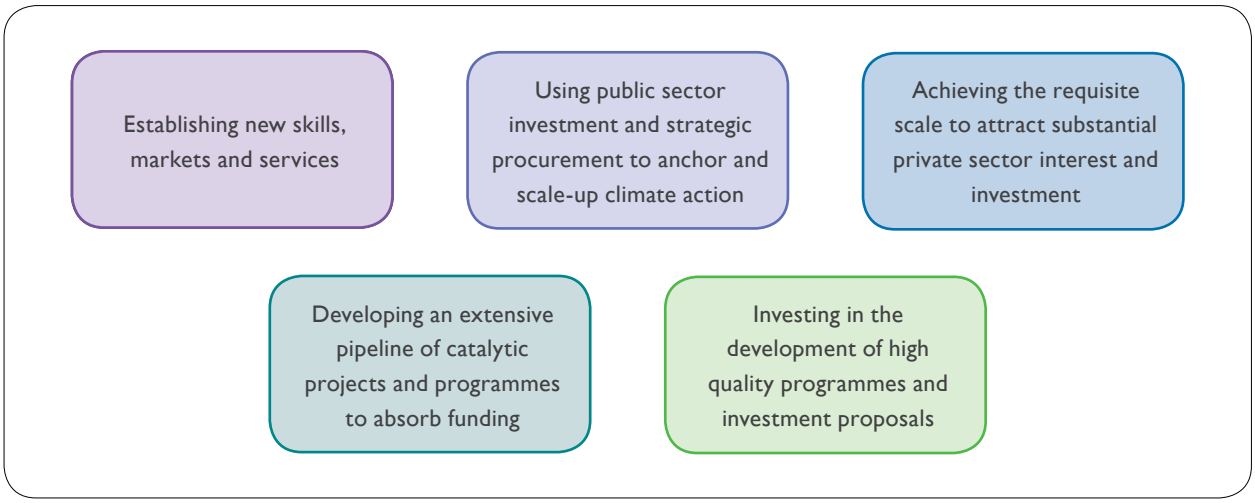

Figure 52: Success factors for achieving a successful transition to a low carbon, climate resilient economy

Figure 53: Elements of the EEPIBP work package that act as catalysts for low-carbon, climate resilient economic growth and development

