Case Study Compendium: Local Climate Change Action in 10 South African Cities

2020

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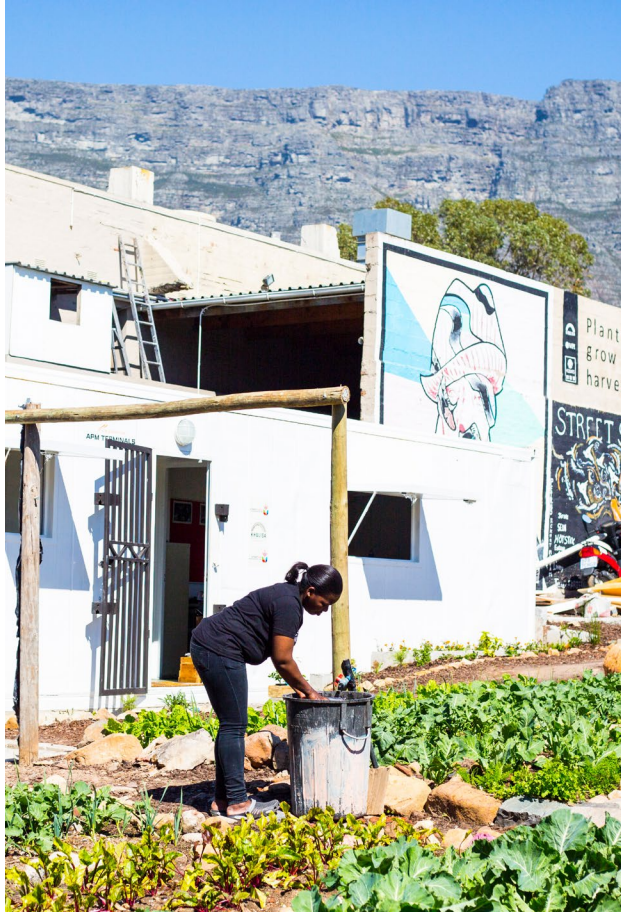
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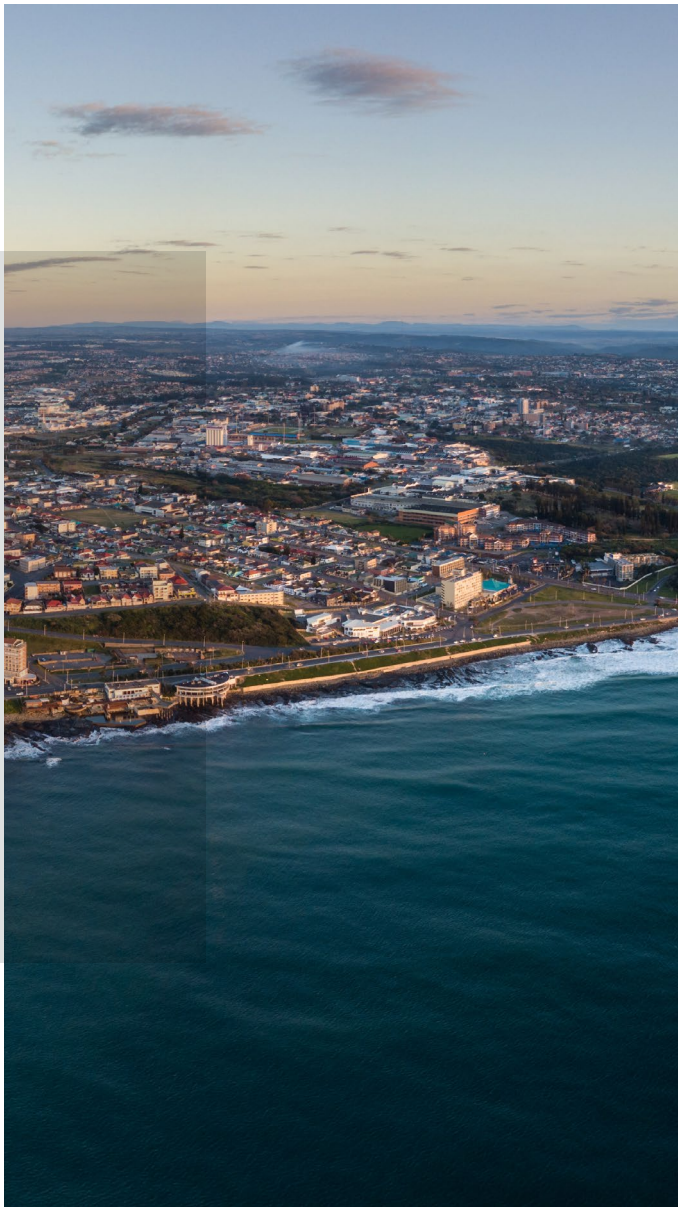
01

