

# Investing in Cities Climate Resilience

Cities State of Preparedness in Addressing Climate Change and Building Climate Change Resilience

13 SEPTEMBER 2019

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This investment plan is submitted under the GIZ project: “Cities Resilience Programme: State of Preparedness of South African Cities in Addressing Climate Change Challenges and Building Climate Change Resilience”, as a deliverable of Activity 8: Propose and develop a first pass two-year programme of support for the Cities Resilience Programme (CRP), based on gaps across the building blocks.

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# Abbreviations and acronyms

AE	Accredited Entity
AFD	Agence Francaise de Developpement (French Development Agency)
AUDA-NEPAD	The African Union Development Agency
BEPP	Built Environment Performance Plan
C-88	Circular 88 of National Treasury
CIF	Climate Investment Fund
CoGTA	the Department of Cooperative Governance and Traditional Affairs
CRF	Cities Resilience Forum
CRIF	Cities Resilience Indicator Framework
CRIP	Cities Resilience Investment Plan
CRISC	Climate Resilience Investment Steering Committee
CRP	Cities Resilience Programme
CSIR	Council for Scientific and Industrial Research
CSR	Corporate Social Responsibility
CTF	Clean Technology Fund
DBSA	Development Bank of Southern Africa
DEA	Department of Environmental Affairs
DPME	Department of Planning, Monitoring and Evaluation
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DTI	Department of Trade and Industry
EMDE	Emerging Markets and Developing Economies
EPWP	Expanded Public Works Programme
EWS	Early Warning Systems
FDI	Foreign Direct Investment
FBE	Free Basic Electricity
GCF	Green Climate Fund
GEF	Green Environment Facility
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HDA	Housing Development Agency
IDP	Integrated Development Plan
IGG	Inter-Governmental Grant
IPP	Independent Power Producer
IUDF	Integrated Urban Development Framework
IUDG	Integrated Urban Development Grant
LDC	Least Developed Countries
M&E	Monitoring and Evaluation
MFMA	Municipal Finance Management Act
MRV	Monitoring, Reporting and Verification
MSDF	Municipal Spatial Development Framework
NCCAS	National Climate Change Adaptation Strategy
NDA	National Designated Authority





NDMF	National Disaster Management Framework
NT	National Treasury
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OECD DAC	OECD Development Assistance Committee
PFMA	Public Finance Management Act
PPPs	Public-Private Partnerships
PSC	Programme Steering Committee
R&V	Risk and Vulnerability
RfP	Request for Proposal
SA	South Africa
SANBI	South African National Biodiversity Institute
SAWS	South African Weather Service
SC	Steering Committee
SDF	Spatial Development Framework
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
SEA	Sustainable Energy Africa
SHRA	Social Housing Regulatory Authority
SMEs	Small and Medium sized Enterprises
SoNA	State of the Nation Address
SPLUMA	Spatial Planning and Land Use Management Act
UNFCCC	United Nations Framework on Climate Change
UNDRR	United Nations Office for Disaster Risk Reduction (formerly UNISDR)
UNEP	United Nations Environment Programme
UNISDR	see UNDRR
USF	Urban Sustainability Framework



# 1

## Executive Summary

Local government plays a crucial role in several aspects of building urban climate resilience, through its various roles and mandates, including human settlements and urban development planning; the provision of municipal infrastructure and services; water and energy demand management; and local disaster response, amongst others. With a view to strengthening urban resilience, the Department of Environmental Affairs (DEA) developed a project to assess the ‘State of Preparedness of South African Cities in Addressing Climate Change Challenges and Climate Change Resilience’. This project is part of DEA’s Cities Resilience Programme (CRP), which aims to enhance capacity and training on climate change adaptation, with a specific focus on climate resilience for metropolitan and secondary municipalities.

This Investment Plan responds to the Climate Resilience Indicator Framework and baseline assessment. Together, these are key outputs of Cities State of Preparedness project. The Investment Plan is intended as the ‘go-to’ investment guideline for DEA and South African municipalities to build urban climate resilience. The Investment Plan is intended as a tool for stakeholders (DEA and city practitioners, and potential investors) to deploy in directing and guiding investments towards resilience-building activities that are scalable, and which aim to incrementally transform the way cities build their climate resilience in South Africa.

### Strategic investment objectives

The Investment Plan aims to contribute to and progress cities’ efforts in building sustained climate resilience, and specifically to:

- Reduce the vulnerability of municipalities to climate impacts, by restoring and protecting ecosystem health and promoting climate resilient urban infrastructure, while managing uncertainty to minimise potential harm and loss through a systematic Disaster Risk Management (DRM) approach;
- Build commitment to responding to climate change through inclusive decision-making across all levels of governance and types of actors;
- Promote transformation and inclusive urban design, through equitable access to basic services and opportunities within cities, particularly water, energy and transport;
- Promote green growth and resilient livelihoods by stimulating employment and enterprise development through climate resilience and adaptation interventions.



## A programmatic approach to building resilience

Four resilience pathways underpin the investment plan, providing a **long-term framework** to motivate the investments that could be made in the shorter term (2020 – 2025) under the CRP. The four pathways appear below (and are shown graphically in Figures 5 to 8 in Section 3.2):

- Municipal climate governance
- Sustainable urbanisation
- Ecosystem services
- Disaster risk reduction (DRR).

The potential investments to be made by 2025 are organised within a matrix according to the following criteria:

- the pathway they relate to; and
- the type of intervention, namely governance and planning, inclusive economy, infrastructure, and behaviour.

Each investment pathway contains investments across each type of intervention (climate resilience option type), highlighting the cross-sectoral nature of these programmes and the importance of collaboration across multiple fields in order to achieve overall objectives.

Proposed investments that build climate resilience relate to specific **indicators from the Indicator Framework** developed during this project (see Section 3.4 and the Indicator Framework documents), to facilitate integrated Monitoring, Reporting and Verification (MRV).

### Mobilizing financial resources

Investors are central to the success of the investment plan for building the climate resilience of South African municipalities. Identified investors are organized in the same matrix, by pathways and type of options. This allows for potential Investment to be matched with potential investors that are already operating within specific fields, and towards specific objectives in the country. The investment matrix also highlights the role that DEA will play, along with the investors, in implementing this investment plan for further uptake.





# 2

## Investing in climate resilient cities

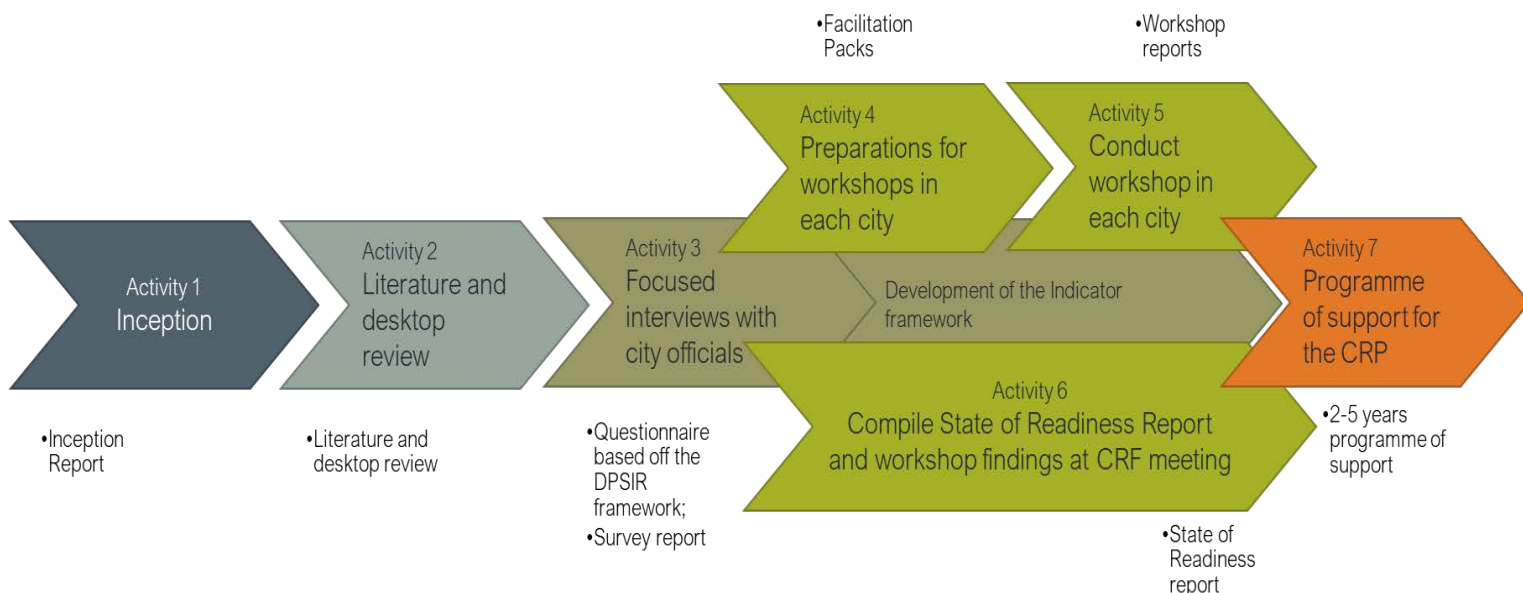
### 2.1. Introduction

Local government plays a central role in several aspects of building urban climate resilience, particularly through delivering against its two primary mandates: i) for delivering basic services and ii) for promoting local socio-economic development. Specifically, cities can build resilience through a range of roles and mandates, to include, among others, human settlements and urban development planning; the provision of municipal infrastructure and services; water and energy demand management; and local disaster response. With a view to strengthening urban resilience, the recently restructured Department of Environmental Affairs (DEA) embarked on a project aimed at assessing the ‘State of Preparedness of South African Cities in Addressing Climate Change Challenges and Climate Change Resilience’. This project is part of DEA’s broader CRP.

DEA, supported by GIZ South Africa, commissioned a OneWorld-led consultancy to undertake this project. The objective is to support local government in building climate resilience through the development of a climate resilience indicator framework and an investment plan for building climate resilience in cities. This document is the Investment Plan for Resilient South African Cities.

Figure 1 below illustrates the various activities of this project, leading up to the development of the investment plan, or programme of support for cities, as described above. The activities of this project informed this investment plan, through understanding the progress made by South African metros and secondary cities to enhance or build their resilience and to identify gaps to be addressed.

**Figure 1. Project activities and their deliverables**



### Structure of this document

This Investment Plan (document) is structured in the following way. The rest of this section (Section 2) presents the methodology and overall project outcomes, and the mapping of climate interventions carried out during this project. Section 3 presents the Investment Plan itself, beginning with the objectives, and then outlining the four pathways for climate resilience and the investment action matrices. The last section discusses the audience of such an investment plan. The indicator framework is a separate deliverable of this project presented separately.

Section 4 presents the investor and implementation strategy and plan, including a discussion of the global enabling environment and development framework, as well as the financing mechanisms for the implementation plan and sequencing of investments.

Key terms are explained in the glossary at the end of this document.

## 2.2. Methodology and Project Outcomes

### Approach

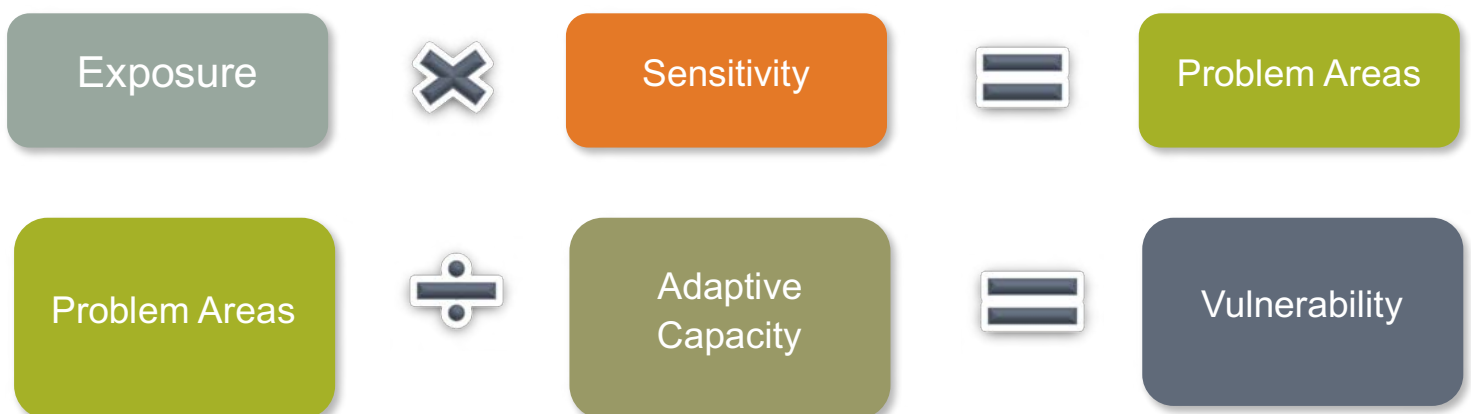
The concept of resilience is understood as “... the ability of a social, economic or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation and the capacity to adapt to stress and change” (Climate Change Bill, 2018). This definition necessitates a systems-

thinking approach. Cities are dynamic ecological, social and economic systems, encompassing people, natural resources, biodiversity, wildlife, infrastructure, open spaces, livelihoods and industries. The **adaptive capacity** of cities (see Glossary for further explanation), and therefore their resilience, is based on the strengths, attributes, capacities and resources available to the systems that make up that city.

As shown in Figure 2, the vulnerability of a system to climate change is a function of how exposed the system is to climate changes, along with the sensitivity of that system, coupled with its adaptive capacity – or ability to adapt and cope or recover. Across all systems, including cities, building adaptive capacity is the key aspect of resilience-building. Improved adaptive capacity can considerably reduce vulnerability to the impacts of climate change. Adaptive capacity is the aspect of vulnerability which human beings have the most influence or control over.

This means that if climate change reduces a city’s crucial functions (social relations, primary productivity, ecosystems services and economic prosperity), the impacts can be mitigated by increasing the city’s adaptive capacity. In other words, municipalities can increase their city’s climate resilience by minimising the vulnerability of the city’s components. Furthermore, systems thinking recognises that resilience is both critical to, and dependent on, livelihoods and populations (related to land-use), whilst governance (including institutional arrangements) is either a key resilience enabler or barrier.

**Figure 2. Understanding climate vulnerability (following the AR4 IPCC definition)**



## Investment Plan objectives

With this systemic approach in mind, the investment plan has been developed through examining the interrelationships in urban systems, for example influence, constraints and enhancers. This has been done in consultation with stakeholders. The early stages of developing the investment plan were based on two previous activities in the project: the baseline assessment (Activity 3 in Figure 1); and participatory analysis in the 15 city workshops conducted (Activity 5 in Figure 1); as well as on the expertise of the urban development and climate adaptation experts on the project team. The Cities Resilience Forum (CRF) workshop, held in July 2019, provided feedback and validation of the Cities Resilience Investment Plan (CRIP), along with its Indicator Framework.

The implementation of the investment plan supports international and national strategic goals and priorities and aims to **build the resilience of South African municipalities to climate change by promoting inclusive urban development and resource wealth** through achieving four strategic objectives:

- Reduce the vulnerability of municipalities to climate impacts, by restoring and protecting ecosystem health and promoting climate resilient urban infrastructure, while managing uncertainty to minimise potential harm and loss through systematic DRM approaches;
- Build commitment to responding to climate change through inclusive decision-making across all levels of governance and types of actors;
- Promote transformation and inclusive urban design, through equitable access to basic services and opportunities within cities, particularly water, energy and transport;
- Promote green growth and resilient livelihoods by stimulating employment and enterprise development through climate resilience and adaptation interventions.

**Transformation of development is at the heart of the solution to building climate resilience and shifting from crisis management to readiness preparation** (as shown in Figure 3).

Transformed development is both equitable and sustainable: these are necessary conditions for increasing climate resilience by integrating risk in planning and financing decision-making processes. Investments must then support incremental steps to development transformation, towards climate resilience readiness along the climate resilience continuum.

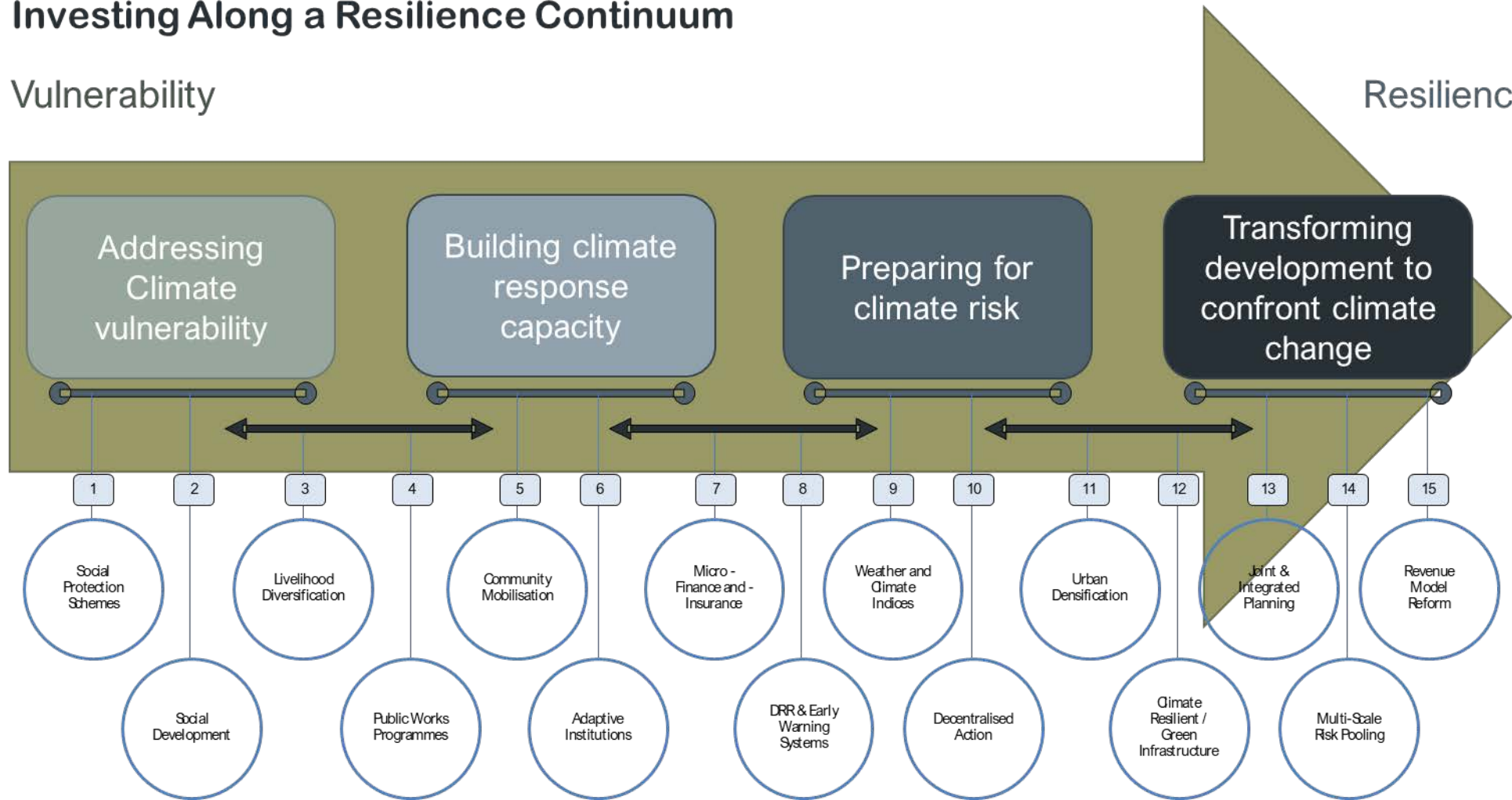


Figure 3. The climate resilience continuum

## Investing Along a Resilience Continuum

Vulnerability

Resilience



Source: OneWorld, forthcoming. Developed for the Global Centre for Disaster Protection





## 2.3. Mapping interventions for climate resilience

In order to develop an investment plan to build climate resilience in cities, participants in each municipal workshop worked in groups to map climate-resilient interventions for investment. These options, and their potential outcomes, were analysed against the project indicator framework. This analysis identified the priority interventions and needs of the project cities, as elucidated by the workshop participants. The outcomes of this analysis are presented below and led to the definition of the climate resilience

pathways (presented in Section 3.2).

During the workshops, more than nine municipalities out of the 15 mapped interventions for the following (as reflected in Table 1 below):

- Inclusion of ecosystems services in the municipal infrastructure system
- Strength and integration of the economy
- Access to safe water
- Integration of the policy environment and ability to promote resilience.