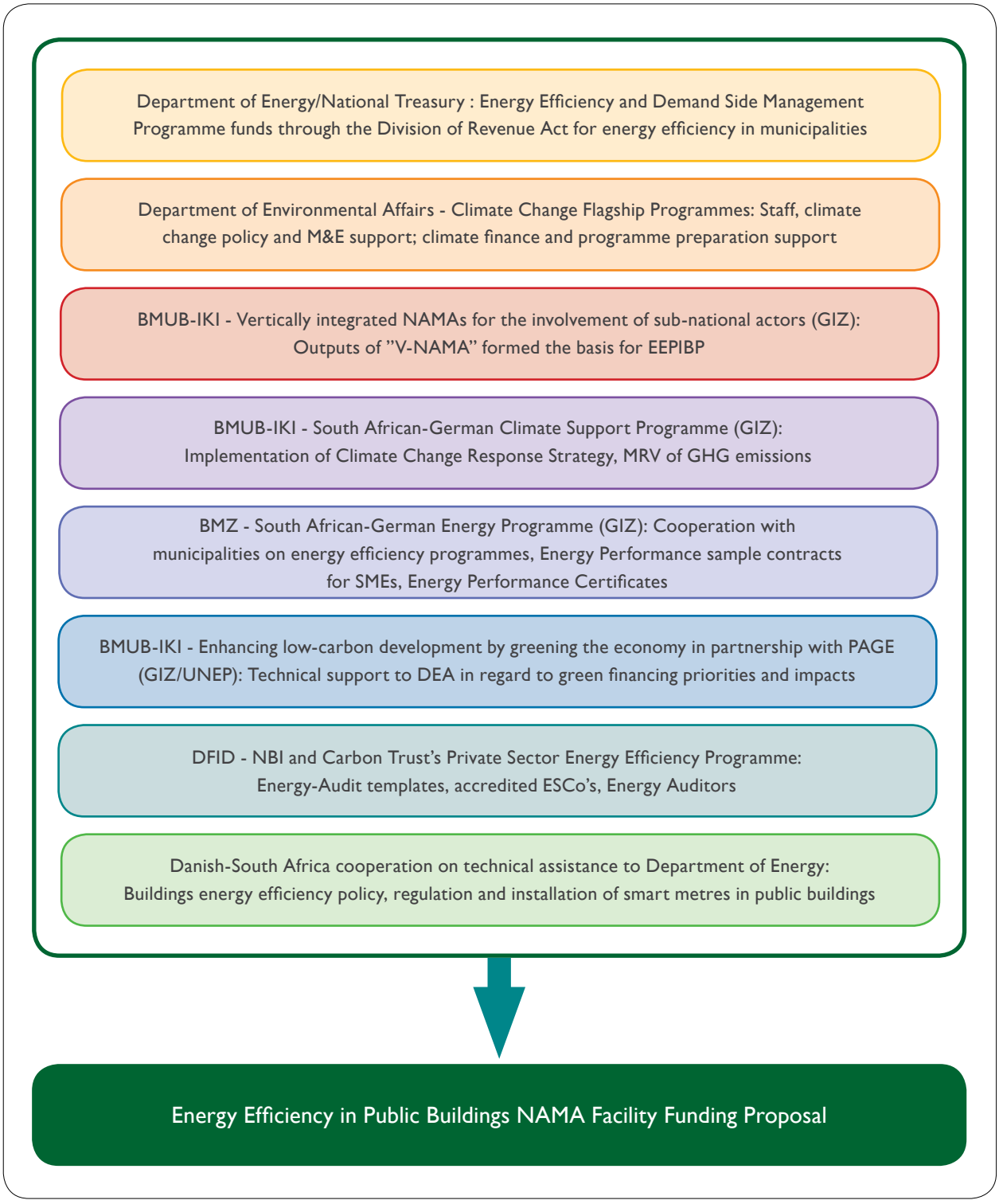

Figure 54: Key initiatives contributing to the development of the EEPBIP

Resources to develop high-impact investment ready projects and programmes need to be made available on a consistent and predictable basis and built into the national climate change response to increase South Africa's ability to absorb climate finance and resources. Extensive preparatory work, study and analysis are often required to develop strong funding, as has been the case with the EEPIBP. As is evident from **Figure 54**, current approaches to achieve the level of preparation required for well-conceptualised funding proposals are highly dependent on international funding and thus rather ad hoc. The EEPIBP has, however, been able to consolidate various smaller pilot measures to develop a full funding proposal, overcoming the current lack of dedicated national funding to support this process.

The EEPIBP emphasises the anchoring power of a strong public sector as the catalyst for implementation at scale. The co-funding contribution from existing municipal energy efficiency fiscal allocations provided the initial stepping stone for accessing additional complimentary sources of funding necessary for scaling-up. Some level of co-funding is a requirement for accessing most of the major climate funds, such as the GCF. In most cases, public funds are used, but so far this has been ad hoc.

Enhancing access to project/programme preparation support and implementation at subnational levels is therefore a critical intervention for realising South Africa's NDC ambitions. Going forward, public co-funding needs to be used to leverage funding from the private sector and climate finance mechanisms such as the GCF.

7.6 IMPLEMENTING THE CLIMATE CHANGE FLAGSHIP PROGRAMMES

The DEA is mandated by the NCCRP to oversee and coordinate the implementation of the policy, including the Climate Change Flagship Programmes. The DEA's Flagship Unit, located within the Climate Change and Air Quality Branch, works under the leadership of the Chief Directorates for Mitigation, Adaption, Climate Change Monitoring and Evaluation, and International Climate Change Relations and Negotiations (**Figure 55**).

The overarching aim of the Flagship Programmes Unit is to build a stable, continuous and consistent pipeline of high-impact investment-ready climate change programmes. This is done in partnership with all relevant spheres of government and other implementing partners.

The key role of the Flagship Unit is to support Flagship Programme coordinators in the effective implementation and scaling-up of the Flagship Programmes. This includes enabling the pipeline of programmes and projects to reach investment-grade, supporting the process of accessing funding, and assisting with documenting / communicating progress on implementation (**Figure 56**).