CASE STUDY

BUFFALO CITY METROPOLITAN MUNICIPALITY



1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

Buffalo City is a Metropolitan Municipality located on the east coast of the Eastern Cape Province. It encompasses the towns of Bisho, Dimbaza, East London, Kidd's Beach, King William's Town, Mdantsane, Phakamisa, and Zwelitsha. The Municipality covers an area of approximately 2,536 km2 and has an estimated population of 848 000. The climate in the City area is considered mild, with year-round sunshine and an average annual rainfall of 850mm. The African National Congress (ANC) is the ruling political party in Buffalo City.

The main economic sectors in the City are finance, manufacturing, trade, community services, and transport. Buffalo City has a world-renowned manufacturing base, primarily centred in the automotive industry. In 2016, the Buffalo City Municipality attained an annual growth rate of 0.35%, which is significantly greater than the 0.25% Gross Domestic Product (GDP) growth of the Eastern Cape Province. Buffalo City's GDP growth rate for 2016 was also greater than that of the country, given South Africa's 2016 GDP growth rate was 0.28%. This is also greater than that of South Africa, where. Buffalo City's Economically Active Population (EAP) was 362 000 in 2016, which is 42.69% of its overall population of 848 000, and roughly 17.59% of the total EAP of the Eastern Cape Province. Employment within Buffalo City increased annually at an average rate of 0.98% from 2006 to 2016.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

Buffalo City has a diverse set of threats or risks impacting the municipal area due to climate change. Some of the main sectors that are regarded as a significant risk include water resources, which are likely to be subject to increased variability and intensity of stormflow, while dry spells and droughts may be more frequent. Secondly, human health is a significant concern, as there is expected to be an increase in the number of days when the temperature will rise above 32° Celsius, and more extreme weather events (such as storm surges and floods) are expected to occur.

Another significant risk factor is that of the increased exposure of settlements located in flood and inundation-prone areas as well as an increased risk of shack fires, which poses a threat to the "urban" in terms of human society, livelihoods, and services in the City. Rural threats include an increased risk of the failure of rain-fed and subsistence crops, which would affect food security, and an increase of stress on rural communities who may suffer from water scarcity during droughts and contamination of potable water during floods. The coastal infrastructure and ecosystems are at risk of increased erosion and inundation from the rise in sea-level, flooding events, and storm surges. Finally, municipal infrastructure is threatened by the possibility of extreme weather events, such as intense storms, floods, droughts, exceptionally hot days, and the associated risk of fires.

In 2008, Buffalo City developed a Sustainable Energy and Climate Change Mitigation Strategy, and climate change thus appeared on the City's agenda at around this time. This may be attributed to the energy sector being particularly vulnerable in Buffalo City, and the City recognises that its energy security is at risk. This is because energy is not necessarily used efficiently or sustainably in the City, and it is significantly contributing to global warming through greenhouse gas emissions.

Buffalo City furthermore recognises various manifestations of climate change in the community, such as the continuous rise in average temperature, which may lead to an increase in the prevalence of sweltering days and heatwaves. The annual average precipitation is increasing, but how it occurs is changing. For instance, in the future, there will be a noticeable increase in variability from one year to the next, and the City will experience heavier and more intense rainfall with a higher likelihood of destructive storms. Longer dry-spells may occur during periods of rain, which increase the likelihood and severity of droughts.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

The City has responded to the threats posed by cli-

mate change by developing various key measures and mechanisms. As mentioned above, the first response by Buffalo City was to adopt a Sustainable Energy and Climate Change Mitigation Strategy in 2008. The Municipality also developed a Climate Change Strategy in 2015, which provides both adaptation and mitigation measures, the prioritisation of actions to address climate change risks, and sets out the City's review and assessment of its Integrated Development Plans (IDPs) and Sector Plans.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