**Table 1. Type of interventions mapped by more than nine municipalities**

OUTCOMES	INTERVENTIONS MAPPED BY MUNICIPALITIES	NO. OF MUNICS HIGHLIGHTING A RELATED INTERVENTION
Inclusion of <b>ecosystems services</b> in the municipal infrastructure system	<b>Support of ecosystems to deliver services</b> , such as buffer zones for floods. [Food/Fruit-] Tree planting. <b>Clearing alien vegetation</b> , planting indigenous vegetation and crops, and controlled burning interventions.	13
Strength and integration of the <b>economy</b>	<b>Climate-smart agricultural sector</b> (crops and livestock types, farming practices). Support to small businesses in various sectors. Decentralisation of industrial nodes and development. Eco-tourism.	9
Access to <b>safe water</b>	<b>Alternative water sources</b> at home, including rainwater harvesting techniques and the use of boreholes <b>Harvesting and recycling of storm water and grey water</b>	9
Integration of the <b>policy environment</b> and ability to promote resilience	<b>Climate-smart policies and urban planning</b> <b>Policy development:</b> Disaster Management Plan and strategy, Waste and Water Management Plan, Infrastructure Maintenance, financial impact of climate change on insurance and municipal budget. Green building <b>standards</b> . <b>Integration of climate change and health</b> into all policies, e.g. the Spatial Development Framework (SDF).	9

Between five and eight municipalities mapped interventions relating to the following indicators, in each case (as summarised in Table 2 below):

- Biodiversity and wildlife conservation and enhancement
- Availability and enforcement of legislation
- State of critical infrastructure, facilities and stocks (climate-proofing)
- Adequacy and sustainability of supply of water
- Improved energy sustainability
- Collaboration in policy planning and empowerment of stakeholders
- Level of mainstreaming of climate change and resilience in all applicable policies, regulations, standards, by-laws
- Adequacy and predictability of flows of finance for climate resilience
- Effectiveness of emergency response services
- Level of monitoring, maintenance and renewal of essential utility infrastructure, with effective contingency planning
- Skills for a diverse and green economy.



**Table 2. Type of interventions mapped by more than 5 but less than 9 municipalities**

OUTCOMES	INTERVENTIONS MAPPED BY MUNICIPALITIES	NO. OF MUNICS MENTIONING A RELATED INTERVENTION
Biodiversity and wildlife conservation and enhancement	<b>Wetlands and open spaces</b> monitoring, rehabilitation and maintenance. <b>Sustainable land-use management</b> and enforcement of land use management plan.	8
Availability and enforcement of legislation	<b>Enforcement of municipal by-laws</b> , development approval processes. Police presence and multi-disciplinary crime prevention operations	6
State of critical infrastructure, facilities and stocks (climate-proofing)	Expansion and evolution of <b>infrastructure capacity</b> , i.e. upgrade of hard infrastructure, specifically water, energy and transport infrastructure. Implementation of <b>sustainable urban designs</b> .	8
Adequacy and sustainability of supply of water	<b>Water quality monitoring</b> , in aquifers, water tables and streams. Buffer zones and <b>water recharge systems</b> taking into consideration green infrastructure. Implement <b>water restrictions according</b> to available resource and residents' needs.	7
Improved energy sustainability	<b>Renewable energy projects</b> , i.e. Solar Water Heaters, wind production, partnership with Independent Power Producers (IPPs). Increase use of gas. <b>Energy saving</b> measures such as energy saving bulbs. <b>Waste to energy</b> projects.	7
Collaboration in policy planning and empowerment of stakeholders	<b>Partnerships, awareness of municipal staff</b>	6
Level of mainstreaming of climate change and resilience in all applicable policies, regulations, standards, by-laws	<b>Co-design, co-creation of policies</b>	6
Adequacy and predictability of flows of finance for climate resilience	<b>Budget control (use 100%)</b>	5
Effectiveness of emergency response services	Development of <b>disaster management system and plan</b> and implementation of Early Warning Systems (EWS)	5
Level of monitoring, maintenance and renewal of essential utility infrastructure, with effective contingency planning.	Planning and implementation of revised <b>maintenance guidelines</b> . Create a <b>maintenance and contingency budget</b> .	5
Skills for a diverse and green economy	Adaptation of <b>working hours</b> . Implement <b>climate-smart Expanded Public Works Programme (EPWP)</b> , in relation with ecosystem services conservation, biodiversity, vegetation and alien plants	5

No interventions were **directly** mapped for four outcomes of the draft indicator framework, namely:

- Social cohesion
- Learning from the past
- Access to criminal and civil justice in terms of effectiveness, affordability and accessibility of mechanisms to promote justice for citizens
- Trust and norms of reciprocity.

**The analysis outlined above informed the development of adaptation, or resilience building pathways, for South African Cities, as shown in Figures 5, 6, 7 and 8 in the following Section.**

Investments made within these pathways, collectively, will build resilience in South African cities, noting that the investment plan needs to be applied in a differentiated manner in different cities. Local circumstances, development priorities and vulnerabilities to climate change vary from city to city, along with their capacities to respond. The Baseline Assessment and Cities State of Preparedness Reports developed for this project from the baseline survey and city workshops reflect the differentiated priorities, perspectives and capacities for each project city.



# 3

## The Cities Resilience Investment Plan

Investments in building climate resilient cities, by necessity, need to reflect cross-sectoral, coherent strategies for long-term adaptation and resilience building. As such, the Cities Resilience Investment Plan (CRIP) is predicated by sustainable development and underpinned by a developmental approach. This is reflected in the long-term goals and objectives, with indicators, in the adaptation pathways defined in the plan. Because change is a process, the investment pathways comprise incremental investments across the typical sectors and functions of South African cities, and reflect indicative timelines to implement these investments.

### 3.1. Alignment with national objectives

The primary objective of the CRIP is to **build the resilience of South African municipalities to climate change by promoting inclusive urban development and resource wealth**, particularly in terms of land-use, water and energy. It is important to note that resource poverty is integral to low levels of adaptive capacity prevalent across South African cities. The investment plan supports international and national strategic developmental goals and priorities. For instance, the Sustainable Development Goal (SDG) targets and indicators are particularly relevant to the CRIP and its accompanying Indicator Framework, as they are internationally set targets that underline all investments presented in this investment plan (See Section 4).

While climate risks vary from city to city, all urban areas need to address the challenge of protecting the most vulnerable people within their boundaries.

An **inclusive economy and society** is characterised by equitable participation in growth across the formal and informal sectors – participation in decision making in sustainable development processes, and in the benefits of urban growth itself.

Part of cities' mandates is to address this issue in a future where climate change threatens developmental outcomes and equitable access to basic services and opportunities. The aspirational goals set by the indicator framework and supported by the monitoring system it puts in place contribute to achieving the inclusivity and sustainable urban development priorities announced by the South African national government.

Overall, the themes outlined in the CRIP align closely with the National Climate Change Adaptation Strategy (NCCAS) and the objectives stated in the first State of the Nation Address (SoNA) of the 6<sup>th</sup> Parliament on the 20<sup>th</sup> June 2019. The NCCAS emphasises the importance of adapting to climate change through transformational change thus building resilience to decrease vulnerability to climate change, especially for the poor. The strategy highlights the need for integration and collaboration between and across sectors to ensure societal resilience is built holistically.

President Ramaphosa's SoNA established seven presidential priorities under the broad theme of "Lets grown South Africa together as we celebrate 25 years of freedom" (See Box 1 below). He highlighted the need for **spatial integration, human settlements and local government**; and **social cohesion and safe communities** in his address to the nation.

**Box 1. Seven governmental priorities, June 2019**

President Ramaphosa's seven priorities, as established during his first State of the Nation Address in the 6<sup>th</sup> Parliament, June 2019:

- Economic transformation and job creation
- Education, skills and health
- Consolidating the social wage through reliable and quality basic services
- Spatial integration, human settlements and local government
- Social cohesion and safe communities
- A capable, ethical and developmental state
- A better Africa and World.

These messages and strategies from the top level of government re-affirm and give impetus to the CRIP in building sustained climate resilience in South African cities, through a commitment to protect, transform and promote actions to strengthen resilience and reduce vulnerability across the 15 project municipalities.

**A key aspect of strengthening urban resilience revolves around managing climate risks, and in particular deploying effective Disaster Risk Management (DRM).** This includes implementing Disaster Risk Reduction (DRR) policies and strategies. DRM and DRR taken together, is the systematic approach and practice of managing uncertainty to minimise potential harm and loss. There are two components to risk management: risk assessments or analysis, and strategies and actions to control, reduce and transfer risks (preparedness) (UNISDR, 2019).

Risk assessments include multi-hazard disaster risk assessments, or risk and vulnerability assessments for instance. Strategies and actions include disaster risk management plans, early warning systems, contingency funds, disaster prevention and preparedness initiatives (DFID, 2016).

The growing reality – and increasing costs – of climate change and climate risks to cities has made it impossible for cities to continue with a business-as-usual approach. Building climate resilience implies the need **for transformational change** – to establish pathways going forward that incorporate climate resilience into every aspect of development, and particularly so in cities, which continue to be growing hubs for employment, shelter and livelihood diversification opportunities.

**Target audience**

The CRIP is targeted primarily at DEA in planning for its investments in climate resilience in South African cities. It is also however applicable to at all government practitioners working in or supporting urban development in South Africa as well as their development partners and investors.

The pathways provide an overarching framework with specific interventions to be funded to build municipal climate resilience. Specifically, the investment matrix emphasises the possible role and investments that DEA will support, to build climate resilience in municipalities, as DEA holds the national mandate for facilitating climate change responses in South Africa.



## 3.2. Climate resilience pathways

The CRIP is based off the four adaptation pathways, namely **Municipal Climate Governance** (Figure 5 in the following pages), **Sustainable Urbanisation** (Figure 6), **Ecosystem Services** (Figure 7) and **Disaster Risk Reduction** (Figure 8). Investments within these adaptation pathways cut across the four dimensions of climate resilience identified within a city system. Cross cutting aspects, such as behaviour change and the economy, are integrated within each pathway.

Ultimately, the combined interactions of various climate resilience pathways and actions contribute towards an inclusive economy and society that is thus enabled to respond to specific, and cumulative climate change risks.

To promote climate resilience, an inclusive economy and society requires a sustainable long-term outlook. This is an important characteristic of the pathways for resilience in this investment plan.

Outcomes of investments aimed at building South African cities' climate resilience can then be measured by the climate resilience indicators from the Cities Resilience Indicator Framework (CRIF), provided separately. Aligned with the seven priorities announced by the President and

“

*An inclusive economy and society is characterised by equitable participation in growth across the formal and informal sectors. Participation of vulnerable population groups in growth processes is via non-discriminatory employment, while participation in the benefits manifests in income improvement and in increased social expenditure benefits that reduce disadvantages, such as education and human capacity development*

”

(Ramos et al. 2013; Fourie, 2014)

with the **four dimensions** of the CRIF, the Investment Plan incorporates four investment types, namely related to:

- Governance and planning
- The city's economy
- Infrastructure (green and grey)
- Behaviour

This typology of investments for climate resilience is shown in Table 3 below and the investments type are also represented in the conceptual framework outlined in Figure 4.

**Table 3. Typology of climate resilient investments**

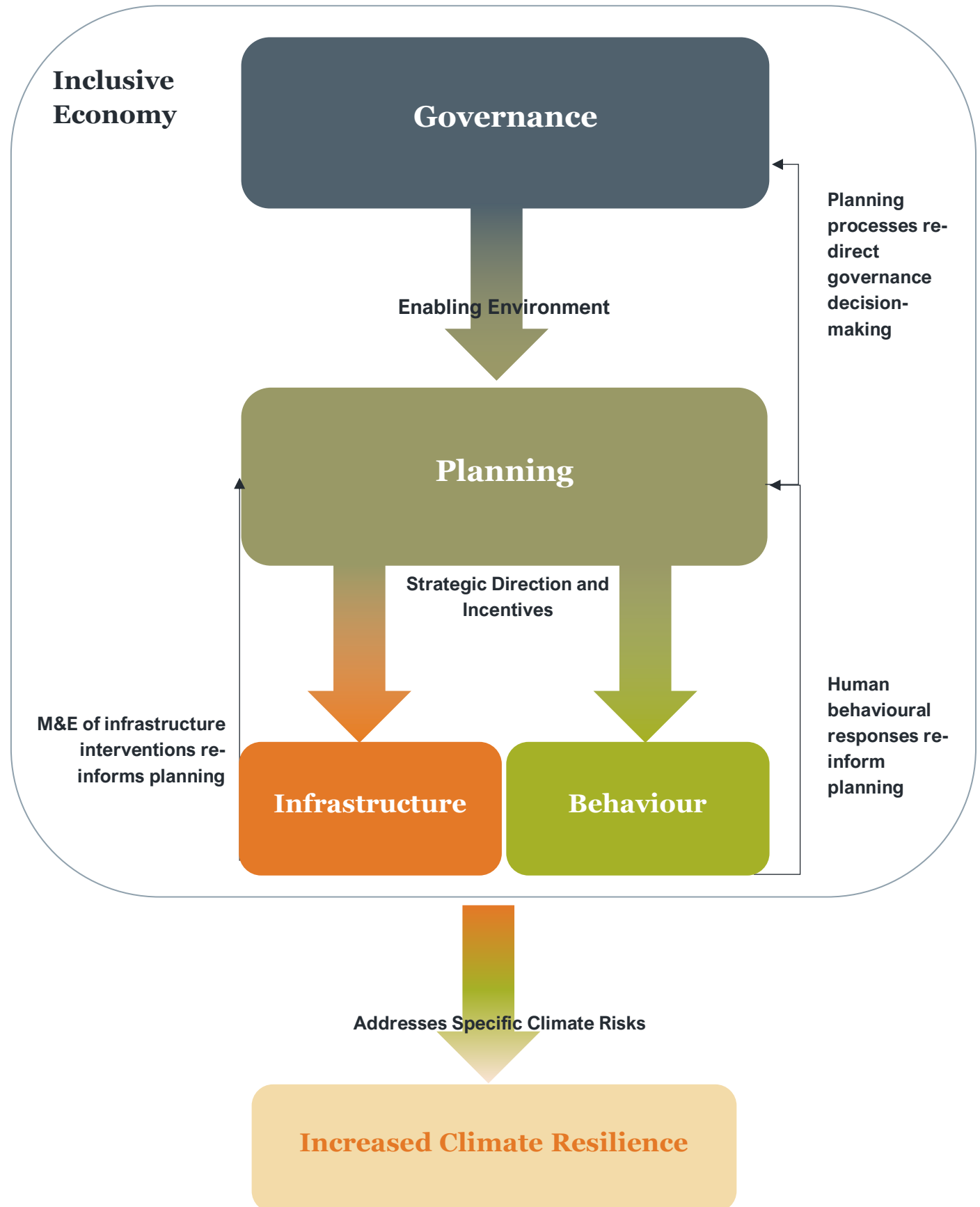
TYPE/CATEGORY	DESCRIPTION
<b>Governance &amp; Planning</b>	Resilience investments for using/adapting leadership, policy, regulations, laws and strategies, and institutional arrangements to transform or alter pertinent governance aspects across a city for enhanced climate action and optimal disaster risk reduction. Investments in climate-adaptive and disaster risk-reducing, transformational planning, that is jointly conducted and integrated across relevant sectors.
<b>Economy</b>	Resilience investments that increase per capita income, and green economy investments that enable enterprises that promote climate change adaptation, while also creating alternate revenue streams for the municipality.
<b>Infrastructure</b>	Resilience investments for climate-mainstreamed, climate-resilient and integrated infrastructure development, across green and grey infrastructure, for enhanced nature-based solutions and to limit the incidence of stranded economic assets and to reduce or eradicate the impact of extreme climate events.
<b>Behaviour</b>	Resilience investments in changing behaviour for climate-adaptive, capital decision making, planning and management by a city's social partners (government, labour, industry and civil society).



The resilience pathways incorporate multiple integrated investments for climate resilience

across the typology and conceptual framework of investments, as shown in Figure 4.

**Figure 4. Climate Resilience Investments: a Conceptual Framework**



To provide an example within the conceptual framework (Figure 4 above), **municipal governance investments** (Pathway 1: Figure 5 below) provide the overarching impetus to create and/or strengthen the existing **enabling environment** for climate resilience **planning** within local cities. The policy and regulatory environment will then guide **strategic planning** and **incentivise investment** across the other three pathways.

The **sustainable urbanisation pathway** (Pathway 2: Figure 6) includes key policy interventions, such as those related to guiding long-term city densification. Densification creates the enabling environment for strategic investments in densified development, such as low-income housing, water and energy efficiency and improved stakeholder engagement, amongst others. Importantly, these strategic adaptation investments facilitate the improvement of **ecosystem service provision** (Pathway 3: Figure 7), through investments such as restoration of polluted land, climate-resilient stormwater management and water quality improvements. Moreover, the same integrated

logic applies to **DRR** (Pathway 4: Figure 8), for example community-based and managed drought and flood responses are closely linked to the availability of ecosystem services to reduce flood and drought impacts.

Ultimately, **the interrelated and connected nature of these investment pathways** is essential to maximising the benefits (including co-benefits) of investments, with limited municipal resources. Additionally, integrated investment strategies provide greater leverage for further co-financing options.

While individual investments or projects are embedded in the pathways, it is important to consider each pathway holistically, as a set of incremental and integrated actions.

**The four pathways for urban resilience appear in Figures 5 to 8, which follow.**

Incremental investments/interventions to underpin an actionable programme of support are embedded in these pathways. As such, the pathways represent the investment plan framework. This was validated at the CRF workshop in July and has since been further revised and elaborated.