The heavily composite nature of a programme requires that a strongly integrated approach to planning be adopted to properly reflect deliverables, resources and external dependencies. DEA provides portfolio-level coordination as the secretariat and convener of the Climate Change Flagship Programmes Steering Committee, which reports to the Intergovernmental Committee on Climate Change.

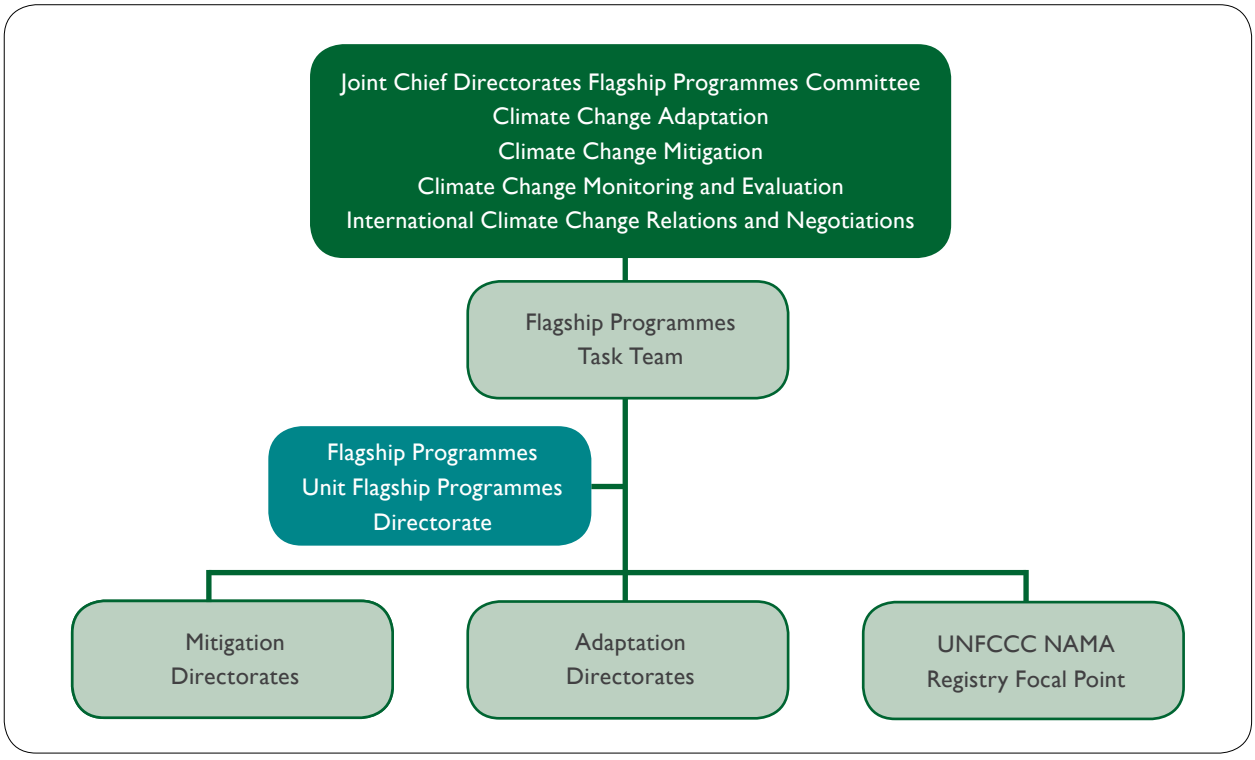

Figure 55: DEA Flagship Programmes Coordination

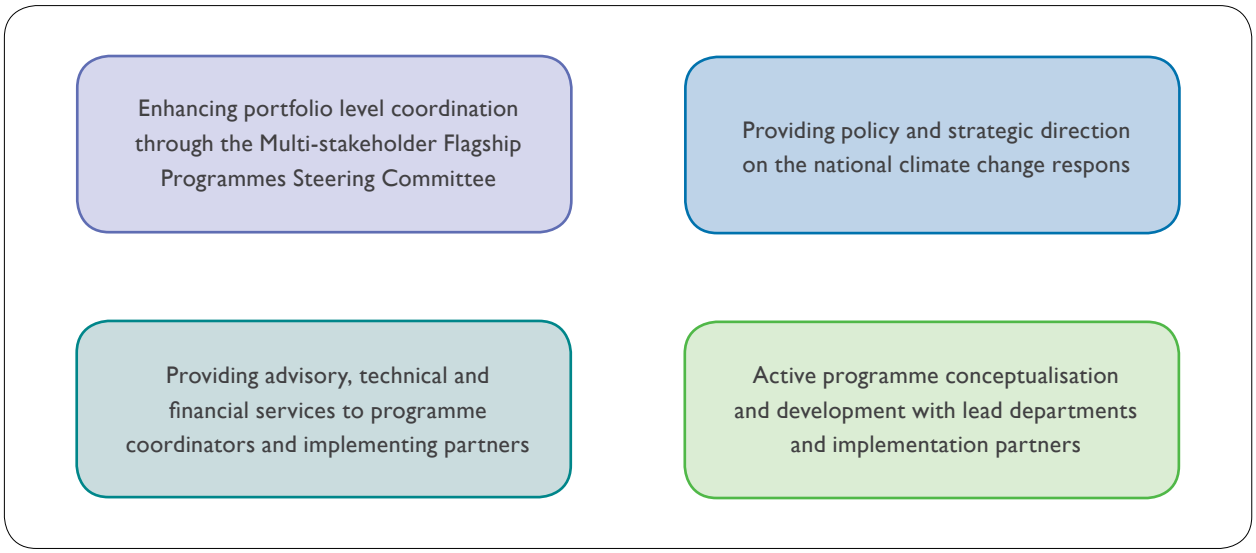

Figure 56: Summary overview of the DEA's role in the Climate Change Flagship Programmes

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ABBREVIATIONS

BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BMUB-IKI	BMUB International Climate Initiative
BMZ	German Federal Ministry for Economic Cooperation and Development
BRT	Bus Rapid Transport
CCAR-1	1st Climate Change Annual Report
CCAR	Climate Change Annual Report
CO_2	Carbon Dioxide
COP21	Conference of the Parties (21st)
CSA	Climate Smart Agriculture
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DFID	Department for International Development (UK)
DME	Department of Minerals and Energy
DoT	Department of Transport
DOE	Department of Energy
DPW	Department of Public Works
DRDLR	Department of Rural Development and Land Reform
DST	Department of Science and Technology
DWS	Department of Water and Sanitation

EEEDM	Energy Efficiency and Energy Demand Management Flagship Programme