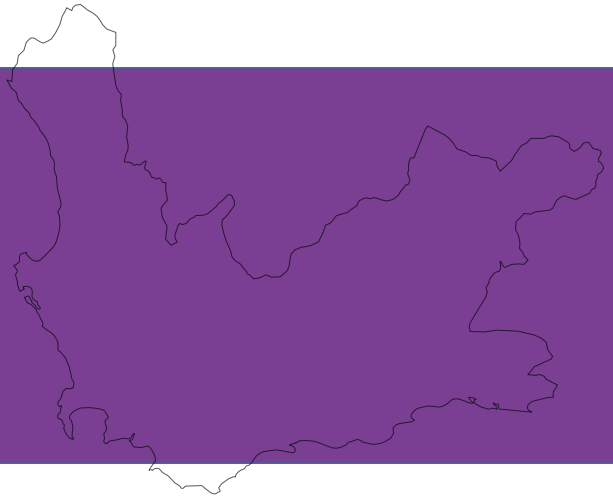
One of the innovative approaches Buffalo City has taken to address climate change in its area was to arrange two workshops in which they engaged with the various Buffalo City departments representing various IDP sectors. These departments included Coastal Management, Disaster Management, Environmental Health, Environmental Pollution, Housing, Spatial Planning, Waste Management, and Transport Planning. During this engagement, the City was able to identify some of the risks and response opportunities available to it (including mitigation and adaptation), as well as to develop response programmes.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

Buffalo City has partnered with the ICLEI (Local Government for Sustainability) on specific projects about the Buffalo City area. For instance, the Municipality joined the ICLEI-led Local Action for Biodiversity: Wetlands South Africa project in 2015 and has taken decisive steps towards improving wetland management. This was done firstly by developing a Wetland Report which collates together all the available wetland information from within the Metro to assist the Municipality with identifying the gaps in its wetland management. Secondly, this was achieved by developing a Wetland Strategy and Action Plan which identifies where focussed work needs to be performed to efficiently manage its wetlands in the future and increase the provision of ecosystem services in Buffalo City.

NEXT:

CITY OF CAPE TOWN METROPOLITAN MUNICIPALITY



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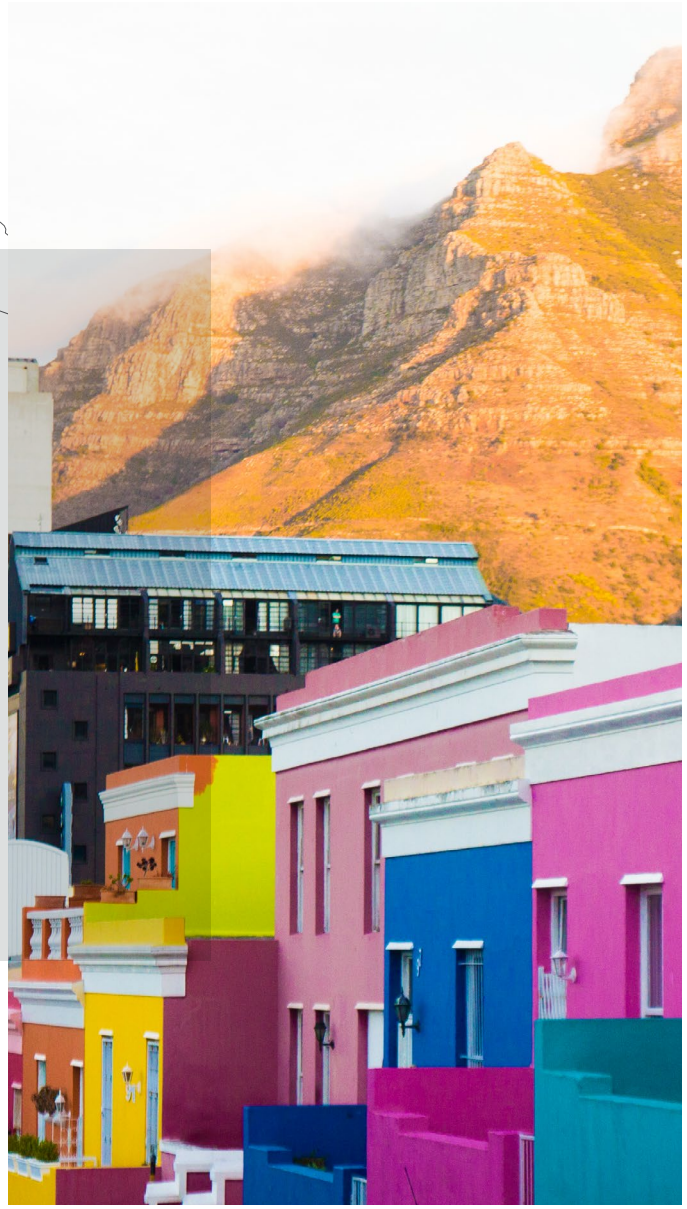
CASE STUDY