Figure 5. Municipal Climate Governance Pathway

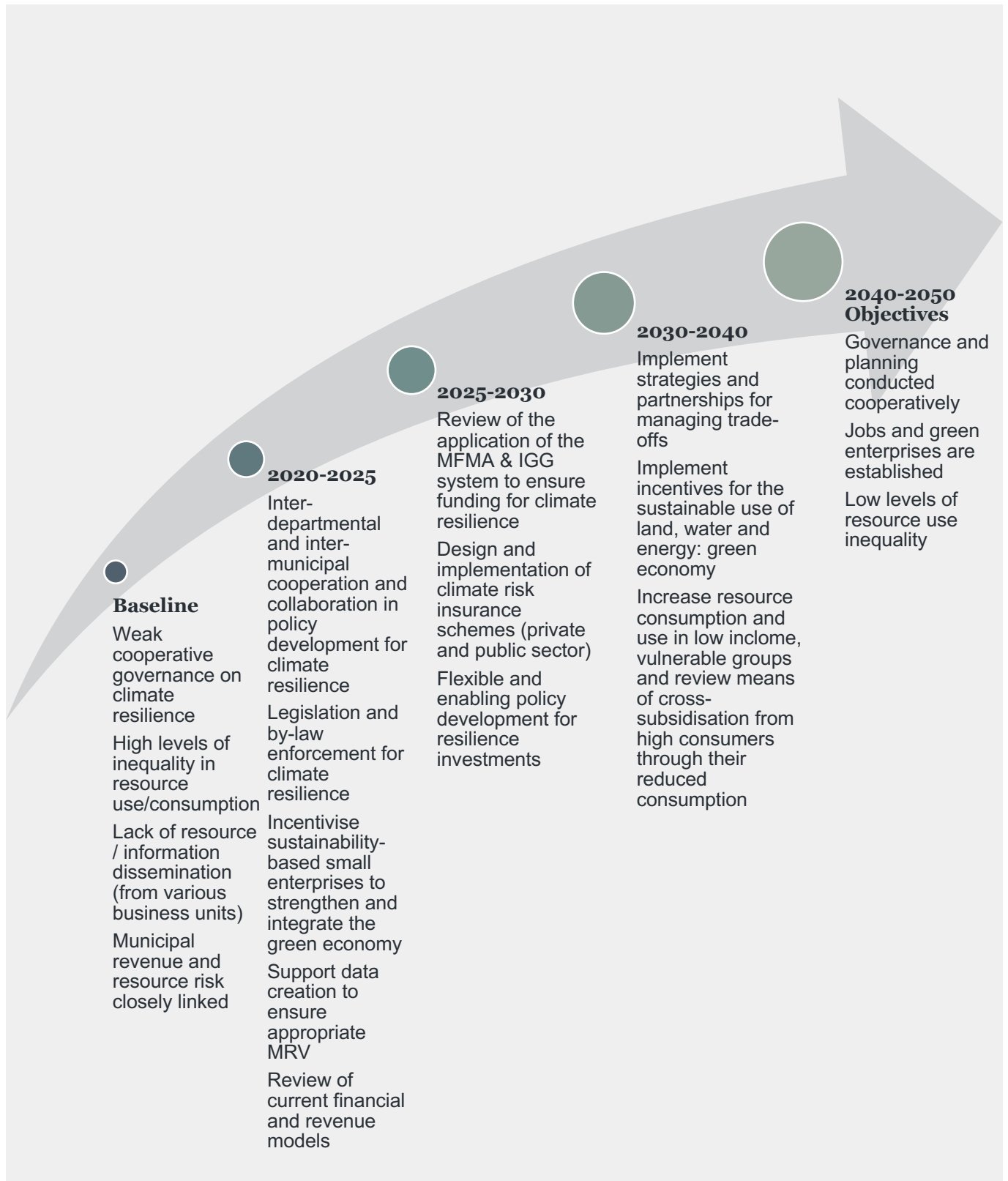


Figure 6. Sustainable Urbanisation Pathway

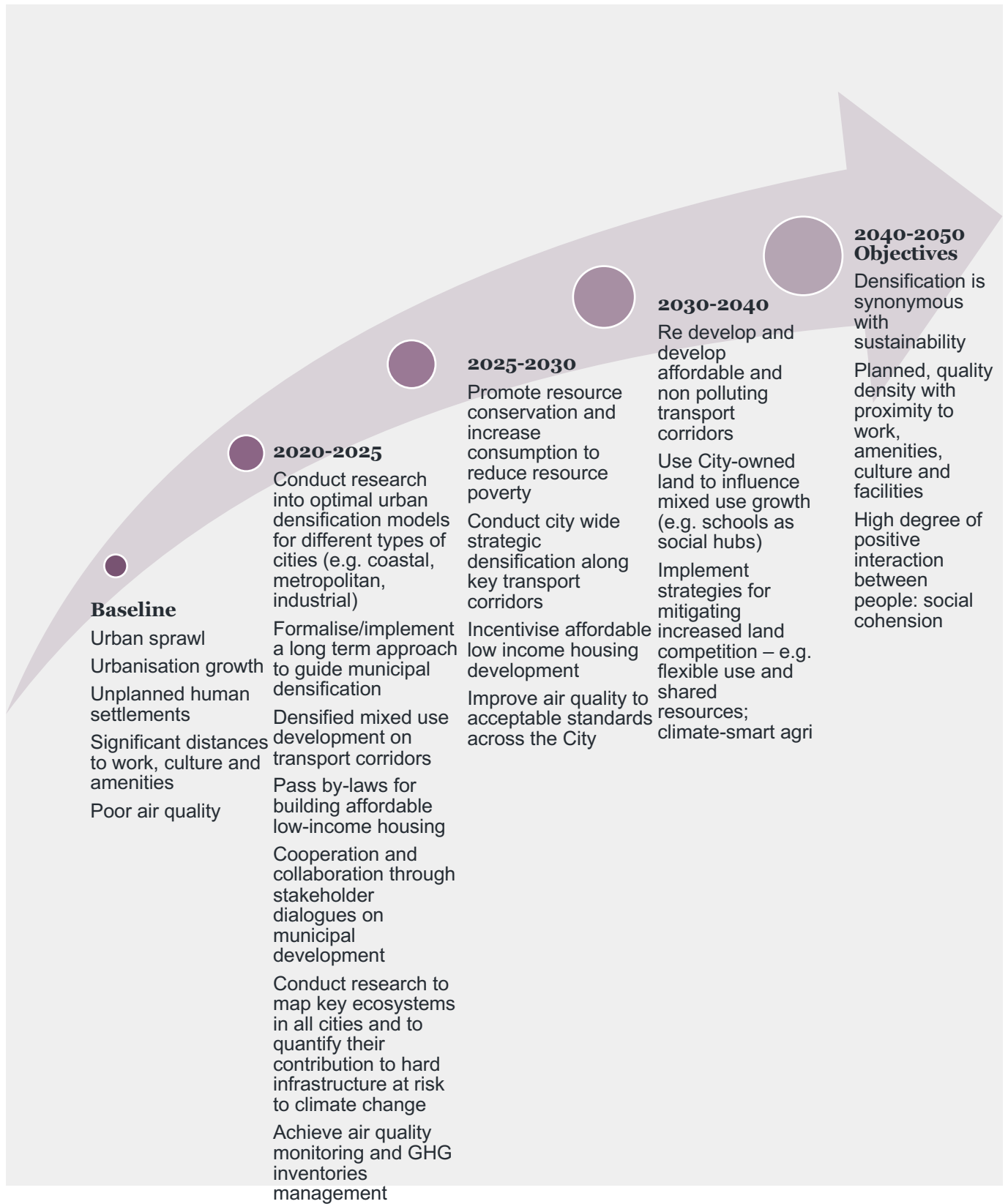


Figure 7. Ecosystem Services Pathway

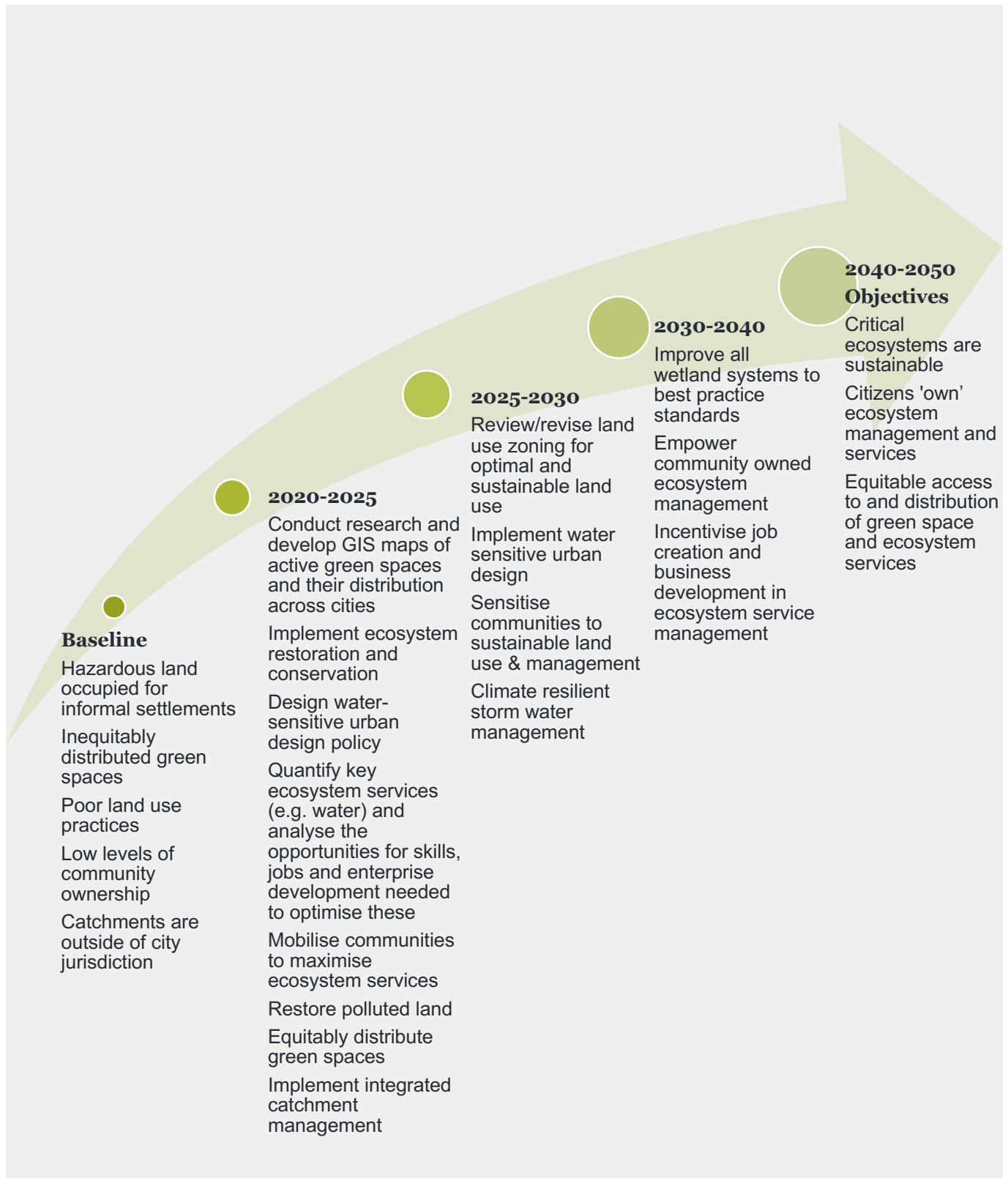
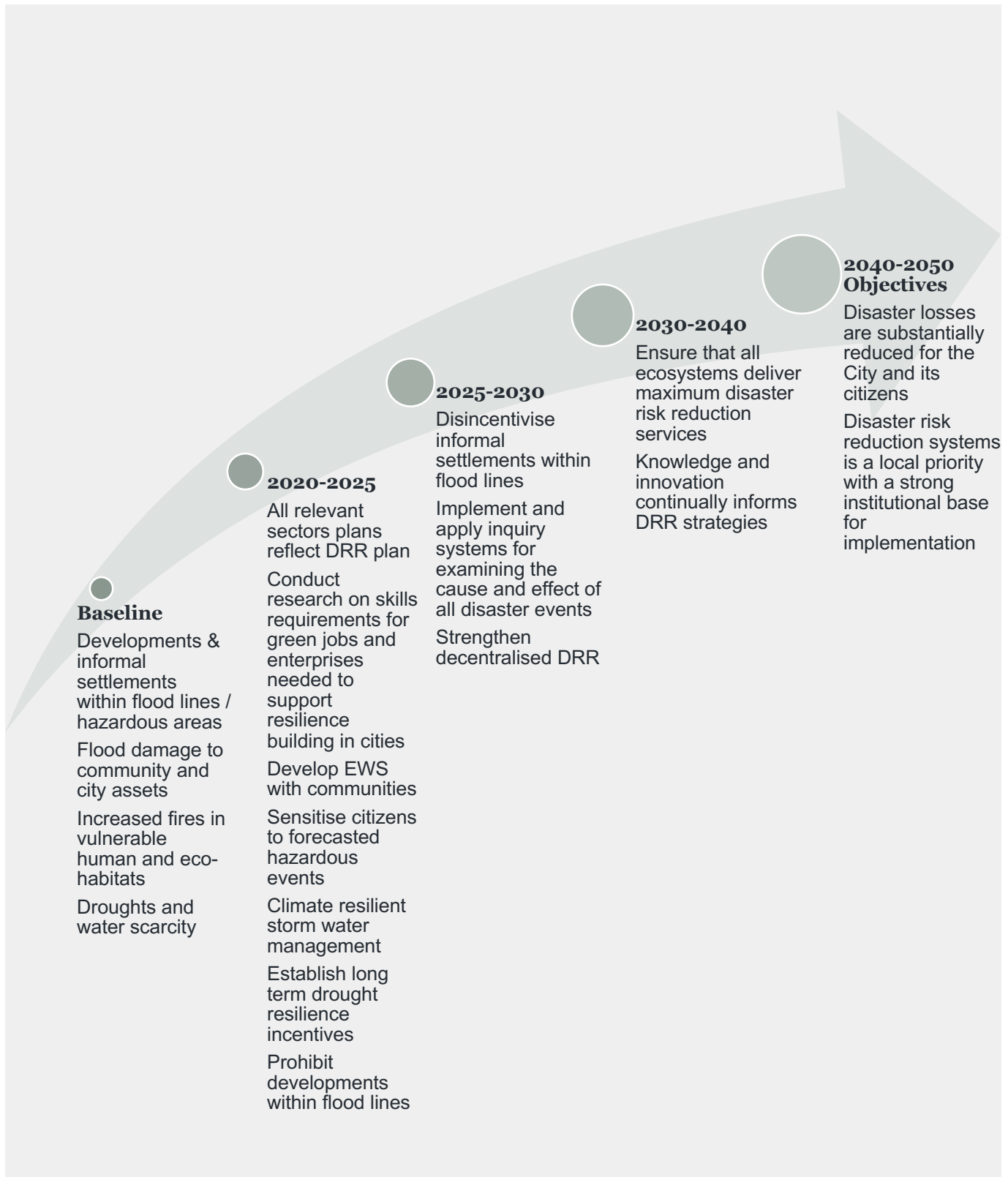




Figure 8. Disaster Risk Reduction Pathway



## Resilience investment matrix

Table 4 below presents the investment options for each pathway (to be implemented by 2025) by type of investment. As such, programmes of investments can be designed according to types

of pathways. The table also shows the interrelationship between climate resilience options across the pathways.

**Table 4. Overall resilience investment matrix by type of investments and pathway for the 2020-2025 timeframe**

PATHWAYS TYPE OF INVESTMENT	MUNICIPAL CLIMATE GOVERNANCE	SUSTAINABLE URBANISATION	ECOSYSTEM SERVICES	DISASTER RISK REDUCTION
<b>Governance and planning</b>	<ul style="list-style-type: none"> <li>Inter-departmental and inter-municipal cooperation and collaboration in policy development for climate resilience</li> <li>Legislation and by-law enforcement</li> <li>Support data creation to ensure appropriate MRV</li> <li>Review of current financial and revenue models</li> </ul>	<ul style="list-style-type: none"> <li>Conduct research into optimal urban densification models for different types of cities (e.g. coastal, metropolitan, industrial)</li> <li>Formalise/implement a long-term approach to guide municipal densification</li> <li>Cooperation and collaboration through stakeholder dialogues on municipal development</li> <li>Achieve air quality and greenhouse gas (GHG) inventories monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Design water sensitive urban design policy</li> <li>Conduct research and develop GIS maps of active green spaces and their distribution across cities</li> <li>Equitably distribute green spaces</li> </ul>	<ul style="list-style-type: none"> <li>Develop Early Warning Systems (EWS) with communities</li> <li>All relevant sector plans reflect Disaster Risk Reduction (DRR) plan</li> </ul>
<b>Inclusive economy</b>	<ul style="list-style-type: none"> <li>Incentivise sustainability-based enterprises and jobs to strengthen and integrate the green economy</li> </ul>		<ul style="list-style-type: none"> <li>Quantify key ecosystem services (e.g. water) and analyse the opportunities for skills, jobs and enterprise development needed to optimise these</li> <li>Mobilise communities to maximise ecosystem services</li> </ul>	<ul style="list-style-type: none"> <li>Establish long term drought resilience incentives</li> <li>Conduct research on skills requirements for green jobs and enterprises needed to support resilience building in cities</li> </ul>
<b>Infrastructure</b>		<ul style="list-style-type: none"> <li>Densified mixed-use development on transport corridors</li> <li>Pass by-laws for building affordable low-income housing</li> <li>Conduct research to map key ecosystems in all cities and to quantify their contribution to hard infrastructure at risk to climate change</li> </ul>	<ul style="list-style-type: none"> <li>Restore polluted land</li> <li>Implement ecosystem restoration and conservation</li> <li>Implement integrated catchment management</li> </ul>	<ul style="list-style-type: none"> <li>Climate resilient storm water management</li> </ul>
<b>Behaviour</b>				<ul style="list-style-type: none"> <li>Sensitise citizens to forecasted climatic events</li> <li>Prohibit developments within flood lines</li> </ul>

### 3.3. Investment action matrices

This section breaks down the interventions contained within each pathway according to the costs, potential co-benefits, and implementation characteristics (responsible entities and potential funders). These matrices (Tables 5 to 8 that follow) summarise the possible investment options by 2025 (according to the pathway they correspond to and the type of adaptation option).

The various columns are useful to understand in detail what each investment option entails (description, estimated costs and potential co-benefit), who would be responsible for their implementation and who could fund it. The last columns help strategise and prioritise investments according to municipal needs.

## Pathway 1: Municipal climate governance investment action matrix

**Table 5. Investment action matrix for Pathway 1: Municipal climate governance**

TYPE	INVESTMENT OPTIONS 2020-2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S POTENTIAL ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
Governance and planning	Inter-departmental and inter-municipal cooperation and policy development for climate resilience action.	Legislation and by-laws to be co-designed and co-created to ensure the mainstreaming of climate resilience in all applicable policies, regulations, standards and by-laws. The policy environment to be integrated to be able to promote climate resilience through climate-smart policies and urban planning, green building standards, as well as infrastructure maintenance guidelines and the integration of the link between climate change and its socio-economic impacts.		Improved coordination will result in greater mainstreaming of climate resilient development planning and climate change in general. This will assist with 'de-siloing' of development planning. Moreover, this will improve the coordination of communication of risks and how these are managed by different departments in the city.	<u>DEA and Municipal departments</u> Facilitate cross coordination through existing platforms (CRF) and interdisciplinary and intergovernmental working groups to support work across catchments and boundaries Running governance and planning training/capacity development workshops for/with municipalities Promotion of municipal knowledge sharing and co-creation	Most municipalities in SA have embarked on the design of regulations and standards to promote climate resilience in one way or another (for instance, Green Design Guidelines – Ekurhuleni, Climate Change Policy, Green Building Guideline Toolkit - Msunduzi), but this is not done systematically or in a collaborative manner. Some platforms exist at the international, national and provincial levels (such as the KZN Compact of Mayors or the CRF) but these should be convened more regularly, and in an integrated manner to avoid duplication and municipal burden, while being expanded to overall cities functions and tailored towards policy development.
Governance and planning	Legislation and by-law enforcement	Implement, facilitate and develop partnerships and associated strategies for managing trade-offs of sustainable urban development. This includes: - partnerships with and between private, public and non-governmental organisations which are stakeholders in	In these Public-Private Partnerships (PPPs) the design is very much driven by government which integrates private components to	Partnerships will lead to improved buy-in, social and institutional cohesion, transparency and trust within and across the City. Sharing of knowledge and expertise will improve	Municipal council and technical departments <u>DEA potential role:</u> Identification of best practices of cooperation and policy development for sustainable urban development	Municipal departments do not currently cooperate and collaborate with private, public and non-governmental organisations in a systematic manner.

TYPE	INVESTMENT OPTIONS 2020-2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S POTENTIAL ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
		<p>or managers of different City functions that will change with a revised revenue and development approach.</p> <ul style="list-style-type: none"> <li>- partnerships (i.e. Public-Private Partnerships (PPPs)) for integrated resources management and conservation</li> <li>- professional and technical relationships with universities to provide support into partnerships, municipal staff and broader governance issues.</li> </ul>	<p>implement policies or provide resources. In this approach, private actors are brought into the policy-making process for cost-efficiency reasons or for effectiveness reasons (Marx, 2019). \$\$</p>	<p>decision-making around complex trade-offs and ultimately maximise the benefits and minimise the costs of building resilience in a more equitable manner. A key benefit could be increased transparency of governance and private sector activities as they relate to climate resilience.</p>	<p>and climate resilience action and dissemination of best practices</p> <p>Technical support to institute partnerships for managing trade-offs of sustainable urban development</p>	<p>Municipalities that use PPP for service delivery are slightly more advanced (Joburg, Tshwane, Cape Town, eThekweni, for instance) in this regard, but this is not the norm.</p>
Governance and planning	Review of current financial and revenue models	<p>Review of current financial models (subsidies and risks) - analysis of possible alternative and innovative revenue streams, their future sustainability and feasibility. The review should begin with the development of a new conceptual framework for revenue generation, collection and expenditure, with explicit targets for future sustainability in order to address the triple challenges of poverty, inequality and unemployment (e.g. petrol and diesel cars phased out by 2050 and public transport becomes the dominant mode of transport). Review of the Intergovernmental Grants (IGG) system – e.g. application of the Local Government Equitable Share for building climate resilience. Review of the application of the Municipal Finance Management Act (MFMA) / Public Finance Management Act (PFMA) to</p>	<p><i>“The process to develop innovative financing alternatives are complex, nuanced, multi-faceted and will require the engagement of a wide range of stakeholders and methodologies.”</i> (South African Cities Network, 2017).</p>	<p>Diversifying the revenue streams supporting City functions will improve the financial sustainability of the City through systematic de-risking of the revenue model. If revenue streams face lower risks and are more predictable, this will improve the credit worthiness of the City and the ability of the City to invest in its citizens and the necessary infrastructure to adapt to climate change (amongst the other essential services that the City provides). (Chernick et al. 2011)</p>	<p>Municipal manager and departments</p> <p><u>DEA potential role:</u></p> <p>Support the investigation of alternate municipal revenue options (e.g. waste recycling) and provide technical support to other national departments in the review and application of national laws and framework (MFMA, PFMA and IGG system).</p> <p>Provide technical support to national government, to promote the ability of municipalities to purchase directly from Renewable Energy (RE) Independent Power Producers (IPPs).</p> <p>Conduct research on the adaptation co-benefits of RE use and access (and clean energy in general) and</p>	-



TYPE	INVESTMENT OPTIONS 2020-2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S POTENTIAL ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
		determine entry points for change. Political economy analysis of possible winners and losers (vested interests); trade-offs, possible synergies and conflicts from possible changes in municipal revenue model.			track adaptation progress	
Economy	Incentivise sustainability-based enterprises and jobs to strengthen and integrate the green economy	Support to small businesses that contribute to climate resilient sectors, and eco-tourism. Innovative financial incentives for sustainable use of water and energy (standards, such as climate-smart agricultural practices, pricing, grants, taxes, subsidies, information disclosure and non-market incentives).	It is acknowledged that the process to develop innovative financing alternatives are complex, nuanced, multi-faceted and will require the engagement of a wide range of stakeholders and methodologies (South African Cities Network, 2017). \$\$	See above	Municipal economic development departments <u>DEA potential role:</u> Scoping small enterprise opportunities and making these and possible incentives available to municipalities for their application Conduct research and establish a baseline of the role of informality (and the informal economy) in the growth of cities Provide technical support to incentivise green enterprises and jobs, and to integrate and mainstream the 'green' economy (climate resilience aspect).	The green economy frameworks have incentivised some municipalities to start addressing the need for supporting SMMEs and sustainable use of resources by businesses (e.g. Climate Change and Green Economy Action Plan - Nelson Mandela Bay), but few have put the policies into action (e.g. waste-to-wealth project in Rustenburg).
Governance and planning	Support data creation to ensure appropriate monitoring, reporting and verification (MRV)	Support municipal departments in the creation and reporting on climate change and environmental information to measure climate resilience of cities.		Collecting and analysing data has several co-benefits, such as developing the capacity of actors to track progress, increase accountability and transparency and better planning through information-based decision-making.	Municipal departments, municipal managers <u>DEA potential role:</u> Advocate and partner with data institutions in SA (DTI, SCIR, universities) and integrate databases. Support and develop capacities within cities to collect data and report on the appropriate platforms.	The level of data collection and reporting in municipalities is very low in SA (with the exception of a few metros such as Cape Town (Corporate Project and Portfolio Management (CPPM) Programme) or eThekweni). Secondary cities are embarking on this process with very low capacities (e.g. Buffalo City - database



TYPE	INVESTMENT OPTIONS 2020-2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S POTENTIAL ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
						template, Polokwane - detailed climate change data collection strategy)