EEPIBP	Energy Efficiency in Infrastructure and Public Buildings work package
ESCo	Energy Service Company
GCF	Green Climate Fund
GHG	Greenhouse Gases
GIZ	Gesellschaft für Internationale Zusammenarbeit
HySA	National Hydrogen and Fuel Cell Technologies Research, Development and Innovation Strategy
IDC	Industrial Development Cooperation
IWMPs	Integrated Waste Management Plans
kW	Kilowatt
LM	Local Municipality
MM	Metropolitan Municipality
MRV	Monitoring, Reporting and Verification
$MtCO_2e$	Metric Tonnes of Carbon Dioxide Equivalent
MW	Megawatt
NAMA	Nationally Appropriate Mitigation Action
NBI	National Business Initiative
NCCRP	National Climate Change Response Policy
NCCRWP	National Climate Change Response White Paper
NDC	Nationally Determined Contribution
NDP	National Development Plan
NERSA	National Energy Regulator of South Africa
NMT	Non-Motorised Transport
NPC	National Planning Commission
PAGE	Partnership for Action on Green Economy (joint GIZ-UNEP project)
RE	Renewable Energy
REI4P/REIPPPP	Renewable Energy Independent Power Producers Procurement Programme
SMMEs	Small Medium and Micro Enterprises
S-NDC	support component of the NDC
SUM	Sustainable Urban Mobility
SWH	solar water heating
tCO_2e	Tonnes of Carbon Dioxide Equivalent
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
V-NAMA	Vertically Integrated Nationally Appropriate Mitigation Actions
WCWDM	Water Conservation and Water Demand Management
W/m^2	Watts per Square Metre
WWTW	Wastewater Treatment Works