## Pathway 2: Sustainable urbanisation investment action matrix

**Table 6. Investment action matrix for Pathway 2: Sustainable urbanisation**

TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
Governance and planning	Conduct research into optimal urban densification models for different types of cities (e.g. coastal, metropolitan, industrial)	Commission research into the most appropriate and optimal urban densification models and approaches for adoption by the different types of cities that make up the South African urban landscape. This research should be targeted at urban planners and city decision makers, as well as their investors and developers. It should aim to inform the future of urban planning while also considering costs, incentives and specific urban densification targets. Such research should include best practice benchmarks and study tours for a group of city decision makers to an example city.	Desk research would be cheaper but a study tour, which adds to the cost, would make the research more meaningful and inclusive, while contributing to behaviour change among city planners and decision makers. \$\$	Behaviour change among city planners and decision makers along with increased, up to date knowledge and skills needed to shift municipal institutions away from entrenched Apartheid planning practices	DEA and Department of Cooperative Governance and Traditional Affairs (CoGTA) <u>DEA potential role:</u> Lead the development of research Terms of Reference and fund the research. Co commission the research with CoGTA and National Treasury. Leverage additional funding from a development bank, such as KfW Development Bank or the French Development Agency (AFD).	Planners in some cities consider urban densification principles to a limited extent. Research that coherently presents sustainable, customised urbanisation models for different types of South Africa cities is not available.
Governance and planning	Formalise/ implement a long-term approach to	Develop/ revise Densification Strategies to formalise and implement a long-term approach to guide municipal densification; promote high	Social housing/ development is unattractive to investors, so	Various incentives for sustainable and equitable densification will increase the rate of change towards	DEA, CoGTA and Dept. of Planning, Monitoring & Evaluation (DPME) <u>DEA potential role:</u>	The Integrated Urban Development Framework (IUDF) is a policy initiative driven by CoGTA to guide

TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
	guide municipal densification	densities within convenient walking distance of all of the city's high capacity transport systems except on land required for protecting ecological assets, agriculture, river and wetland corridors. Guide and plan for human mobilisation, migration and development (in line with the Municipal Spatial Development Framework (MSDF) and Built Environment Performance Plan (BEPP)) to facilitate rapid land settlement in predefined locations suitable for further development, as well as plan for possible future relocations to more sustainable living locations.	government financial support/ incentives would be needed (Central Densification Plan 3A, eThekweni, 2017) \$	a densified development model and spur new business opportunities relating to sustainable development and construction. These may bring in alternative revenue for the city and limit settlement on uninhabitable land, amongst others. The multiple indirect benefits associated with the resulting changes in behaviour and/or infrastructure development patterns will create a long-term sustainability dividend for the city (Grieg-Gran, 2002), which will limit impacts of climate change in the long-run by improving living standards, the ease of doing business, etc.	Identify and develop global best practice case studies on sustainable urban densification  Identify a roster of experts to support municipalities on sustainable urban densification  Promote best practices on sustainable urban densification within national government (e.g. Housing Development Agency (HDA))  Conduct training and capacity development workshops with municipalities on sustainable urban densification	urbanisation in South Africa. In its current state, it is not systematically localised at the municipal level and needs to include climate resilience considerations. Therefore, some municipalities have developed their own development strategies (e.g. 2040 Growth and Development Strategy (Johannesburg); Ekurhuleni's Vision 2030 Strategy). Such urban plans need to incorporate notions of urban climate resilience and be integrated with the Integrated Development Plan (IDP), Spatial Development Framework (SDF), BEPP and the implementation of the Spatial Planning and Land Use Management Act (SPLUMA), which is currently widely used in secondary cities.
Infrastructure	Densified mixed-use development on transport corridors	Prioritise settlements within 3km of work centres; or 5km where transport is good; integrate with all service delivery functions. The following principles should be integrated in the legislation and by-laws supporting mixed-use development: -Sustainable urban design -Maintenance, restoration and protection of green infrastructure (e.g. buffer zones, concrete coverage on developments);	Research from the Financial and Fiscal Commission used a model to compare the costs of a hypothetical compact (or denser) city with the current reality. The study concluded that compact cities are considerably more efficient than	As climate risk in the city is largely a function of poor adaptive capacity and levels of resilience - largely related to poverty, inequality and lack of access to essential resources and services – strategically planned and rapidly advanced densification will minimise the impacts of climate	Municipal departments <u>DEA potential role:</u>  Identify and develop global best practice case studies on sustainable urban densification including mixed-use development within national government  Promote best practices on sustainable urban densification and support training and capacity	Currently, municipalities in South Africa do not have a coordinated approach to densification. Therefore, densification is defined in an ad hoc manner, without a clear national objective or guidelines.  Moreover, some municipalities also include rural areas, which are usually not addressed in



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
		<ul style="list-style-type: none"> <li>-Maintenance, restoration and protection of critical infrastructure, facilities and bulk infrastructure (e.g. water, energy and transport infrastructure maintenance and upgrade);</li> <li>-Implementation of water sensitive urban design (i.e. 50% of plot concretised);</li> <li>-Design of standards for housing (e.g. green buildings, heat and cold stress, fire risk, adaptive design - passive cooling/heating);</li> <li>-Prohibition of developments within flood lines;</li> <li>-Resource efficiency requirements on new developments (i.e. rainwater harvesting, solar panels, energy-saving lighting, use of gas);</li> <li>-Open space standards</li> <li>-Zoning schemes (i.e. new developments to be zoned with consideration of climate change impacts).</li> </ul>	<p>the current sprawling form of South African cities, with savings to the state, households and environment. Over 10 years, a sprawling city will cost R57 billion more than a compact city, equal to 1.4% of projected GDP (Financial and Fiscal Commission, 2011).</p> <p>\$\$</p>	<p>change on critical infrastructure (Temmer and Venema, 2017), which can thus attract greater investment and serve a greater population of people living in closer proximity. If densification is done strategically and planned together with ecosystem management and restoration activities, as well as human mobilisation and settlement strategies, this will provide the opportunity to improve the quality of green and natural spaces in the City to counteract the risks associated with greater population densities. There is a myriad of co-benefits associated with densification, ranging from decreased carbon emissions, greater economic productivity, shorter commutes to work, increased availability of affordable urban housing, decreased pressure on land-resources and the environment, improved (centralised) provision of essential services such as hospitals, transport etc.</p>	<p>building on the co-benefits of safe and clean energy access</p> <p>Identify and establish incentive schemes for municipalities to increase Free Basic Electricity (FBE)/sufficient affordable electricity</p> <p>Support the development of by-laws for densified mixed-use development on transport corridors</p>	<p>the urban development plans in an integrated manner.</p>

TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
Infrastructure	Pass by-laws for building affordable low-income housing	Support the development of affordable low-income housing in new mixed-use development zones, through incentives or subsidies.	\$	Incentives and subsidies would remove the barriers which constrain low-income housing developments and create an enabling environment for such developments. Affordable housing has multiple benefits for a wide section of society.	Municipal manager and human settlements departments. <u>DEA potential role:</u> Support the development of affordable low-income housing in new mixed-use development zones, through incentives or subsidies.	Some municipalities have carried out housing projects for low-income housing (e.g. George housing project), however the Housing Development Agency (HDA) or the Social Housing Regulatory Authority (SHRA), or other stakeholders leading the development of housing for low-income households do not systematically include climate resilience and densification as part of the development of affordable low-income housing.
Infrastructure	Conduct research to map key ecosystems in all cities and to quantify their contribution to hard infrastructure at risk to climate change	Commission research to map key ecosystems across all relevant cities and to quantify their contribution to hard infrastructure, such as dams, which are at risk from providing municipal services such as water during extreme weather events. Target the information at institutions managing existing services and infrastructure and at those that plan for and invest in hard infrastructure that is ecosystem dependent, to limit their investment risks.	\$\$	Improved body of work on ecosystems and their services; strengthened relationship between hard and soft infrastructure; strengthened cross silo management and decision making	<u>DEA:</u> Development research Terms of Reference and fund the research. Commission the research and leverage additional funding from a development bank, preferably the Development Bank of South Africa (DBSA).	
Governance and planning	Cooperation and collaboration through cross-stakeholder dialogues on municipal	Develop and implement a cross-cutting coordination hub for climate resilience and development in the City. This platform will act as a cross-department and directorate coordination hub, as well as a stakeholder mobiliser to facilitate,	\$	Improved coordination will result in greater mainstreaming of climate resilient development planning and climate change in general. This will improve the level of	<u>DEA</u> Facilitate cross-coordination through gathering and sharing of best practices to make a case for such practices to be implemented.	Municipal departments do not currently cooperate and collaborate within the municipality and with private, public and non-governmental organisations in a systematic



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
	development	plan and implement cross-cutting climate resilient initiatives ranging from policy development to on-the-ground actions.		integrated planning and assist with 'de-siloing' of development planning. Moreover, this will improve the coordination of communication of risks and how these are managed by different departments in the City.		manner, and especially not on climate resilient municipal planning.
Governance and planning	Achieve air quality and GHG inventories monitoring	Develop and undertake air quality management plans and GHG Inventories through local government operations and community wide approach, i.e. both at the level of government facilities and operations (government buildings and other facilities, streetlights and traffic signals, vehicle fleet) and at the municipal level, including all stakeholders (settlements, private sector...))		Beyond reducing emissions under local government operational activities and mitigating climate change, such activities promote overall green government operations, which need to be resilient to climate change (adaptation co-benefits). Air monitoring and GHG reduction also has health benefits at the municipal level.	<u>DEA</u> Develop a coordinated approach to GHG inventories and air quality reporting and support the development and monitoring of air quality and health management approaches	Some national guidance exists for specific aspects such as the Environmental Management Frameworks or the National Waste Management Strategy, but these need to be localised and supported for integrated implementation building climate resilience.



### Pathway 3: Ecosystem services investment action matrix

**Table 7. Investment Matrix for Pathway 3: Ecosystems services**

TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
Governance and Planning	Conduct research and develop GIS maps of active green spaces and their distribution across cities	Urban green spaces are critical to climate resilience, providing opportunities for multi-purpose community areas that can provide cooler areas in heat waves, while also offering community access to refrigerated water, for example in an adjacent community hall, or school. In the main, the most vulnerable, poor communities have access to the least green spaces. Mapping existing and potential green spaces will provide a blueprint for the equitable distribution thereof.	\$	Green spaces also reduce dust in areas where air quality is poor and if adequately managed and maintained, can provide opportunity for improved social cohesion.	<u>DEA</u> Develop the terms of reference and commission and disseminate the research	The City of Cape Town is currently undertaking such research.
Governance and planning	Equitably distribute green spaces	Equitably distributed and sustainably managed green spaces across the City, including nature reserves, green belts, parks, vegetation buffer zones, etc.	Costs can be summarised as acquisition, development (design and construction) and maintenance. Will vary depending on specific characteristics, such as size, location, ownership, etc (Tempesta, 2015). In general maintenance costs are 85-95% of the total cost (McPherson et al., 2005). One study found maintenance costs of, on average, 1.10 Euro per meter squared in the Veneto region	Strong benefits in terms of increasing City aesthetics and broader liveability. Mitigate urban heat island, balancing water flows, runoff and groundwater recharge, carbon sequestration and storage. Mitigate environmental degradation caused by urbanisation. Reducing energy costs of cooling nearby buildings, improve	<u>Municipal environmental departments and DEA</u> DEA maps green infrastructure spatially across all municipalities and identifies inequalities and solutions for municipalities to include in their development and land use plans	Green spaces and open spaces in cities are not valued for their biodiversity and adaptation benefits in South Africa.  They are incrementally being recognised and valued in municipal planning, but there is a need for a stronger alignment between their current status and use, and their potential for biodiversity

TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
			(Venice). In 15 UK parks the average maintenance cost was 0.28 - 1.34 Euro per square meter (Tempesta, 2015). <u>Re-vegetation:</u> Two Australian case studies: (1) revegetation of 0.25 hectares over two years costs \$150.50 with these costs including labour for seed collecting, planting and weed removal as well as buying seedlings and the use of equipment. (2) rehabilitating 100 square metres of riverbank cost \$4 638 as result of labour, equipment and seedling costs (Taman, 1999). \$\$	local quality of life, create environments for biodiversity, recreation areas. Roy, Byrne and Pickering (2012); Haq (2011); Orru et al. (2014).		and adaptation benefits.
Economy	Quantify key ecosystem services (e.g. water) and analyse the opportunities for skills, jobs and enterprise development needed to optimise these	Optimising ecosystem services necessitates skilled communities who could also benefit from related job creation or enterprise development. Research is needed to identify and quantify the primary ecosystem services that necessitate skills development and to analyse the related job/enterprise opportunities.	The size of investment will depend on the extent of the research (e.g. geographical coverage, validation required, etc.). A typology of ecosystems and their services could be researched, acting as a proxy for like ecosystems across the country. \$-\$\$	Enhanced body of knowledge on high value ecosystem services and improved opportunities for employment, including among women and youth. Opportunities for improved social cohesion.	<u>DEA</u> Develop the ToR and commission and disseminate the research to cities, academic institutions, community groups and relevant national departments	
Behaviour	Implement ecosystem restoration and conservation	Sensitise and mobilise community owned ecosystem management initiatives, this includes	\$\$	Improved social cohesion, resilient and diversified food source, improved management and security	<u>Municipal environmental departments and DEA</u> Identify priority ecosystems	Currently vulnerable areas are not fully mapped in South African cities, which hinders the ability of cities to engage



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
		targeted community capacity building and engagement activities in vulnerable areas.		of local ecosystems, ecosystem services can be improved which will help to decrease drought and flooding. Increased biodiversity increases access to healthy foods for low income households. Job creation, aesthetic improvements (Agustina and Beilin, 2011).	requiring restoration Facilitate a programme for ecosystem restoration in partnership with EPWP Integrate ecosystem restoration and conservation activities within the municipal DRM activities	communities in the management of these resources. Some good examples exist (e.g. eThekweni catchment management) but this is not the norm.
Infrastructure	Restore polluted land	Restoration of polluted or hazardous land through indigenous revegetation and other bioremediation and clean-up activities.	Clean-up activities costs can vary depending on the level of pollution; restoring an abandoned mine for instance is very expensive, while cleaning up a polluted park would be substantially cheaper.	Contribution to sustainable regional development and tourism; carbon storage and climate regulation; Improved supply of fresh water (impact on human health and sustainable livelihoods); income generation; Cost savings; improved health and safety of local residents; can foster biodiversity; agricultural opportunities.	<u>Municipal environmental departments and DEA</u> Identify priority land for restoration and repurposing (e.g. for agriculture from mining) Incentivise land restoration in priority areas through jobs, enterprises and possible tax incentives (for private sector) in priority land restoration areas Include the notion of informality in land restoration activities (informal settlements and informal economy)	Restoration of polluted or hazardous land is an issue that DEA has been tackling. Municipal activities in this field could benefit from piggybacking on existing programmes such as the Effective Environmental Improvement Interventions (2E2I) - a programme which focuses on the rehabilitation of degraded land.
Economy	Mobilise communities to maximise ecosystem services	Sensitise and mobilise community and city-wide energy and water conservation practices through targeted community capacity building and engagement activities in areas where there is big potential for saving, as well as city-wide communications around		Improved social cohesion, resilient and diversified food source, improved management and security of local ecosystems, ecosystem services can be improved which will help to decrease drought and flooding. Increased biodiversity increase access to healthy foods for	<u>Municipal environmental departments and DEA</u> Disseminate water conservation best practice to municipalities Support awareness campaigns in municipalities (human and financial resources) Design municipal cost benefit system for encouraging investment	In a water scarce South Africa, cities face concrete challenges in the provision of water services. Water and ecosystems services conservation has been happening occasionally out of necessity and on an ad hoc basis, without national coordination or support.



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
		the need for sustainable use of resources. Build on existing and past awareness campaigns.		low income households. Job creation, aesthetic improvements (Agustina and Beilin, 2011).	in the protection of high-water yielding spaces	
Governance and planning	Design water sensitive urban design policy	Implement water sensitive urban design; maintenance, restoration and protection of green (and blue) infrastructure (e.g. buffer zones, concrete coverage on developments).		See above.	<u>Municipal environmental departments and DEA</u>  Identify and disseminate best practice examples of water sensitive urban design and case studies on maintenance, restoration and protection of green (and blue) infrastructure (e.g. buffer zones, concrete coverage on developments). Provide training and capacity development to targeted, water security vulnerable municipalities on water sensitive urban design	See above
Governance and planning	Implement integrated catchment management	Develop and implement a cross-cutting institution tasked with regional coordination and management of systems beyond municipal boundaries; integrated and sustainable flood systems management; integrated and cooperative water resources management / catchment management.	An ongoing problem for policy design in the water sector across developed and developing countries is how to allow or even encourage regulation to adapt to new issues and priorities while keeping down regulatory risk and the associated cost of capital. In the past, slow rates of demand, supply and technological change in the water sector made this seem an easier task than in other sectors, adequately addressed by periodic reviews of tariffs and targets. Now, the pace and scale of urbanization, climate change and the development of decentralised treatment	Improved regional management, coordination, cooperation and integration (facilitated through active institutional engagement and partnerships) will improve the cooperative management of broader resource systems (e.g. food and water) in the region. In this way, the benefits and costs associated with generating these essential resources can be shared more equitably and reduce conflict. Moreover, up-to-date regional development information is essential to	<u>DEA</u> DEA considers the current governance and management challenges and identifies and promotes solutions to integrate municipalities into catchment management outside their administrative boundaries  Enhance and improve support to catchment management forums and discussions  Interdisciplinary and intergovernmental working groups to be developed / strengthened to support work across catchments and boundaries	Water catchment providing the water resources to a municipality are often located outside the city boundary. To date, there are only punctual example of municipalities, which have started to put in place catchment management systems outside a city boundary. One example is the compact of Mayors for the KZN region which was launched to establish a partnership between various municipalities to work and plan urban development collaboratively.



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
			<p>technologies may shake up the established model of a single municipal water and wastewater utility, with significant implications for the way the sector is structured and regulated. In the future, elements of adaptive policy-making such as defining triggers for policy review and processes to institutionalise learning (Walker, Rahman, and Cave 2001) may be usefully integrated into economic regulation in the water sector. (Jensen, 2019).</p> <p>\$\$</p>	<p>consider in the city's development planning processes, most notably with regards to the movement of people and the management of food, water and energy systems that extend beyond the municipal boundaries of the system (Timmerman and Bernardini, 2009; Leigh and Lee, 2019).</p>		

## Pathway 4: Disaster Risk Reduction investment action matrix

**Table 8. Investment Matrix for Pathways 4: Disaster Risk Reduction**

TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
Governance and planning	Develop Early Warning Systems (EWS) with communities	Develop EWS with communities to educate and sensitise citizens to forecasted hazardous events, to improve community and system disaster response. Social media platforms can be used to educate and provide targeted EWS to improve disaster response.	Using social media to raise awareness and sensitise citizens. Social media is a cost-effective solution in comparison to large-scale systems (Chatfield and Brajawidagda, 2012; Middleton, Middleton and Modafferi, 2010).  As a form of communication, social media has very few costs and the potential to reach a very large audience. It is also remarkable in its ability to create communities, or networks, of people with shared interests and a common purpose (Berry & Weigeldt, 2012).  \$	People are able to access targeted adaptation information through social media, increasing awareness of risks.  People are able to access disaster related information timeously and directly through their phones. This enables quick and efficient action in response to disasters. Improves social cohesion and combined disaster response efforts. Potential for disaster detection as well as warning, which can be used to develop real time crisis maps, damage detection and better understanding of impact, help emergency services to locate people.  (Chatfield and Brajawidagda, 2012; Sakaki et al., 2010; Middleton, Middleton and Modafferi, 2010; Avvenuti et al., 2016).	<u>DEA and DRM municipal departments</u>  Identify and disseminate best practice and train key municipalities.  Partner with SAWS to ensure climate information and risks are included in EWS.  Support municipalities in the localisation of such EWS for climate risks and specifically through communities' engagements to ensure systems designed are relevant to their users.	The South African Weather Service (SAWS) is the main source of early warning in South Africa. SAWS operate the Multi-Hazard Early Warning System.  The Council for Scientific and Industrial Research (CSIR) has a pilot project aimed at an SMS based EWS for coastal areas, used by fishermen.  Such activities need to be built and localised at the municipal level, and municipalities need to engage with such systems, as this is not necessarily the case.
Governance and planning	All relevant sector plans reflect DRR	All municipal sectoral plans must include DRR principles and guidance	It is widely accepted that effective preparedness or preventative actions have lower	Frequent revisions of the monitoring, forecasting and response protocol for	<u>DEA and municipal managers</u>  Support to municipalities through	DRM departments are well established departments in South African municipalities,



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
	plan	and be aligned with DRR plans.	costs than responding to disaster (Jongman et al., in prep; (Red Cross Red Crescent Climate Centre, 2015).	climate-related hazards and disasters will improve performance of these processes and ultimately reduce the economic, social and environmental impacts of floods, fires, strong winds, droughts etc. These benefits will largely accrue to the most vulnerable sections of the population and will help to realise numerous co-benefits related to improved standards of living, reduced risk of economic loss (which has knock-on impacts) for investor confidence and lower expenditure on aid or disaster recovery (UN/ISDR, 2007).	training and capacity development Support to disaster management forums	which exist across the different type of municipalities. It has emerged that DRM departments and environmental departments work together in cities in relation to climate change adaptation work. This trend needs to be embraced and developed further.
Behaviour	Sensitise citizens to forecasted climatic events	Creating awareness and building sensitisation of citizens to climate change and climatic events through greater access to information, being able to better access and understand climate knowledge, etc.  Knowledge to be developed include weather literacy, climate and environmental monitoring for flood flows, fire risks...	Targeted planning sessions could be a cost-effective solution to equip households with the relevant climatic understanding and knowledge. Community/ local newspapers could also be used along with social media/ television to bolster awareness and sensitisation.	Awareness and sensitisation of citizens to climatic events contribute to their adaptive capacity and ability to respond to climate disasters.	<u>DEA</u> Support to the development of appropriate training and awareness creation materials and support the roll out of these in target municipalities	Municipalities in South Africa do engage in community training and education programs on DRM or environmental issues (e.g. Rustenburg is rolling out education officers from the Integrated Environmental Management Unit). Such activities must be linked with climate risk information, including fire risks.



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
Infrastructure	Climate resilient storm water management	Construction of new and retrofitting of wastewater reuse and recycling systems for improved performance of water treatment and reuse. Improvement of stormwater harvesting infrastructure from collection systems to storage, treatment and redistribution.	<p>Wastewater Reuse:</p> <p>Building a wastewater treatment system using a constructed wetland costs about \$5 per gallon of capacity which is roughly half the cost of conventional facilities (Foster, Lowe &amp; Winkelman, 2011).</p> <p>Stormwater harvesting induces water treatment costs; but low-cost treatment devices can be used (Rohre &amp; Armitage, 2017).</p> <p>Capital costs of creating a stormwater wetland between \$1 to \$2 per cubic foot of storage provided (NOAA). (Shaw, Colley &amp; Connell, 2007).</p> <p>\$\$\$</p>	Climate resilient storm water management improves drought resilience through overall increase in water availability in the system (i.e. system augmentation), reduced water pollution and improved quality. It improves environmental conditions, has positive health impacts, and potential to provide natural habitats and open spaces for communities. Possibility of large-scale impacts such as increased investor confidence and business activity due to decreased drought or flood risk. (Shimabuku et al.,2018; Walsh et al.,2015; Luthy et al., 2019; Rohre and Armitage, 2017)	<p><u>DEA and municipal infrastructure departments</u></p> <p>Identify the most vulnerable municipalities to poor storm water management and incentivise enhanced stormwater management in target municipalities</p> <p>Design incentive schemes for municipalities to promote waste recycling enterprises including as an alternate revenue stream</p>	<p>Storm water management infrastructures are aging infrastructures, which are costly to maintain for municipalities. However, the lack of maintenance of storm water management infrastructure makes municipalities more at risk to floods and drought and further infrastructure degradation.</p> <p>Depending on their revenue capacity, municipalities like Ekurhuleni (Architectural Departmental Action Plan) are working on a storm water projects.</p>
Economy	Conduct research on skills requirements for green jobs and enterprises needed to support resilience building in cities	A body of robust research, that builds off current work on developing Sector Jobs Resilience Plans and the National Employment Vulnerability Assessment is required to identify and promote skills, jobs and enterprise development in the green economy at city level. This will enable cities to deliver their mandate for	\$	Improved employment opportunities, including for women and youth, both groups that are highly vulnerable to climate impacts.	<p><u>DEA</u></p> <p>Develop the Terms of Reference and commission and disseminate the research to cities, universities, skills development entities, and institutions involved in evolving the green economy</p>	Little, if any work is being done at present.



TYPE	INVESTMENT OPTIONS BY 2025	INVESTMENT DESCRIPTION	ESTIMATED COST (\$ - LOW COST, \$\$ - MEDIUM COST, \$\$\$ - HIGH COST)	POTENTIAL CO-BENEFITS	MAIN STAKEHOLDER RESPONSIBLE (AND DEA'S ROLE WHEN NOT THE MAIN STAKEHOLDER)	RELEVANT EXISTING WORK AT THE MUNICIPAL LEVEL
		local economic development and to support climate resilience building.				
Economy	Establish long-term drought resilience incentives	Innovative financial incentives for sustainable use of water and energy to support the adoption of resilient behaviour and the development of resilient technologies.			<u>DEA and municipal managers</u> Identify appropriate drought resilience incentives and standardise these as appropriate DEA works with National Treasury (NT) and provides technical support through Circular 88 (C-88) to support the implementation of these incentives in target municipalities	Corporate Project and Portfolio Management (CPPM) Programme (Cape Town) is mapping projects related to drought; Nelson Mandela Bay has a Climate Change and Green Economy Action Plan looking at rainwater harvesting as a means of promoting drought resilience.
Behaviour	Prohibit developments within flood lines	Implement, facilitate and develop partnerships and associated strategies for ensuring sustainable urban development, which does not put settlements and populations at risk.		Multiple indirect benefits associated with the resulting changes in behaviour and/or infrastructure development patterns will create a long-term sustainability dividend for the City (Grieg-Gran, 2002), which will limit impacts of climate change in the long-run by improving living standards, the ease of doing business etc.	<u>DEA and CoGTA</u> Municipalities prohibit developments within flood lines with the support of DEA in identifying and mapping flood lines and populations at risk. Support drafting and sharing best practice from other municipalities in terms of prohibition of developments within flood lines, and technical support in the implementation of such practices.	Municipalities in South Africa can create policies and by-laws to prevent urban developments within flood lines. However, the enforcement of such is limited.

### 3.4. Investments and resilience assessment

#### Links with the Cities Resilience Indicator Framework

The Draft Indicator Framework builds off the framework for resilient cities designed by the Organisation for Economic Co-operation and Development (OECD). The OECD framework sets out the foundational structure of an indicator framework for urban resilience. This foundation

comprises the four aspects of urban resilience to climate change: economic, social, environmental and institutional dimensions (see Table 9 below). These dimensions guide the development of indicators that measure the different sub-dimensions of urban resilience.

**Table 9. OECD dimensions and indices of urban resilience to climate change**

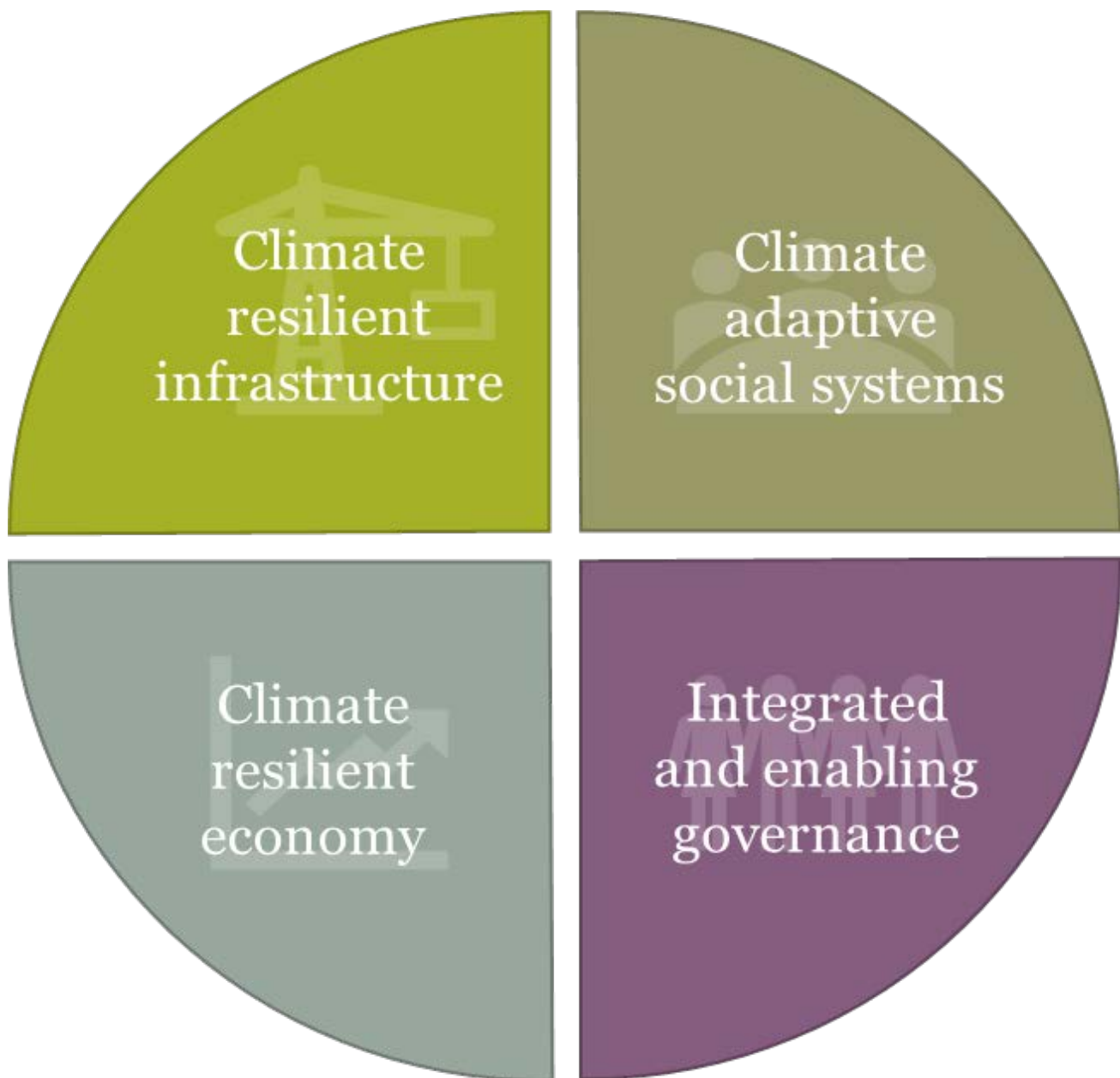
DIMENSION	INDICES
<p><b>Economic</b> (The <b>economic conditions</b> of a city or community)</p>	<ol style="list-style-type: none"> <li>1: Industries are diverse, to generate growth</li> <li>2: Innovation takes place to lead the economy</li> <li>3: The workforce has diverse skills</li> <li>4: Reliable infrastructure, supporting economic infrastructure</li> <li>5: Overall exposure in global economic value chains.</li> </ol>
<p><b>Social</b> (The <b>well-being</b> of a society and its members; organised or not)</p>	<ol style="list-style-type: none"> <li>1: Society is inclusive and cohesive</li> <li>2: Citizens' networks in communities are active</li> <li>3: People have access to services</li> </ol>
<p><b>Environment</b> (This dimension refers to the <b>natural environment</b> and to the systems and networks implemented to <b>manage</b> it)</p>	<ol style="list-style-type: none"> <li>1: Urban development is environmentally balanced</li> <li>2: Infrastructure is adequate and reliable</li> <li>3: Adequate natural resources are available</li> </ol>
<p><b>Institution</b> (This refers to the <b>institutional capacity</b> [knowledge sharing, capacity development, learning processes and participatory channels] as well as <b>organisations</b> and <b>decision-making processes</b> that administer a city or community. Stakeholders: governments, organised civil society and private stakeholders)</p>	<ol style="list-style-type: none"> <li>1: Leadership and long-term vision are clear</li> <li>2: The public sector has necessary resources</li> <li>3: Collaboration with other levels of government takes place</li> <li>4: Government is transparent, and citizens are encouraged to participate</li> </ol>

Source: adapted from OECD (2016). *Resilient cities (for internal consultation only)* in: Figueiredo, Honiden and Schumann, 2018; Figueiredo, Honiden and Schumann, 2018; and authors' elaboration.

Based on the OECD framework, the **four inter-related dimensions of urban climate resilience have been identified**, as reflected

in Figure 9, against which indices, indicators and measures have been developed for South African cities.

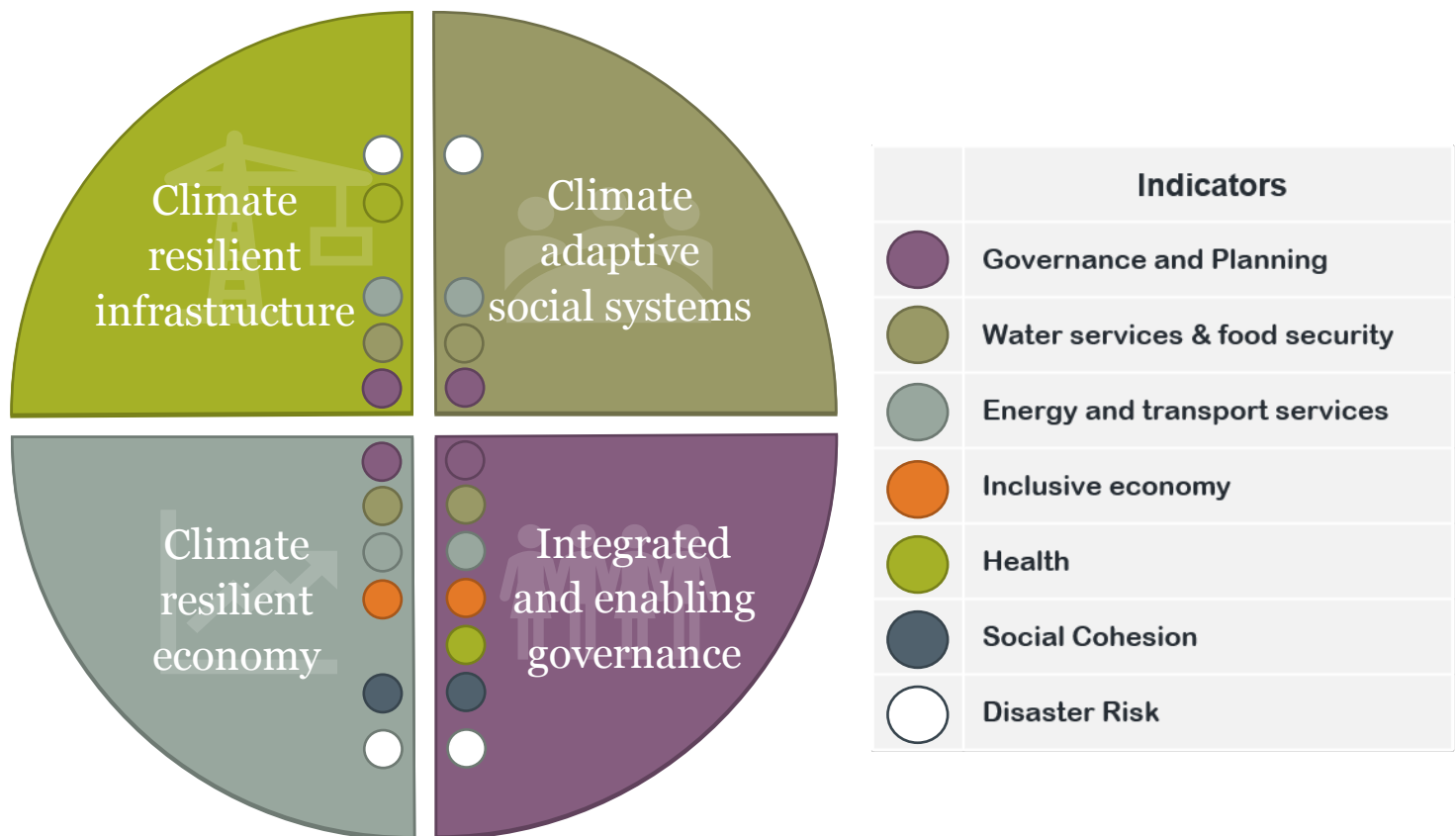
**Figure 9. Dimensions of climate resilience within a city system**



The Cities Resilience Indicator Framework (CRIF) is the tool used to measure the outcomes of the investments made. In other words, the investment options contribute to climate resilience in cities and the indicator framework measures the progress made by cities towards climate resilience. As such, the climate resilience

options and investments contribute to change and progress in the four dimensions of the CRIF. Below, Figure 10 gives a visual representation of the CRIF, showing how the seven categories of indicators align with the four dimensions of urban climate resilience.

**Figure 10. The CRIF has seven categories of indicators, which align with the four dimensions of urban climate resilience**



### Lead indicator framework

The Lead Indicator Framework (see Table 10 below) synthesises the CRIF by focussing on lead indicators for each of the seven indicator categories to initiate the assessment of South African cities. As such, the Lead Indicator Framework supports the MRV of investment impacts.

Categories and indicators are aligned with the four dimensions of urban climate resilience. The indicators fall into **seven categories**, namely:

- 1) Governance and Planning
- 2) Water services & food security
- 3) Energy and transport services
- 4) Inclusive economy
- 5) Health
- 6) Social Cohesion
- 7) Disaster Risks.

Extracted from the 74 indicators in the CRIF, the Lead Indicator Framework comprises a set of key indicators per category that embody *key aspects relating to urban resilience*.

In the Lead Indicator Framework, each resilience category has two to three lead indicators, allowing the municipality to routinely self-assess and monitor its progress toward climate resilience readiness. This framework allows the user to initiate a monitoring process of the climate resilience of South African cities.

Such an approach to the Indicator Framework, starting with a Lead Indicator Framework, builds in flexibility by allowing indicators to be chosen and integrated according to the purpose of the monitoring exercise. Targets and indicators can be added incrementally to the Lead Indicator Framework to monitor climate resilience comprehensively across all South African cities.

The Lead Indicator Framework is represented in Table 10 below.



**Table 10. Lead Indicator Framework**

CATEGORY	LEAD INDICATOR
<b>Inclusive Economy</b>	
<b>1.1 Municipal revenue</b>	
Does the municipality have sufficient revenue to deliver its mandates?	<p>2 - Yes, the municipality can adequately meet its financial demands</p> <p>1 - Partially, the municipality has a shortfall, but its credit rating allows it to raise additional sources of finance.</p> <p>0 - The municipality underspends on services because it cannot source adequate revenue</p>
<b>1.2 Literacy</b>	
Does the citizenry have levels of literacy required to be economically active?	<p>2 - Less than 15% of adults find themselves at the lowest levels of literacy skills (Level 1 and 2)</p> <p>1 - Between 15% and 30% of adults find themselves at the lowest levels of literacy skills (Level 1 and 2)</p> <p>0 - More than 30 % of adults find themselves at the lowest levels of literacy skills (Level 1 and 2)</p>
<b>1.3 Green Jobs</b>	
Are new jobs and enterprises being created through building climate resilience?	<p>2 - Reporting on job creation in climate resilient sectors is done and some jobs are created</p> <p>1 - There are plans to report and count the amount of jobs created in climate resilient sectors or there is evidence that such jobs will be created</p> <p>0 - There is no reporting on this, or no jobs created in climate resilient sectors</p>
<b>Energy and transport</b>	
<b>2.1 Renewable energy available</b>	
Is there sufficient diversification of energy to afford citizens equal access to sufficient clean and safe energy services?	<p>2 - Yes, RE is a significant part of the energy mix of a city (more than 20%) and is proactively strategised</p> <p>1 - Partially, some RE is available at the municipal level but this is not the norm. Small Scale embedded Generation (SSEG) schemes are allowed for renewable energy</p> <p>0 - No, energy comes from one source - no diversification or no information</p>
<b>2.3 Equitable Consumption</b>	
Are all citizens consuming sufficient energy?	<p>2 - Yes, all households use safe and clean energy for lighting and other uses</p> <p>1 - Partially, some household use clean and safe energy for lighting only</p> <p>0 - No, there are households without access to enough safe and clean energy</p>
<b>Governance and planning</b>	
<b>3.1 Collaborative policy &amp; planning</b>	
Is the municipality proactively planning for climate resilience across sectors and functions?	<p>2 - Yes, all relevant groups and departments have been invited and attended joint planning meetings. Stakeholders have been fully briefed on the process and receive regular updates on the progress of the plans. They contribute to the review of the municipal policies.</p> <p>1 - Partially, only a few groups and departments have been engaged / consulted and contribute to the review of the municipal policies.</p> <p>0 - No stakeholder engagement has been undertaken and/or no review has happened yet.</p>
<b>3.2 Households with access to adequate housing</b>	

Do all citizens live in affordable and safe housing?	2 - Yes, less than 10% in informal settlements 1 - Partially, between 10 and 20% in informal settlements 0 - No, more than 20% of population living in informal settlements
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## Health

### 4.1 Incidence of respiratory disease

Are all citizens equally protected from respiratory disease?	2 - Yes, pneumonia is the cause of death in less than 1% of children under 5 deaths cases 1 - Partially, between 1 and 2% of children under 5 die of pneumonia 0 - No, more than 2% of children under 5 deaths cases are due to pneumonia
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### 4.2 Households with waste collection services

Are all households protected from unhygienic waste matter?	2 - Yes, more than 95% of households have basic refuse removal services 1 - Partially, more than 80% of households have basic refuse removal services 0 - No, less than 80% of households have basic refuse removal services
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## Water

### 5.1 Ecosystems health for water

Are ecosystems healthy enough to provide water services?	2 - Yes, ecosystems are healthy and provide water services 1 - Partially, generalised decline in ecosystem service status to severe degradation in status known or suspected. 0 - Potentially fatal damage to some or many key eco-system services or no information.
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### 5.2 Households with access to piped water

Do all households have access to piped water within their homes (or less than 200m from their home)?	2 - Yes, more than 80% of households have access to piped water on site 1 - Partially, between 50 and 80% of households have access to piped water on site. 0 - Less than 50% of households have piped water on site.
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### 5.3 Quality of water supplied

Is the water supplied to households safe?	2 - Blue drop certification above 95% 1 - Blue drop certification between 80 and 95% 0 - Blue Drop certification below 80% or no certification
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## Social cohesion

### 6.1 Employment rate

Are all employable citizens earning a living?	2 - Yes, less than 15% of the labour force (in low income groups) is unemployed. 1 - Partially, between 15 and 30% of the labour force (in low income groups) is unemployed 0 - No, more than 30% of the labour force (in low income groups) is unemployed
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### 6.2. Cooperative governance

How effective is the city in engaging civil society and partnering with them to promote (climate-resilient) development?	2 - Yes, the civil society contribute multiple channels - communication and coordinated planning. 1 - Partially, civil society is reached several times per year but no coordinated planning is implemented, and updates are not shared on a regular basis. 0 - Poor or no civil society engagement on (climate resilient) development matter.
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### 6.3 Income distribution

Are incomes increasingly evenly distributed across population groups?	2 - Yes, GINI coefficient below 0.5 1 - Partially, GINI coefficient between 0.5 and 0.6 0 - No, GINI coefficient above 0.6
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## Disaster Risk

### 7.1 Populations living in exposed flood/coastal zones

Are the poor living in climate safe locations?	2 - Yes, no informal or low-income settlements are located in flood plain and exposed coastal zones. 1 - Partially, no low-income (formal settlements) are located in flood plain and exposed coastal line, but informal settlements are. 0 - No, both formal (low-income) and informal settlements are located in flood plain and exposed coastal zones
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### 7.2 Ability of ecosystems to perform disaster management critical services

Are ecosystems able to perform critical services in terms of disaster risk protection?	2 - Yes, ecosystems are healthy and provide critical services against disasters 1 - Partially - generalised decline in ecosystem service status to severe degradation in status known or suspected. 0 - Potentially fatal damage to some or many key eco-system services or no information.
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## Cities Resilience Comparative Assessment

This Lead Indicator Framework was applied across the 15 project cities to establish a baseline of the level of municipal climate resilience. Throughout the duration of the project and through stakeholder engagements in all 15 project cities, municipal data, publication, documentation and knowledge was harnessed and recorded through various reports and publications. Such data was used to populate the Lead Indicator Framework and conduct the analysis presented below. This baseline comparative assessment is supported by the Lead Indicator Framework Analysis Excel file available with this document.