CHAPTER 8

SOUTH AFRICAN YOUTH PARTICIPATION IN CLIMATE CHANGE: A GOOD STORY TO TELL

CHAPTER 8: SOUTH AFRICAN YOUTH PARTICIPATION IN CLIMATE CHANGE: A GOOD STORY TO TELL

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8.1. INTRODUCTION

Almost one third of South Africa's population is made up of young people aged 15 to 24.[5] This means that young people are particularly vulnerable to the impacts of climate change and as such can play a key role in addressing climate change challenges.

The aim of this chapter is to profile selected youth climate change activities and actions in South Africa. The report further draws on how youth involvement is critical for effective action against climate change through policy inputs and awareness raising.

There are several youth-led organizations in the climate change space at international level such as CliMates or the Youth Climate Change Movement, often referred to as YOUNGO. Further, the Conference of the Youth, is a parallel youth gathering to the Conference of the Parties (COP) climate negotiations. In addition, there are continental activities such as Jeunes Volontaires pour l'Environnement (JVE) that is implemented in sixteen African countries and the 350Africa youth movement with a global footprint that is active in South Africa. Moreover, on regional level, in the Southern African Development Community (SADC), organisations such as the Southern African Youth Movement (SAYM) provide youth development programmes in climate change.

5 United Nations Population Fund South Africa. 2013. Young People: Fact Sheet. Available from: http://countryoffice.unfpa.org/filemanager/files/southafrica/young_people_march_2013_fact_sheet.pdf

8.2 YOUTH ACTIVITIES IN SOUTH AFRICA

8.2.1 South African Institute of International Affairs and the South African Youth Climate Change Coalition

Youth participation in South Africa, in many ways, mirrors the global pattern of involvement. Youth led activities are coordinated by the South African Institute of International Affairs (SAIIA) and the South African Youth Climate Change Coalition (SAYCCC). SAIIA activities include:

- Making input into policy development locally and internationally.
- Undertaking research on current issues of importance to Africa generally and South Africa specifically with a focus on governance and accountability; trade, investment and development; foreign policy; and climate change and energy security.
- Developing linkages and joint programmes with international organisations and agencies throughout the world.
- Maintaining a resource centre and reference library (that is a United Nations depository as well as a World Bank Development Information Centre) for students and scholars of international relations.
- Organising conferences, seminars and speakers' meetings on a wide range of topics addressed by prominent South Africans and distinguished international guests.
- Encouraging an interest in international relations among the youth through its leadership programme for postgraduate interns and its youth outreach programmes for university students and high school learners.

SAYCCC aims to address climate change issues by educating the youth and the community about the impacts of climate change. It also serves as the voice of the youth who are against the exploitation of the human habitat (earth).

8.2.2 Youth@SAIIA Programmes and Activities

One of the ways in which young people participate in climate change activities is through the programmes that are offered by Youth@SAIIA. Three main programmes are described below.

The 'Environmental Sustainability Project' (ESP) is a programme that is offered by Youth@SAIIA for high school children and youth. This project challenges high school students to do research on climate change mitigation and adaptation. Integrated solutions to this challenge have been, and can be, implemented in their communities and abroad. The students have to find a local case study of an environmental initiative. This is then combined with theoretical research and an international case study. Students combine their findings into a research paper which is read and marked by a panel of expert judges. The best papers from each province are then presented in person.

The winners from the ESP presentations, along with other exceptional youth delegates, are invited to attend a national Young Leaders Conference that is also hosted by Youth@SAIIA. The conference is aimed at creating a youth declaration that is representative of what the development priorities of young people in South Africa are, while also exposing high school and university students to real negotiation processes.

The Youth Policy Committee has been actively engaging in climate change issues on a local, national, and international

level. The committee consists of young South Africans from all over the country between the ages of 14 to 30, representing a variety of socio-economic backgrounds. Furthermore, young people use this as a platform to share their views on a few topics that they feel passionate about.