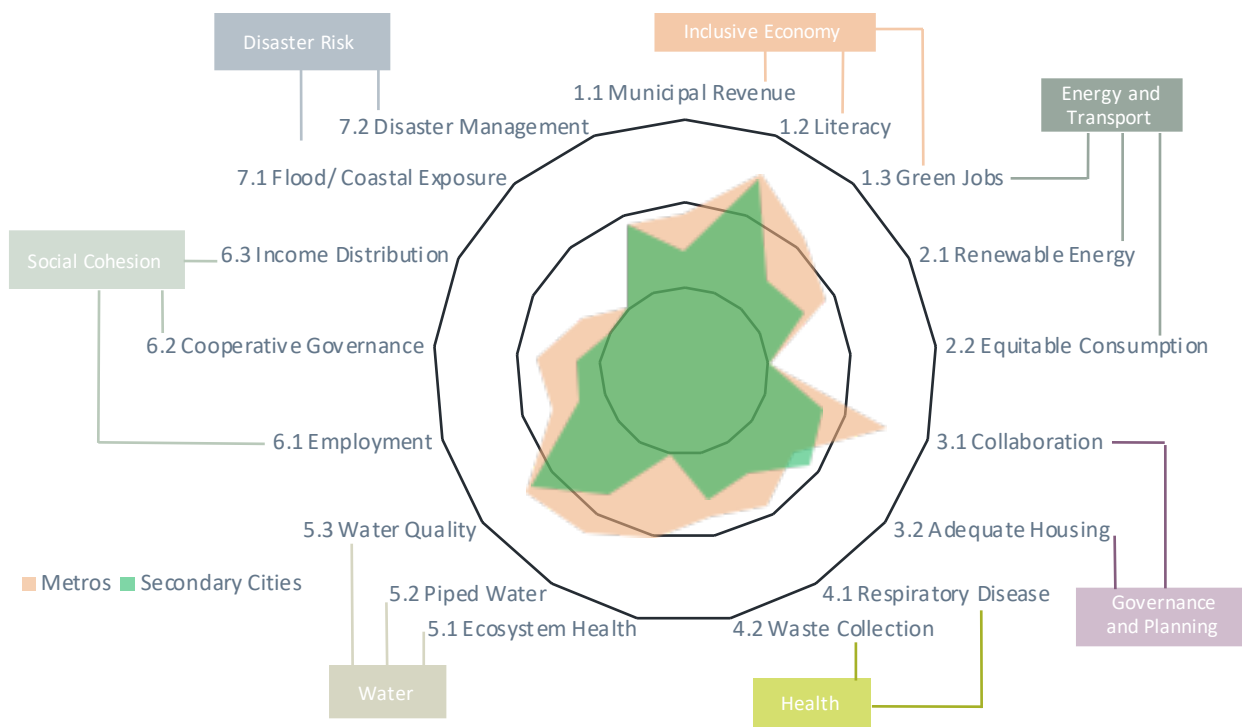
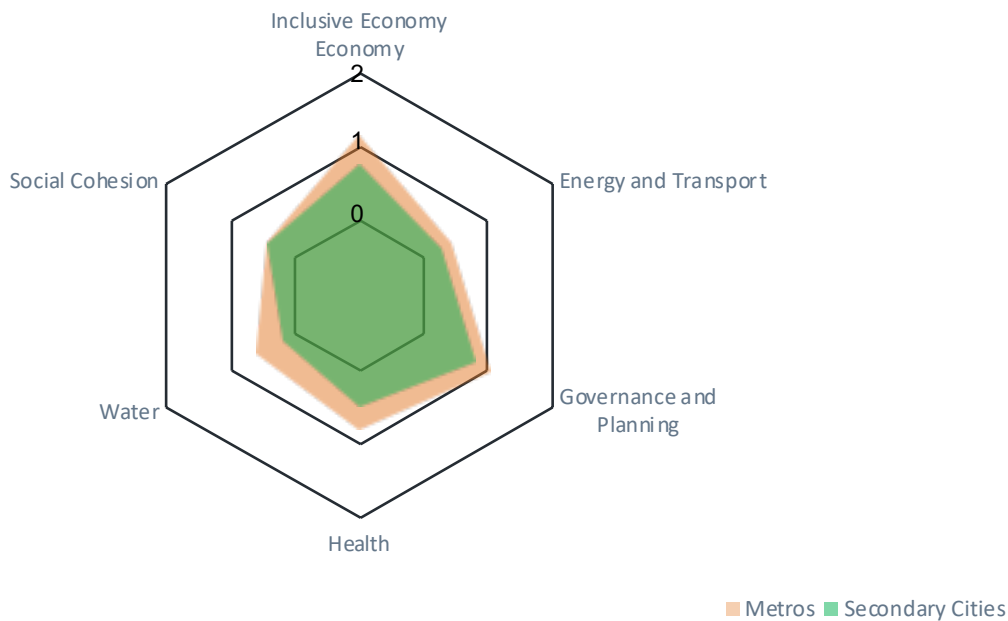
The analysis of the data used graphic tools and analysis methods based on data matrices and graphical representation. The spider diagrams in Figure 11, 12 and 13, are the outcome of the data analysis on the scoring of the 15 project cities against the indicators of the Lead Indicator Framework. The analysis of the data revealed various findings which are presented below. Such findings are important information to support municipal decision-making processes as they correlate level of resilience, adaptation and

resilience project pipeline and alignment with potential national investments.

Overall, the comparative study showed that all the 15 cities equally under-scored in two categories of indicators, namely **Energy and Transport (2)** and **Social Cohesion (6)**, linked to the spatially divided nature of South African cities. Across all project cities, data show a low level of readiness in relation to the specific indicator on **Ecosystem health for water provision (5.1)**.

This is represented graphically in Figure 11 below, based on the data gathered against the Lead Indicators. Less surprisingly, the analysis of the 7 secondary cities data showed lower levels of resilience, in comparison to the 8 metropolitan municipalities. On average per group, across the 18 indicators assessed against, secondary cities consistently show lower scores than metropolitan cities. This can be associated with the higher level of capacity in metropolitan municipalities and the fewer economic and developmental opportunities in secondary cities, amongst other factors.

**Figure 11. Comparative assessment of municipal resilience using the Lead Indicator Framework: Metros vs. Secondary Municipalities**



The analysis differentiates the comparison between metropolitan municipalities (Metros) and secondary cities (Secondary Cities), in line with the structural and contextual differences that characterise them (this correlates with the outcomes seen in Figure 12 and 13).

For each type of municipalities (Metros and Secondary Cities), municipalities can be grouped according to their climate resilience strengths and weaknesses and readiness trends, as reflected in the assessment of the indicators. Such grouping allows to target investments according to the needs of municipalities. These groups are as follows, without order of preference within the groups:

- **Secondary Cities Group A:** Msunduzi, Polokwane, Rustenburg, and Sol Plaatje.
- **Secondary Cities Group B:** George, Mbombela, and Mogale
- **Metro Group A:** Buffalo City, Mangaung and Nelson Mandela Bay
- **Metro Group B:** City of Cape Town, City of Ekurhuleni, City of Johannesburg, City of Tshwane and eThekweni

The analysis of all cities shows a similar lack of readiness with respect to the energy and transport and social cohesion indicators in all four groups. On the positive side, all groups similarly achieved higher scores on indicators related to **Inclusive Economy (Category 1)** and **Governance And Planning (Category 3)**. Indicators related to the Health, Water and

Food Security and Disaster Risk categories are the most variable between the groups.

For the municipalities in the Metros Group A, indicators related to water and health are next in line, in terms of scores. Particularly, indicators on **municipal revenue (1.1)** and **employment rate (6.1)** show the lowest level of readiness in Metros Group A. Similarly, the data for both Secondary Cities Group A and Metros Group A reflect **underperformance on Health (4)** indicators.

The data gathered on Group A municipalities related to **basic services delivery** (such as quality of water supplied (5.3), ecosystem health (5.1) and waste collection rates (4.2)), score lower than the data for municipalities in Group B. On the positive side, municipalities in group A demonstrate a relatively high level of readiness in terms of governance and planning and inclusive economy.

The biggest difference in terms of the level of inclusivity and governance is found between Metros and Secondary Cities municipalities, due to lower scores on the inclusion and creation of green jobs in Secondary Cities.

It is interesting to note that the Metros in Group B all scored the higher score on the indicator related to **quality of water supplied (5.3)**. While Metros in Group A show on average the highest scores for **literacy rates (1.3)** indicators (see Figure 12 below).



Figure 12. Metros Group A and Secondary Cities Group A comparison

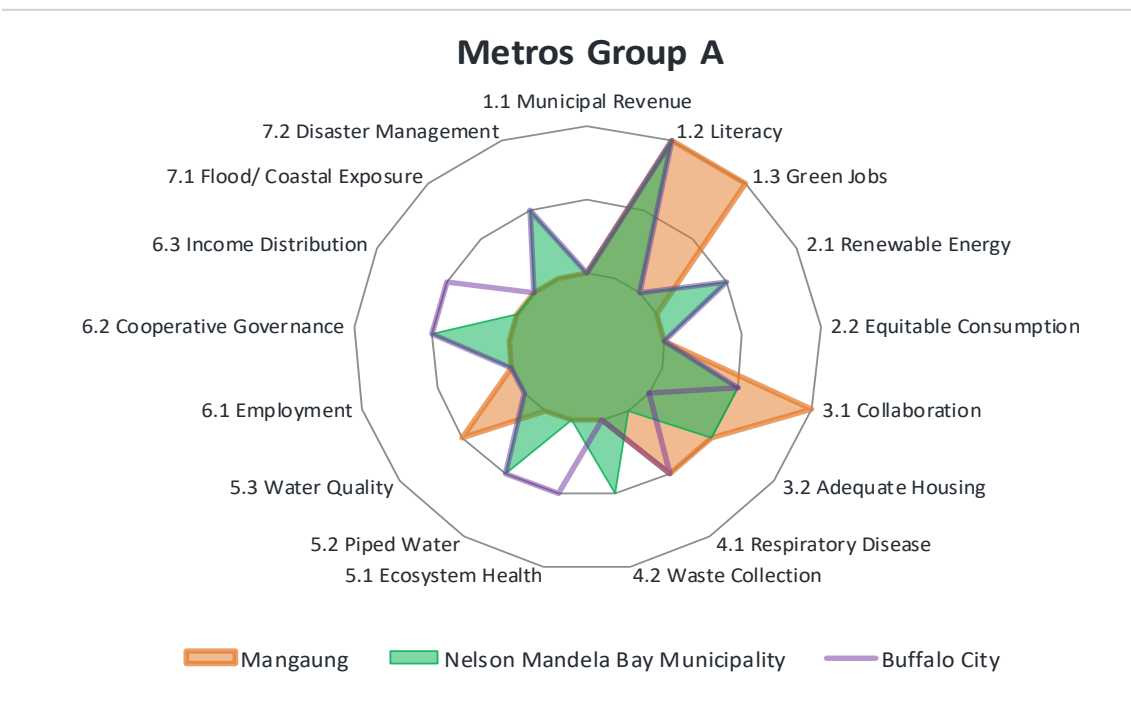
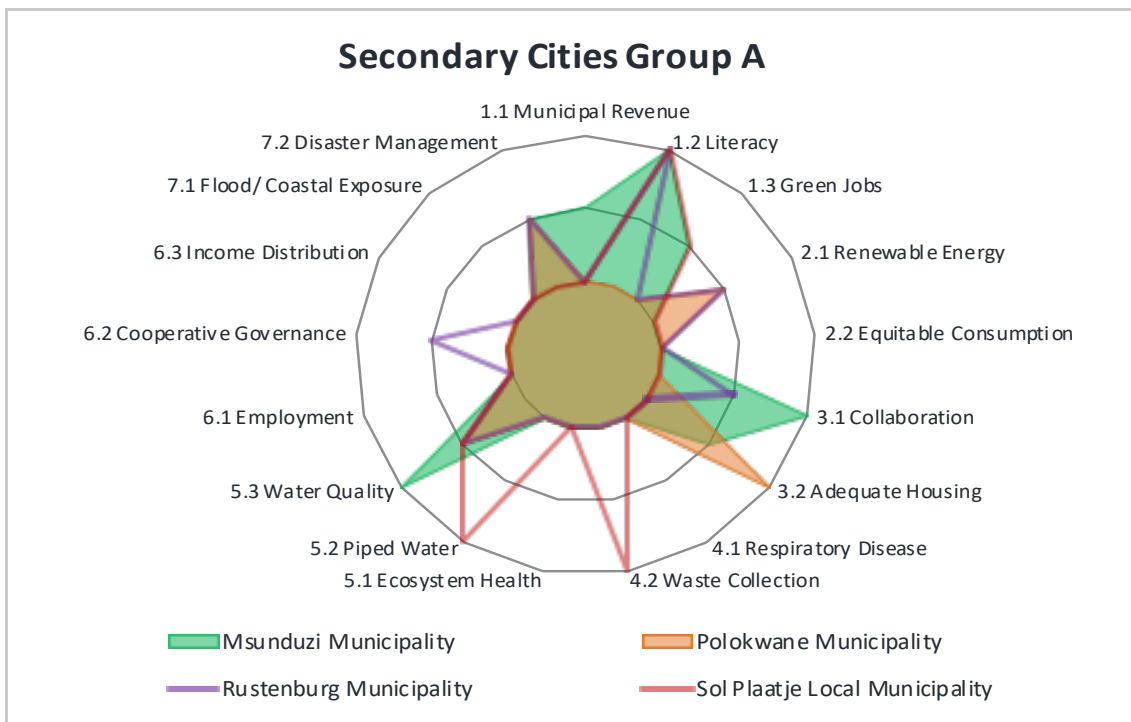
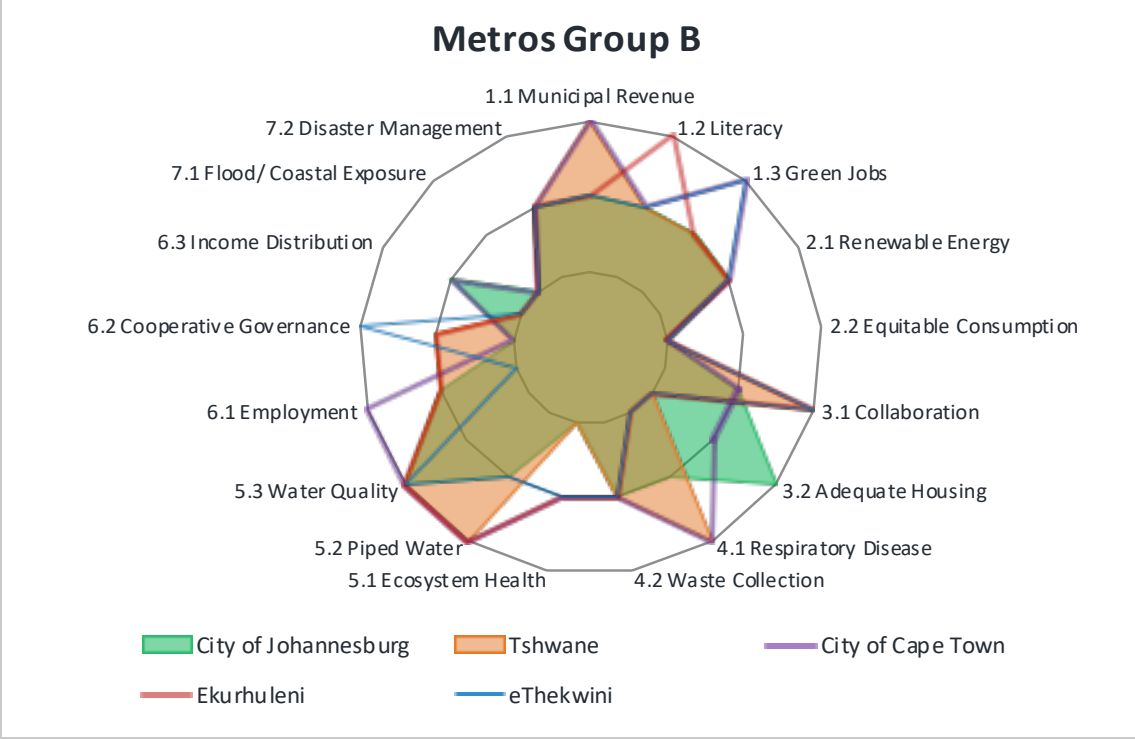
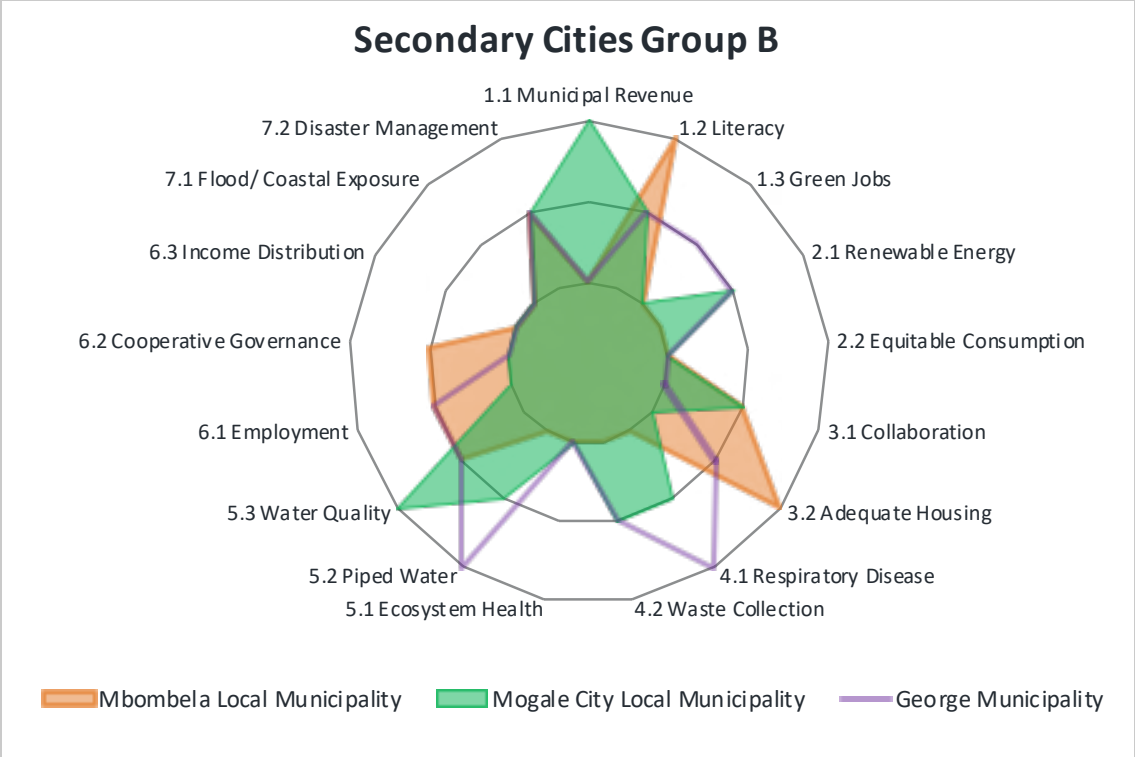


Figure 13. Metros Group B and Secondary Cities Group B comparison



More comparative analysis can be generated by the Lead Indicator Framework baseline assessment tool, by:

- applying various filters, comparing cities against other cities or groups of cities;
- comparing various groups of cities against others, and analysing the cities readiness within these groups of cities; and
- looking at the various categories of indicators and how cities scores, in their various groups, against these specific indicators (See Excel file attached: Lead Indicator Framework Analysis Excel file).

### Monitoring investment impacts

It is important to recall the alignment of the CRIP with national priorities, and to state that the investment options in the NCCAS point towards the same trends in investments to build climate resilience. Given that this investment strategy is based on the analysis of the 15 targeted municipalities, it can complement the NCCAS, giving more detail on the types of investments and definition of roles.