8.2.3 Young People at the UNFCCC Conferences of the Parties

The participation of youth at COPs began at COP5 in Bonn, Germany, and since COP11/CMP1, YOUNGO has organised Conferences of the Youth (COYs) prior to the COPs in which young people from different NGOs around the world gather to come to a collective youth position in preparation for the COP. Throughout the COP process, the constituency then forms thematic working groups in which they follow the negotiations, and contribute to policy where possible.[6]

The experiences of young South African delegates who attended COP21 and COP22 are highlighted below. Morategi Kale shares her story below regarding their attendance at COP21 (**Text Box 4**). Her detailed blog posts are available on the Youth@SAIIA website.

Text Box 4
Young South African delegates who attended COP21 and COP22

"The involvement of Young South Africans is slowly increasing on the international level. In 2015, the Department of Environmental Affairs invited me to be a youth representative and an official member of the South African delegation at COP21 in Paris. Although I began researching climate change when I was 15 years old through Youth@SAIIA's Environmental Sustainability Project, the experience of being in Paris for the conference was one that was characterised by a lot of learning. By the time the Paris Agreement had been voted on, I left COP21 feeling extremely passionate about meaningful and effective participation of young people in the UNFCCC and other policy and decision-making forums. My role, and the role of other young people at COP21, was mainly to put forward suggestions and comments that are in line with the youth agenda and principles. However, I felt that this is not enough. Young people have to be given the opportunity to play an active role in making decisions that will directly affect our lives and be seen as partners for addressing climate change, rather than means through which adult decision-makers implement the decisions that have been made in the absence of young people".

By Morategi Kale (21 yrs old)

6 https://unfccc.int/cc_inet/cc_inet/youth_portal/items/6795.php

8.2.4 Wildlife & Environmental Society of South Africa Eco-Schools: Youth in Climate Change Adaptation and Education

The Wildlife & Environmental Society of South Africa (WESSA) is a South African environmental organisation that supports and initiates high impact environmental and conservation programmes and projects. The programmes encourage public participation in sustainability and taking action against climate change and caring for the Earth. WESSA also focuses on many initiatives which include; Eco-Schools programmes, environment education and training, conservation of biodiversity and water resources and climate change. Alinah Motjamela shares her experiences of working in an Eco-Schools project by WESSA.

Text Box 5
Youth experiences in working in an Eco-Schools project by WESSA

"Our long-term action projects, in partnership with the Interact group, have involved planting a food garden between the classrooms in previously water-thirsty, lawned areas. Now the whole school can observe the development of crops and the use of mulch and watering during the early morning. Our gardening skills are also being shared with the Grace Hope Centre for Abused Women and Children. We use environmental days, like Arbor Day, to reach a wider audience in the school and have designed and printed inspirational T-shirts for our members.

Litter and rubble from the Dorps River were removed as we realise that this water might be needed by people downstream. During the water shortage earlier this year in our province, we collected 287 litres of potable water to take to Ledig Village to assist a poorly resourced school. We also used our creativity and artistic skills to make toys from waste for early childhood development. Pictures, shapes, textured material and other objects can serve as great educational tools for the young mind. These have been distributed to the Rustenburg Early Learning Centre and Temogo Special Needs School. We have used our talents and interests to prepare a multimedia presentation for a Wetlands Day school assembly. It was well received and this encouraged us to make a video on mobilising youth for climate change mitigation through Eco-Schools. We are also finalising a video on energy use and why solar energy is the solution for the North-West Province. After all our fantastic efforts, we received our Green Flag in 2016. We encourage young people everywhere to join our efforts against climate change and environmental damage".

By Alinah Motjamela (17 years old)

8.2.5 Youth led programmes at the Department of Environmental Affairs

Youth projects and programmes that are run by the Department of Environmental Affairs (DEA) include the Youth Environmental Services Programme and the Youth Jobs in Waste Programme.[7] In addition, there are several youth climate change groups and young individuals that the government engages with. For example, in June 2015, Minister Edna Molewa hosted a Young Women's Dialogue on Climate Change. The South African Government – and especially national departments such as the DEA – strive to include as many stakeholders as possible into their policy formation processes. At COP, for example, the South African delegation hosts regular meetings with all stakeholders in which an overview of the negotiations is given from our country's side, followed by a period of questions and suggestions from the various stakeholders in attendance. Numerous stakeholder consultation workshops were also hosted by DEA where the ideas of the wider public were taken into consideration.