For example, the action: “Monitor and control the spread of alien invasive species that benefit from climate change” in the NCCAS is complementary to the CRIP’s investment option “Sensitise and mobilise community owned ecosystem management initiatives, this includes targeted community capacity building and engagement activities in vulnerable areas.” This investment option that the CRIP proposes (**Pathway 3 - Ecosystem Services**) targets behaviour and supports the investment action outlined in the NCCAS (Intervention 1, action 1.1.6).

Another example includes the CRIP’s investment option to prohibit development within flood lines through investing in sustainable urban design, maintenance and restoration of green infrastructure and various legislature to enforce standards for housing (**Pathway 2 - Sustainable urbanisation**). This builds on the investment action in the NCCAS under Outcome 1.1, action 1.1.22, “Identify individuals and communities at most risk from climate change within local municipalities and deliver targeted climate change vulnerability reduction

programmes...” While proposed investments and actions are not always identical, the goals are aligned in achieving greater resilience and reduced vulnerability.

As an incremental step to promoting investments to build climate resilience and to put in place systematic MRV of the impact of these investments, the project team has mapped climate resilience investments with their corresponding indicators from the **Lead Indicator Framework of the CRIF** (see Tables 11-14). The comparative analysis points out where groups of cities underperform in terms of climate resilience. The Tables below allows the user to prioritise investments by matching the areas of weakness with potential interventions that will have positive impacts on the municipal resilience levels monitored by the indicator framework.

The user can also apply the indicators in relation to the investment pathways, to set a timeframe to the reporting system, or can map them against the implementation of international and national frameworks, such as the SDGs (see Box 2, Section 4) or the Priorities of the government (Box 1, Section 3 earlier). Table 2 above, shows how indicators from the Lead Indicator Framework can be used to track specific investment impacts in cities.

Using the comparative analysis of the 15 project cities, interventions from **Pathway 2** would be appropriate to address overall underperformance on indicators related to **Energy and Transport (2)** and **Social Cohesion (6)**, such as:

- Incentivise sustainability-based enterprises and jobs to strengthen and integrate the green economy
- Densify mixed-use development on transport corridors
- Pass by-laws for building affordable low-income housing

An intervention of **Pathway 3** on ecosystem services can address the **lack of climate resilience and the vulnerability of ecosystems (Indicator 5.1)** to provide services. Such a decision would have to be weighted and analysed for each group of cities, to ensure efficiency and relevance.

**Table 11. Indicators to monitor impacts of investments in the municipal climate governance pathway**

<b>Pathway 1: Municipal Climate Governance</b>		
<i>Investment option</i>	<i>Detailed investment</i>	<i>Corresponding impact indicators</i>
Inter-departmental and inter-municipal cooperation and policy development for climate resilience action.	Facilitate cross coordination through existing platforms (CRF) and interdisciplinary and intergovernmental working groups to support work across catchments and boundaries Running governance and planning training/capacity development workshops for/with municipalities Promotion of municipal knowledge sharing and co-creation	3.1 Collaborative policy & planning
Legislation and by-law enforcement	Identification of best practices of cooperation and policy development for sustainable urban development and climate resilience action and dissemination of best practices Technical support to institute partnerships for managing trade-offs of sustainable urban development	7.1 Populations living in exposed flood/coastal zones
Support data creation to ensure appropriate MRV	Advocate and partner with data and research institutions in SA (Department of Trade and Industry (DTI), CSIR, universities) and integrate databases. Support and develop capacities within cities to collect data and report on the appropriate platforms.	5.3 Quality of water supplied
Review of current financial and revenue models	Support the investigation of alternate municipal revenue options (e.g. waste recycling, service supply) and provide technical support to other national departments in the review and application of national laws and framework (MFMA, PFMA and IGG system). Provide technical support to national government, to promote the ability of municipalities to purchase directly from RE IPPs. Conduct research on the adaptation co-benefits of RE use and access (and clean energy in general) and track adaptation progress	1.1 Municipal revenue 2.1 Renewable energy available

**Table 12. Indicators to monitor impacts of investments in the sustainable urbanisation pathway**

## Pathway 2: Sustainable Urbanisation

<i>Investment option</i>	<i>Detailed investment</i>	<i>Corresponding impact indicators</i>
Conduct research into optimal urban densification models for different types of cities (e.g. coastal, metropolitan, industrial)	Research into the most appropriate and optimal urban densification models and approaches for adoption by the different types of cities that make up the South African urban landscape, targeted at city planners.	3.1 Collaborative policy & planning 6.2. Cooperative governance
Incentivise sustainability-based enterprises and jobs to strengthen and integrate the green economy	Scoping small enterprise opportunities and making these and possible incentives available to municipalities for their application Conduct research and establish a baseline of the role of informality (and the informal economy) in the growth of cities Provide technical support to incentivise green enterprises and jobs, and to integrate and mainstream the 'green' economy (climate resilience aspect)	1.3 Green Jobs 6.1 Employment rate
Formalise/ implement a long-term approach to guide municipal densification	Identify and develop global best practice case studies on sustainable urban densification Identify a roster of experts to support municipalities on sustainable urban densification Promote best practices on sustainable urban densification within national government (e.g. Housing Development Agency (HDA)) Conduct training and capacity development workshops with municipalities on sustainable urban densification	3.2 Households with access to adequate housing
Cooperation and collaboration through stakeholder dialogues on municipal development	Facilitate cross coordination through gathering and sharing of best practices to make a case for such practices to be implemented	3.1 Collaborative policy & planning
Achieve air quality and GHG inventories monitoring	Develop a coordinated approach to GHG inventories and air quality reporting and support the development and monitoring of air quality and health management approaches	4.1 Incidence of respiratory disease
Densified mixed-use development on transport corridors	Identify and develop global best practice case studies on sustainable urban densification, including mixed-use development Promote best practices on sustainable urban densification, including mixed-use development within national government Support by-laws for densified mixed-use development on transport corridors	2.2 Equitable Consumption 3.2 Households with access to adequate housing
Conduct research to map key ecosystems in all cities and to quantify their contribution to hard infrastructure at risk to climate change	Research to map key ecosystems and to quantify their contribution to hard infrastructure, such as dams, which are at risk from providing municipal services such as water during extreme weather events.	7.2 Ability of ecosystems to perform disaster management critical services 5.1 Ecosystems health for water
Pass by-laws for building affordable low-income housing	Support the development of affordable low-income housing in new mixed-use development zones, through incentives or subsidies.	6.3 Income distribution



**Table 13. Indicators to monitor impacts of investments in the ecosystem services pathway**

### Pathway 3: Ecosystem Services

<i>Investment option</i>	<i>Detailed investment</i>	<i>Corresponding impact indicators</i>
GIS maps of active green spaces and their distribution across cities	DEA maps existing and potential green spaces across all municipalities and identified inequalities and solutions for municipalities to include in their development and land use plans.	3.2 Households with access to adequate housing
Design water sensitive urban design policy	Identify and disseminate best practice examples of water sensitive urban design and case studies on maintenance, restoration and protection of green (and blue) infrastructure (e.g. buffer zones, concrete coverage on developments). Provide training and capacity development to targeted, water security vulnerable municipalities on water sensitive urban design.	5.2 Households with access to piped water
Quantify key ecosystem services and analyse the opportunities for skills, jobs and enterprise development	Research to identify and quantify the primary ecosystem services that necessitate skills development and to analyse the related job/enterprise opportunities.	6.1 Employment rate 6.2. Cooperative governance
Equitably distribute green spaces	Equitably distributed and sustainably managed green spaces across the City, including nature reserves, green belts, parks, vegetation buffer zones, etc.	3.2 Households with access to adequate housing 6.2. Cooperative governance
Mobilise communities to maximise ecosystem services	Disseminate water conservation best practices to municipalities; Support awareness campaigns in municipalities (human and financial resources) Design municipal cost benefit system for encouraging investment in the protection of high-water yielding spaces	5.1 Ecosystems health for water
Restore polluted land	Identify priority land for restoration and repurposing (e.g. for agriculture from mining) Incentivise land restoration in priority areas through jobs, enterprises and possible tax incentives (for private sector) in priority land restoration areas Include the notion of informality in land restoration activities (informal settlements and informal economy)	7.2 Ability of ecosystems to perform disaster management critical services
Implement ecosystem restoration and conservation	Identify priority ecosystems requiring restoration Facilitate a programme for ecosystem restoration in partnership with Expanded Public Works Programme (EPWP) Integrate ecosystem restoration and conservation activities within the municipal DRM activities	7.2 Ability of ecosystems to perform disaster management critical services
Implement integrated catchment management	DEA considers the current governance and management challenges and identifies and promotes solutions to integrate municipalities into catchment management outside their administrative boundaries. Enhance and improve support to catchment management forums and discussions Interdisciplinary and intergovernmental working groups to be developed / strengthened to support work across catchments and boundaries	5.1 Ecosystems health for water

**Table 14. Indicators to monitor impacts of investments in the disaster risk reduction pathway**

<b>Pathway 4: Disaster Risk Reduction</b>		
<i>Investment option</i>	<i>Detailed investment</i>	<i>Corresponding impact indicators</i>
Develop Early Warning Systems (EWS) with communities	Identify and disseminate best practice and train key municipalities. Partner with SAWS to ensure climate information and risks are included in EWS. Support municipalities in the localisation of such EWS for climate risks and specifically through communities' engagements to ensure systems designed are relevant to their users.	7.1 Populations living in exposed flood/coastal zones
All relevant sectors plans reflect Disaster Risk Reduction (DRR) plan	Support to municipalities through training and capacity development Support to disaster management forums	3.1 Collaborative policy & planning
Establish long term drought resilience incentives	Identify appropriate drought resilience incentives and standardise these as appropriate DEA works with NT and provides technical support through C-88 to support the implementation of these incentives in target municipalities	5.3 Quality of water supplied
Conduct research on skills requirements for green jobs and enterprises needed to support resilience building in cities	Commission a body of robust research, that builds off current work to identify and promote skills, jobs and enterprise development in the green economy at city level.	1.3 Green Jobs 2.3 Equitable Consumption of energy 6.3 Income distribution
Climate resilient storm water management	Identify the most vulnerable municipalities to poor storm water management and incentivise enhanced stormwater management in target municipalities Design incentive schemes for municipalities to promote waste recycling enterprises including as an alternate revenue stream	4.2 Households with waste collection services
Sensitise citizens to forecasted climatic events	<b><i>Underlying conditions to support EWS, campaigns, skills development and community engagement</i></b>	1.2 Literacy 6.2. Cooperative governance
Prohibit developments within flood lines	Municipalities prohibit developments within flood lines with the support of DEA in identifying and mapping flood lines and population at risk. Support drafting and sharing best practice from other municipalities in terms of prohibition of developments within flood lines, and technical support in the implementation of such practices.	7.1 Populations living in exposed flood/coastal zones

### 3.5 Matching priorities and current municipal project pipeline

As much as data gathering and producing statistical analysis and assessment is useful for decision making, being aware of the actual (current and planned) municipal interventions is key to designing investments that are efficient and viable. As such, the team conducted a survey among the project cities to gather and analyse the existing pipeline of resilience projects.

This process could be refined, as the sample of municipal pipelines gathered is not fully representative of all the project cities. Only two Metros out of eight completed the survey and five secondary cities out of seven. Overall the sample size is not representative of all activities currently undergone in the cities involved in this project, as only seven out of 15 provided information on their current and future climate resilience investments. Therefore, the secondary cities are overrepresented in this survey. We acknowledge this bias and appreciate it as it focuses this baseline survey on the secondary cities of this project. Municipal respondents of this survey correspond to the following groups:

- Secondary Cities Group A: Rustenburg, Sol Plaatje and Msunduzi
- Secondary Cities Group B: Mbombela and Mogale
- Metros Group A: Mangaung and Buffalo City

The investments gathered by this survey can be categorised by type, as presented earlier in Section 3.3 and the investment action matrix. There are four types of resilience projects, namely: Governance and Planning investments, Infrastructure investments, investments building an Inclusive Economy, and investments enhancing Behavioural Change.

This analysis of the municipal project pipelines revealed that most on-going projects are related to **governance and planning** activities. Six out of seven municipalities of the project sample are currently investing in projects related to the development of strategies (for biodiversity protection, wetlands mapping), the creation and implementation of by-laws and regulations (for

air quality and alien invasive species) or the organisation of stakeholder engagements and cooperative planning (forums). **Infrastructure investments** are being pursued by four cities out of seven in this survey and relate to: energy efficiency and building retrofitting, rainwater harvesting, wetland rehabilitation and tree planting.

Four cities are investing in projects related to the development of a **green and inclusive economy**. These investments support waste recycling facilities and processes (biogas), community-based resource management (for wetlands) and permaculture training. In this survey, the pipeline of projects related to behavioural change concerned three cities. Most of these interventions feature schools and community/education centres and relate to awareness raising activities

When looking at **potential investments**, the trends are fairly different. To gather such trends, the survey asked the respondents to point out the investments that they would like to see prioritised, as well as to include the projects that are still in design phase in their municipality but that they would like to see implemented. The investments that have been put forward by the respondents are related to **infrastructure maintenance and development**. Four cities have mentioned projects that are either awaiting uncertain funding, or are ready to be funded but looking for a funder. The activities under this type of investment are similar to the on-going projects, showing a **potential for replication and scaling up of on-going initiatives**. The trends showing the importance and the need for planning and governance investments are confirmed by this survey, with an interesting emphasis on Risk and Vulnerability mapping assessment as well as the development of Early Warning Systems.

The details concerning the types of projects and their specific activities, costs and location are accessible in the Excel document accompanying this investment plan (Baseline Analysis).

# 4

## Implementation

This chapter outlines the implementation of the CRIP. Specifically, it discusses:

- 1) The global enabling framework;
- 2) Critical considerations for financing climate resilience, including possible sources of finance, and, broadly, the types of investors and funding mechanisms available; and
- 3) the critical “next steps” towards implementing the strategy and creating an investment-ready environment.

Recognising that many investments will need to rely on more than one source of funding, we consider the need for blending different sources of finance, and propose solutions for accessing and spending finance needed for national and municipal investments. Particular consideration is given to the enabling actors, the critical conditions of success, and to the immediate steps required to mobilise investments.

### 4.1. The Global Enabling Environment

There are numerous global and nationally targeted frameworks to support the transition towards climate-resilient and inclusive cities through the guidance of finance and investment into the appropriate channels. Globally, these include (among others) five key platforms:

- i) the United Nations Framework on Climate Change (UNFCCC)
- ii) the SDGs, noting that Goal 11 focuses on making cities inclusive, safe, sustainable and resilient, through 10 targets and 15 indicators
- iii) the Sendai Framework for Disaster Risk Reduction (2015-2030)

iv) the City Resilience Framework from ARUP and Rockefeller Foundation

v) and the Urban Sustainability Framework from the World Bank.

The SDG targets and indicators are particularly relevant to this investment plan and its accompanying Indicator Framework, as they are internationally set targets that underline all investments presented in this investment plan, and are thus outlined in Box 2 below.

#### Box 2. SDG Goal 11

##### SDG Goal 11: Targets and Indicators

There are 17 goals in the Agenda 2030 SDG Framework. While many of these have implications for urban development and cities, Goal 11 is city specific: “Make cities inclusive, safe, resilient and sustainable. Goal 11 comprises 10 targets, with 15 indicators. The ten targets are as follows:

- 11.1 Safe and affordable housing
- 11.2 Affordable and sustainable transport systems
- 11.3 Inclusive and sustainable urbanization (sustainable urbanization rates; urban planning management)
- 11.4 Protect the world’s cultural and natural heritage
- 11.5 Reduce the adverse effects of natural disasters (deaths and injuries, and; economic losses from natural disasters)
- 11.6 Reduce the environmental impacts of cities (solid waste management; urban air pollution)
- 11.7 Provide access to safe and inclusive green and public spaces
- 11.A Strong national and regional development planning
- 11.B Implement policies for inclusion, resource efficiency and disaster risk reduction (Integrated, and; Local Disaster Risk Management)
- 11.C Support Least Developed Countries in sustainable and resilient building

## 4.2 The developmental framework, and investors

At the national level, policy frameworks include South Africa’s National Framework for Sustainable Development; South Africa’s National Disaster Management Framework; and the National Disaster Management Plan. The national climate change M&E framework and system is the overarching framework for all investments building climate resilience of South African cities.

Specific international and national policy and M&E frameworks deemed relevant to the investment presented in this investment plan are laid out in Table 15 below. This table allows municipalities, DEA and the investors and donors to link the impacts of their investments to build climate resilience, with supporting guidelines and agreed upon frameworks.

**Table 15. Potential investors in urban climate resilience and developmental framework related to investments**

PATHWAYS INVESTMENT TYPE		MUNICIPAL CLIMATE GOVERNANCE	SUSTAINABLE URBANISATION	ECOSYSTEM SERVICES	DISASTER RISK REDUCTION
Governance and planning	Investors	Department of Environmental Affairs; the Climate Change Fund of the African Union Development Agency (AUDA-NEPAD); Green Climate Fund (GCF); Development Bank of Southern Africa (DBSA); SUD-Net (UN-Habitat); The Rockefeller Foundation (100 Resilient Cities Programme); DBSA through the Green Environment Facility (GEF)	GEF through DBSA; SUD-Net (UN-Habitat); The Rockefeller Foundation (100 Resilient Cities Programme); Commercial Banks	South African National Biodiversity Institute (SANBI); SANParks; UNDP; DBSA through GEF; The Rockefeller Foundation (100 Resilient Cities Programme)	DBSA; National Treasury
	Framework	The United Nations Framework Convention on Climate Change (UNFCCC); Urban Sustainability Framework (USF)	The Integrated Urban Development Framework; City Resilience Framework	USF; The City Resilience Framework	National Disaster Management Framework; Sendai Framework
Inclusive economy	Investors	SUD-Net (UN-Habitat); Integrated Urban Development Grant (IUDG); The Rockefeller Foundation (100 Resilient Cities Programme)	South African Cities Network; IUDG; City Resilience Program, World Bank; The Rockefeller Foundation (100 Resilient Cities Programme), Citi	The Rockefeller Foundation (100 Resilient Cities Programme)	City Resilience Program, World Bank



	Framework	City Resilience Framework	Urban Sustainability Framework (USF); City Resilience Framework	USF; National Framework for Sustainable Development	Sendai Framework
Infrastructure	Investors	Department of Transport, South Africa; The Rockefeller Foundation (100 Resilient Cities Programme); Sustainable Energy Africa (SEA), Citi	South Africa's Green Fund; Green Building Guideline Toolkit; Clean Technology Fund (CTF) under the Climate Investment Fund (CIF); Integrated Urban Development Grant (IUDG); The Rockefeller Foundation (100 Resilient Cities Programme), Citi	South Africa's Green Fund; DBSA through GEF; The Rockefeller Foundation (100 Resilient Cities Programme); Commercial Banks	South Africa's Green Fund; City Resilience Program, World Bank; South Africa National Disaster Management Centre
	Framework	City Resilience Framework	The Integrated Urban Development Framework (IUDF); Urban Sustainability Framework (USF); City Resilience Framework; South Africa's National Framework for Sustainable Development	City Resilience Framework	National Disaster Management Framework (NDMF), Sendai Framework
Behaviour	Investors	DBSA through GEF	Department of Transport, South Africa	South Africa's Green Fund; Earthwatch	South African Weather Service (SAWS)
	Framework	UNFCCC Framework			Sendai Framework





### 4.3. Financing Climate Resilience

The transition to a climate resilient city necessitates both a substantial increase in the total quantity of urban infrastructure investment and a shift in how existing streams of finance are allocated (Colenbrander et al., 2018). Therefore, there is a need for innovation, learning, and scaling of financing instruments, financial architecture and governance structures in support of this.

Programming interventions for climate resilience into bundled, multi-objective climate resilience investments will more effectively address the cross-cutting risks associated with climate change. This will also facilitate the implementation of a strategic financing strategy, that is not entirely dependent on local and domestic public budgets, yet aligns with existing public expenditure and development plans. Table 16 briefly describes the nature of the four key categories of the climate compatible development

financing spectrum. However, long-term adaptation investment programmes are almost always financed through some form of blended finance approach.

“

*There is no common conceptual understanding of blended finance, but it broadly involves the strategic combination of sources of public and/or private finance to reduce investment risk, lower the cost of capital and crowd-in further investment into targeted programmes*

”

(Attridge and Engen, 2019; Meltzer, 2018)

**Table 16. Climate Compatible Development Finance (Adapted from World Bank, 2015)**

FINANCE CATEGORY	DESCRIPTION
<b>Domestic Public</b>	A country or city’s own domestic public resources, such as government income from taxes and its budget. For most countries/cities, domestic public finance is the largest resource to fund their integrated development plans.
<b>International Public</b>	This refers to aid, grants, and concessional finance provided by Advanced and Middle-Income Economies to help support development in Emerging Markets And Developing Economies (EMDEs). Official Development Assistance (ODA) is a term introduced by the OECD Development Assistance Committee (OECD DAC) to measure aid. It is widely used as an indicator of international aid flows that meet the OECD DAC criteria for aid. ODA is unique, as it is the main official international resource flow aimed primarily at the economic development and social welfare of developing countries.
<b>Domestic Private</b>	This refers to a country’s domestic private sector resources, including large corporations and SMEs as well as country’s domestic institutional investors, such as the pension funds, insurance funds, and sovereign wealth funds. To be effective, public sector measures to encourage private investment need either to decrease perceived risk or increase anticipated returns.
<b>International Private</b>	These consist primarily of: (i) Foreign Direct Investment (FDI) in developing countries; (ii) remittances from migrants back to their home countries; (iii) private philanthropy, e.g. from foundations; and (iv) financial market-based financing like portfolio equity flows, bonds, short-term debt flows and syndicated bank loans from commercial banks. Some of the newer resource flows are contributed by relatively new actors that are primarily public, but which have private sector-like investment return objectives, such as sovereign wealth funds and pension funds.

**Investors in cities in South Africa** are drawn from a wide range of institutions and groups, from regional entities and national governments, to global and multilateral funds. Building on Table 15, potential investors include:

- **Multilateral Funds**, including the global Climate Investment Funds (CIFs), the Global Environment Fund (GEF) and the Green Climate Fund (GCF)
- **Development and International Cooperation Partners** including networks of global partners working with actors and networks to promote a multi-lateral and inter-disciplinary approach to sustainable urban development, such as the SUD-Net (UN-Habitat)
- **National Government** departments and their agencies, guided by approved national development plans and the related budgets of government including National Treasury, the Department of Environmental Affairs and the Department of Transport, for instance through the Integrated Urban Development Grant (IUDG)
- **The Private Sector** - a broad group of existing and potential investors, including multinational corporations, national and local industries and SMEs. In South Africa, multinational corporations are more dominant in this sphere
- **Commercial Banks:** South Africa has a relatively sophisticated financial services sector and its commercial banks are increasingly concerned with resource-based investment risk such as water availability. These banks are also increasingly geared toward green procurement programmes, having engaged extensively with the Renewable Energy Independent Power Producers Procurement Programme (REI4P). Commercial banks will lend to cities that have good credit ratings, typically only available to a few of South Africa's metros.
- **Civil Society Organisations** and communities who provide private finance, capacity, and skills, and play an important social accountability role.

## Defining Returns on Investment

In the development space, investors seek returns which are not limited to direct financial returns (noting that climate adaptation and resilience building fits into the category of development). Returns depend on the type of investments made. However, **the key benefits** expected to flow from the successful implementation of this strategy **are transformational in their nature:**

- An inclusive, equitable, climate resilient economy and society, where the most vulnerable people and groups in society are protected, in particular;
- An effective enabling environment for resilience building across the city's governance systems;
- Tangible benefits from resource security (biodiversity, urban agriculture and other land uses, water amongst others);
- Secure livelihoods and economies.

**The long-term return on investing in resilience** in South African cities will be on greatly reduced costs of climate change risks and impacts, livelihoods, human safety, infrastructure, economic assets and the economy. **Shorter- or medium-term returns** are more likely to be experienced in terms of improved resilience to climate impacts, resource scarcity and related development constraints.

The financial returns of the **longer- and medium-term investment horizon** will be experienced through development that will be less resource and climate constrained than it is now, yielding greater economic and social investment returns. The environmental and social returns are likely to be more obvious and direct. For example, the heightened vulnerability of municipalities means that improving, protecting and restoring infrastructure functioning will have numerous environmental and social returns through the provision of public goods such as a reliable supply of clean water, viable land uses and protection of zones that are highly exposed to climate risk (e.g. coastal zones, flood plains), along with private financial returns to land users. The public-good nature of investment actions will translate into long-term

socio-economic benefits and will enhance social and environmental capital in each city. This, in turn, will result in positive financial and economic benefits over time.

More specifically, investment returns will be seen through six important dimensions:

- i) Greater adaptive capacity and strengthened ability to withstand climate variability and to recover from shocks;
- ii) Improved resource efficiencies and access: reducing the financial and natural resources required in production and consumption;
- iii) Preservation of critical natural capital: halting and reversing declines in natural capital and focusing on the provisioning of ecosystem services as a means of productivity;
- iv) Enhanced social equity: barriers to participating in the economy are minimised and access to basic services and the provision of human rights is ensured;
- v) Growth: Economic growth and the creation of new economic opportunities and jobs while maximising the number of people in employment, and labour intensity;
- vi) Transformed and/or improved governance: upholding the prevailing regulatory and legal standards and enforcing compliance with regulatory and legal requirements.

The emphasis on economic growth and jobs is such that any investments that yield a combination of returns on these dimensions will create value for South African municipalities and their investment partners. Job creation, economic growth, and social equity are the most highly desirable co-benefits of, or returns on, investments in climate resilience.

### Financing mechanisms

Project-specific funding is the foremost mechanism to support climate resilience building and adaptation (Joyce & Granit, 2010). The types of financing mechanisms available at the sub-

national level include the following (Joyce & Granit, 2010):

- Grants, loans, utility bonds, local debt capital markets, export funds, taxes and sales levies.
- Direct private investment, PPPs, private finance initiatives and voluntary finance schemes.
- Payments for ecosystem services.
- Climate, multilateral and national funds.

*The challenge for municipalities is accessing and implementing finance for the programmes which comprise multi-sectoral initiatives. Alternative financing instruments are therefore also likely to be required for multi-sectoral initiatives, such as a climate resilience finance facility.*

#### *Climate Resilience Finance facility*

A specialised finance facility can assist with project-specific transactions, in addition to developing, funding, building and implementing multi-sector programmes. Finance facilities isolate risk, improve governance, and provide access to lower cost capital (Joyce & Granit, 2010). At the same time, they also provide the opportunity for coherence and ambition, and for ensuring that the investment programmes are implemented as a whole. A revolving fund model can pool resources from the different departments involved in implementation and benefiting from the programme implementation. Domestic (local and national), public funds can be leveraged with financing from donors and the private sector.

However, the governance of a finance facility must be viable for all beneficiaries if implementation is to be successful. The finance facility must have a charter with collective agreement on the activities that are eligible for funding. Projects that are identified and selected can receive funding from a central source, such as DEA or the Development Bank of Southern Africa (DBSA).

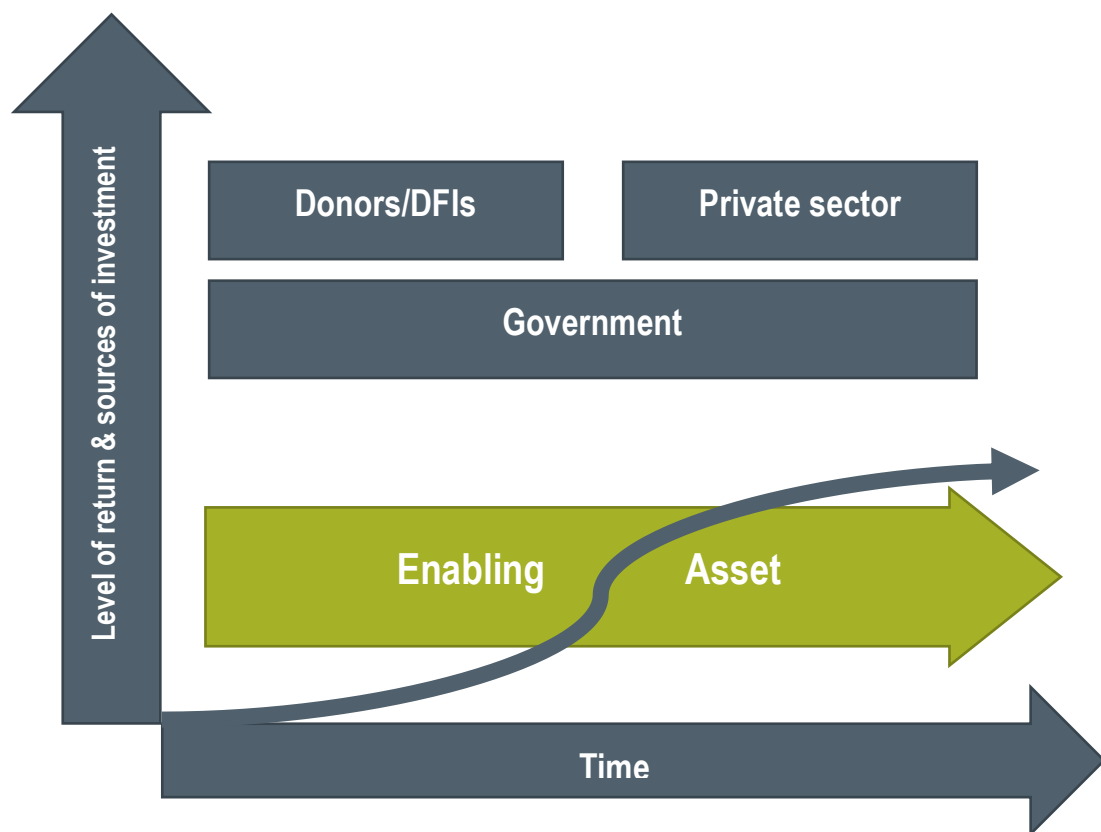
## 4.4 Implementation Strategy

### Sequencing of Investments

The different investment programmes require two classes of investments - enabling or asset investments (see Figure 14 below). Both classes are necessary to building resilience in South Africa's cities. However, different classes of investment are required at different times and attract different investors. The mix of investors and the type of investments that are funded will change over time as the climate resilience investments mature. It is therefore helpful to outline which investors are needed for what type of investments, at which point in the implementation timelines of the Investment Programmes.

As shown in Figure 14 below, in the early stages of resource mobilisation, finance is needed to support enabling investments and this is often provided by domestic sources of finance, donors, philanthropic organisations or through government grants. Multi-sectoral initiatives will need to spend a few years in this stage in order to develop a cohesive vision across the actors concerned, that incorporates the diversity of stakeholders and their climate resilience needs. Private organisations may have some limited involvement at this stage as they may look to invest in building partnerships and testing pilots.

**Figure 14. Sequencing of Investors and Investments (Adapted from Shames et al., 2012)**



After about five years, a programme should look to start diversifying its sources of investment into asset classes of investment. The extent of this diversification will largely depend on the strength of the engagement in the formative years. If the institutional foundations are well established and there has been strong engagement with a diversity of stakeholders, the initiative could start attracting financing from Corporate Social Responsibility (CSR) budgets, companies looking to mitigate against reputational and operational risks, and from government budgets. If it is a government-led initiative, public funding will occur much earlier.

It is important to note that although enabling investments typically happen first, with asset investments, thereafter, enabling investments will need to continue over time in order to facilitate the continued operation of the initiative. The returns line illustrates how, over time, an increase in financial returns should be experienced by landowners and investors, as well as an increase in value of natural capital and services.

## Implementation Plan

Investing in climate resilience can be done directly by the municipalities through behaviour change and/or through relevant budgetary considerations. National government and/or donors and climate related funds can also make investments. The investment plan provides a typology of investments (Table 4) and considers the possible sources of finance matched to the pathways (Table 15). This is done at an indicative level to provide a guideline for municipalities, DEA and external funders.

When comparing the CRIP to the NCCAS, there are significant synergies between investment strategies and options. Investment actions to protect ecosystems, build resilient infrastructure, develop disaster risk management plans, protect vulnerable communities and ensure that climate change adaptation plans and actions are integrated across sectors and departments, strongly align with, or complement, investment options presented below. Where the CRIP differs from the NCCAS is mainly regarding the level at

which investment is targeted and consequently, the role played by local government. Some investments are targeted at national government agencies only and, for most of the action, the nature of the relationship between local government (partners) and the lead is not explicit. Furthermore, M&E to track the implementation for adaption actions outlined in the NCCCS (Intervention 9) are under the sole responsibility of the DEA. The 9 actions that fall under Intervention 8 in the NCCAS, “Enable sustainable flows of climate change adaptation finance from various sources,” involve only the DEA, National Treasury and accredited implementing entities. However, in the CRIP, local government is placed as a key actor in actioning and conducting research to establish baselines of informality and develop innovative financing opportunities and mechanisms (Pathway 1 - Municipal Climate Governance and Pathway 2 - Sustainable Urbanisation). Proposed investments at the municipal level that build climate resilience through data creation and MRV are also highlighted in the CRIP. Investments for action in these areas are targeted at the local level as they would contribute to:

- the achievements of the pathways for municipalities and the country: economic growth, inclusivity and poverty reduction goals;
- progress towards climate resilience, which can be measured by the indicator framework.

Enabling this necessitates four key steps:

### **1. Investment Preparation and Mainstreaming**

Preparing investments is a continual and periodic process that needs to ensure the proposed investment programmes are strongly aligned with existing and planned expenditure in ongoing activities and programmes. This process will highlight which areas need to be financed outside of a municipal budget and where existing expenditure could be optimised to meet certain requirements of each investment programme. Not only will this process assist to mainstream climate change adaptation activities into formal budgeting activities, it will importantly serve to identify current and future co-financing



commitments from the municipality.

## 2. Institutional Arrangements

The lead actors, as well as those involved in implementation, for each intervention, must be identified for each investment programme. However, coordinated, integrated and holistic implementation of this strategy necessitates cross-cutting institutional arrangements, that over time, can include non-governmental partners. A lead entity, or Climate Resilience Investment Steering Committee (CRISC), is envisaged. This will be located within, and reporting to the Executive Management structure of the municipality, with representation of key departments, such as those responsible for planning, water, coastal management, environment, disaster management, resilience, enterprise development, and finances. This CRISC should meet quarterly, to review and evaluate progress, consider financing and human resource mobilisation options, manage risks and challenges, and identify new/ revised opportunities and priorities.

In addition, a Programme Steering Committee (PSC) should be set up for each resilience programme. These SCs would report to, and be represented on the overarching entity, fulfilling the above functions at a programme level.

The Climate Change Units, typically established in the Environmental Management Departments of the various municipalities, can provide the secretariat function for the CRISC, while a lead department can provide this for each programme respectively. DRM is a natural role player in this regard for the pathway for DRR. In addition to coordinating the meetings and providing minutes, this function should include generating annual status reports for each programme, and the overall investment plan implementation respectively.

## 3. Financing Applications and Engagements

Once the investment plan custodians have confirmed the contribution to the proposed investment programmes from local budgets and have identified or articulated the local and international private and international public

(i.e. external) finance requirements, strategically targeted financing applications and engagements can be undertaken. This involves:

- Identifying and applying to key public climate and development financing institutions.  
Key climate and development finance institutions and associated funds need to be investigated in relation to the outcomes of step 1. Requirements and eligibility criteria vary significantly for different climate finance and development financing opportunities. Thus, once the details of the required financing are better understood, then applications to these funds can be targeted to the most appropriate and relevant sources of finance. For example, Box 3 (below) presents the case of the Green Climate Fund (GCF) in terms of relevant eligibility criteria, procurement guidelines and assessment/investment criteria.
- Establish formal partnerships and multi-stakeholder platforms with potential private sector partners  
This happens concurrently with identifying, and applying to key public climate and development financing institutions. Strategic partnerships and stakeholder platforms should be sought with potential private sector partners, both possible investors and implementation partners. Clear communication and transparency over the nature of the work that needs to be done and the current financing shortfall is necessary to develop long-term partnerships. Private sector collaboration includes the procurement of support partners to assist with capacity shortfalls in acquiring climate finance, for example detailed project preparation and the development of GCF proposals.
- Tackling climate change requires going beyond traditional financing approaches and sources to address the risks and opportunities  
Financing arrangements for adaptation investments are continually evolving and the most effective solutions necessitate localised innovation. Thus, both of these two aspects (this point and the one above) necessitate detailed research and development of



innovative financing opportunities and mechanisms to meet the financing shortfall identified in step 1. This requires high levels of communication and engagement with the finance department within the municipality to determine what is possible given the current regulatory environment and where a given city has prior experience in leveraging finance for different purposes. For example, the Greater Cape Town Water Fund is both a funding and governance mechanism that enables water users to invest collectively in catchment restoration alongside upstream communities to improve the flow of ecosystem services to the City of Cape Town (Stafford et al., 2018). The Climate Change arm of the Environmental Management Department in the City of Cape Town should be continually reviewing possible climate finance options and the potential of innovative funding mechanisms to meet both adaptation and mitigation finance shortfalls. These types of innovative financing options range across the investment spectrum, from high to low financial, social and environmental returns. Depending on the degree of intolerable climate risk facing a city, some examples include the climate, catastrophe and green bond markets (e.g. see [www.climatebonds.net](http://www.climatebonds.net)), fund development such as equity and layered-risk funds (EIB, 2014), various crowdfunding schemes, concessionary loans, and the structuring of resources to maximise cost effectiveness of the action through equity/loan participation, first-loss piece or guarantee schemes (UNEP, 2011).

#### **4. Implementation, Learning and Review**

Planning and investing for climate resilience is an iterative process. Investment planning and programming needs to be periodically reviewed and updated to account for developments in technical knowledge of climate change and related impacts, as well as changes in the international climate finance landscape. Moreover, policy and strategic direction within a city evolve over time. Thus, a flexible climate finance strategy is required to align with development objectives of a municipality and

facilitate the periodic review of climate finance options to meet any financing shortfalls. Ultimately, this should form part of a broader review and learning process that serves to re-inform further investment preparation and climate mainstreaming activities.

#### **Box 3. The Green Climate Fund**

##### **The Green Climate Fund (GCF)**

The GCF is a global fund that aims to support developing countries in both climate change mitigation and adaptation. In accordance with The Paris Agreement, the fund seeks to maintain a balanced portfolio between adaptation and mitigation projects and programmes, with the intent to support paradigm shifts in each sphere. Within the adaptation portfolio, the fund aims to allocate at least half of its funds (available to adaptation activities) to particularly vulnerable countries including Least Developed Countries (LDCs), Small Island Developing States (SIDS) and African states in general.

To receive funding from the GCF, Accredited Entities (AEs) of developing countries, with support from the GCF Project Preparation Facility and in close consultation with National Designated Authorities (NDAs) or focal points, develop project/programme proposals. These proposals are developed in response to Requests for Proposals (RfPs) issued by the GCF but can also be submitted to the fund at any time. Concept Notes for small-scale projects can also be submitted by the AEs. The eligibility criteria for these include the readiness for scaling up and the potential for transformation. However, in considering the eligibility of projects, proposed projects/programmes are evaluated and assessed against investment criteria with a set of indicators. These include the impact potential of the project in achieving the funds' objectives and results areas; paradigm shift potential for further impacts beyond a given project/programme; sustainable development potential in terms of environmental, social and economic co-benefits as well as gender sensitive development impact; targeting the vulnerability and financing needs of the recipient/beneficiary country; efficiency and effectiveness of the programme/project; and ensuring country ownership through alignment of policies, stakeholder engagement and capacity development. For adaptation projects, impacts, according to the GCF, are related to the number of lives, physical assets, livelihoods, environmental and/or social losses that can be avoided by an adaptation project (GCF, 2018).

# Glossary

**Adaptation** In human systems, adaptation is the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects. Incremental adaptation maintains the essence and integrity of a system or process at a given scale, while transformational adaptation changes the fundamental attributes of a socioecological system in anticipation of climate change and its impacts (IPCC, 2018).

### *Incremental Adaptation*

Adaptation that maintains the essence and integrity of a system or process at a given scale. In some cases, incremental adaptation can accrue to result in transformational adaptation (Termeer et al., 2017; Tàbara et al., 2018).

### *Transformational Adaptation*

Adaptation that changes the fundamental attributes of a socioecological system in anticipation of climate change and its impacts.

**Urban climate resilience** is the ability of a city to face climate shocks and stresses, while being able to anticipate, adapt to, and flourish in the face of climate change. The most prevalent climate risks in the 15 South African project cities are drought, heat waves, and flooding due to heavy rainfall and storms. Other key risks include sea-level rise and coastal erosion for coastal cities, biodiversity loss, wildfires, air pollution, climate change-driven migration and loss of ecosystem services.

**Air pollution** Degradation of air quality with negative effects on human health or the natural or built environment due to the introduction, by natural processes or human activity, into the atmosphere of substances (gases, aerosols) which have a direct (primary pollutants) or indirect (secondary pollutants) harmful effect (IPCC, 2018).

**Blended Finance** There is no common conceptual understanding of blended finance, but it broadly involves the strategic combination of sources of public and/or private finance to reduce investment risk, lower the cost of capital and crowd-in further investment into targeted programmes (Attridge and Engen, 2019; Meltzer, 2018).

**Climate Change** Refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations, in the Article 1 of the Framework Convention on Climate Change (UNFCCC), defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.’ The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes (IPCC, 2018).

**Climate resilience** The capacity for socio-ecological systems to: i) absorb stresses and maintain functionality in the face of external stresses imposed upon it by climate change; and ii) adapt, reorganize, and/or evolve into more desirable configurations that improve the sustainability and performance of the system, leaving it better prepared for future climate change impacts (Folke 2006; Nelson et al. 2007).

**Early warning systems (EWS)** The set of technical, financial and institutional capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss. Dependent upon context, EWS may draw upon scientific and/or Indigenous knowledge. EWS are also considered for ecological applications e.g., conservation, where the organization itself is not threatened by hazard but the ecosystem under conservation is (an example is coral bleaching alerts), in agriculture (for example, warnings of ground frost, hailstorms) and in fisheries (storm and tsunami warnings) (IPCC, 2018).

**Inclusive economy and society** Characterised by equitable participation in growth across the formal and informal sectors - in decision making decision in growth processes, and in the benefit of the growth itself. Participation of vulnerable population groups in growth processes is via non-discriminatory employment, while participation in the benefits manifests in income improvement and in increased social expenditure benefits that reduce

disadvantages, such as education and human capacity development. (Ramos et al. 2013; Fourie, 2014)

**Maladaptation** Actions that may lead to increased risk of adverse climate-related outcomes, including via increased GHG emissions, increased vulnerability to climate change, or diminished welfare, now or in the future. Maladaptation is usually an unintended consequence (IPCC, 2018).

**Risk** The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. In the context of the assessment of climate impacts, the term risk is often used to refer to the potential for adverse consequences of a climate-related hazard, or of adaptation or mitigation responses to such a hazard, on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence (IPCC, 2018).

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