7 DEA Projects and Programmes: https://www.environment.gov.za/projectsprogrammes

8.3 KEY MESSAGES

The development and implementation of a framework for young people for policy input and decision-making on climate change could strengthen and improve youth participation and involvement on climate change related issues.

The framework should cover the following:

- The promotion of youth participation at national, local and sectoral levels. Leading agencies on climate change must promote these interests in collaboration with other ministries and organisations that have experience in facilitating youth participation.
- The development of youth-specific participation programmes that address cultural, language and other barriers. For example, 'youth-friendly' policy briefs in different languages on important issues.
- The improvement of local capacity to integrate children and youth into local programmes, planning and decision-making forums through.
    - Capacity development to understand and critically evaluate national and international policy planning processes and decision making on climate change.
    - Facilitate an enabling environment on climate through:
        - The adoption of a more interdisciplinary approach to climate change education on all levels of formal education, to ensure inclusion of climate change issues in all fields. For example, introducing the topic of climate change to subjects such as business studies, design and the language subjects.
        - The adoption of a more comprehensive approach to climate change education on all levels of formal education. Climate change is a complex topic, and young people should have the opportunity to learn about as many aspects of climate change as possible.
        - Offering support and climate change resources to teachers and activists in the formal and informal education system to ensure that recipients are well-informed and equipped to face climate change challenges.
        - The development of channels of communication and climate change education resources that are targeted specifically at children and youth. This should be developed and designed mostly by young people.

8.4 CONCLUSION

This report has profiled the activities and experiences of young people in climate change within South Africa and abroad. Noticeably, the resources, passions and talents of the youth on climate change issues can be strengthened and improved. Therefore, there is a need to upscale support and acknowledge the importance of youth inclusion in the action against climate change. A process of co-learning and co-building towards climate resilience needs to take place. Clearly, the experiences and reflections of Alinah Motjamela, Morategi Kale and her other youth counterparts in attending the COP conferences illustrates how effective young people can become when presented with an opportunity to transform the world.

ABBREVIATIONS

COP	Conference of the Parties
COP 5	Conference of the Parties (5th)
COP 21	Conference of the Parties (21st)
COP 22	Conference of the Parties (22nd)
COP11/CMP1	Conference of the Parties (11th)/ Meeting of the Parties (1st)
COYs	Conferences of the Youths
DEA	Department of Environment Affairs
ESP	Environmental Sustainability Project
JVE	Jeunes Volontaires pour l'Environnement
NGOs	Non-governmental Organizations
SADC	Southern Africa Development Community
SAYM	Southern African Youth Movement
SAIIA	South African Institute of International Affairs
SAYCCC	South African Youth Climate Change Coalition
UNFCCC	United Nations Framework Convention
WESSA	Wildlife & Environmental Society of South Africa
YOUNGO	Youth Climate Change Movement

CHAPTER 9

CONCLUSION

South Africa continues to commit itself towards reduction of carbon emissions, creating an enabling environment to reduce and adapt to climate change impacts and facilitate the transition to a climate resilient and low carbon economy. Significant actions have been undertaken to respond to and reduce emissions and climate impacts.

This 2nd Annual Report chronicles and highlights South Africa's progress:

a. Enhancing the transparency of South Africa's base: It also highlight progress made in monitoring actions to ensure that decisions are evidence based. Selected youth climate change actions have also been profiled in this report given the vulnerability of youth to climate change impacts and the role that could be played by youths in addressing climate change.

b. Increasing the inclusiveness of climate action through information sharing: progress on making South Africa's climate change response accessible to a wider audience

c. This annual report further applauds leaders in the implementation of South Africa's climate change response and, acknowledges the benefits their actions contribute towards building a climate resilient and low carbon economy and society, through the following:

    - Creating an enabling environment for effective implementation.
    - Managing climate change impacts nationally and contributing to international efforts to manage climate change.
    - Understanding and quantifying the benefits of climate actions undertaken by all spheres of government, the private sector and civil society.
    - Catalysing the implementation of large-scale climate initiatives.

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