CITY OF CAPE TOWN METROPOLITAN MUNICIPALITY



1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

The City of Cape Town is a Category A municipality and is situated in the southern peninsula of the Western Cape Province. The municipal area covers 2,460 km2 and has a 307 km coastline, two mountain chains, lowland hills, and plains and supports a wide range of natural ecosystems, habitats, and species. Cape Town has a Mediterranean-style climate: wet and cool winters, dry and warm summers. With a population of 4 322 031 in 2018, the City is South Africa's second-largest economic center and second-most populous city after Johannesburg. From 2011 to 2016, Cape Town had the fourth-highest annual population growth of all the metropolitan municipalities in South Africa, increasing from 1.5% between 2011 and 2012 to 1.6% between 2015 and 2016. This rapid urbanisation is largely the result of the inward migration of South Africans, particularly from the Eastern Cape, Gauteng, and other parts of the Western Cape. A significant number of new migrants to Cape Town find a residence in one of the city's many informal settlements.

Cape Town faces several challenges including poor energy security, rapid urbanisation, and associated energy poverty, urban sprawl, vulnerability to the impacts of climate change, high levels of unemployment, substance abuse, and crime. The City is the provincial capital and primate city of the Western Cape, as well as the legislative capital of South Africa, where the National Parliament and many government offices are located. The City is further governed by the Democratic Alliance (DA), a South African political party.

Climate change was first formally identified as an issue that the City of Cape Town needed to address in 2001, with the adoption of the City's Integrated Metropolitan Environmental Policy. The City of Cape Town Energy and Climate Change Strategy was subsequently adopted in 2006. However, this formal recognition in policy was preceded by several years of work on climate change-related matters, the most prominent of which was the Kuyasa Low-Income Energy Efficiency Housing Project which began in 1999 and was the first clean development mechanism (CDM) project registered in South Africa

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

While the timing and magnitude of impacts remain uncertain, there is little uncertainty regarding the types of impacts that Cape Town is facing and will increasingly face. The City is currently facing climatic changes that include a decrease in annual average rainfall and changed seasonality of rainfall; an increase in mean annual temperature: higher maximum temperatures, more hot days, and more frequent and intense heat waves; an increase in average wind and maximum wind strength; and an increase in coastal erosion coupled with the risk of mean sea-level rise. Severe storms also pose a significant risk to infrastructure and residents due to both coastal and inland flooding; although the frequency of these is not currently anticipated to increase into the future, the current level of risk is high and will remain so.

While water remains the most vulnerable sector in the Cape Town, water demand remains somewhat suppressed through both behaviour change and technological interventions. However, it will be some time before the City's supply augmentation programme starts to bring significant quantities of new water to the system. Additionally, this new water (groundwater, desalination, wastewater recycling) will be significantly more expensive than surface water, creating a cost burden both for the City and for water users. However, improved catchment management, including invasive species clearing, has been identified as one of the most cost-effective ways of increasing water supply and is therefore a priority area of implementation.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

As early as 2001 the City of Cape Town adopted an Integrated Metropolitan Environmental Policy (IMEP). The Policy identified the need for an active shift from business-as-usual to a driven and targeted sustainability agenda. Specifically, IMEP noted that only an integrated approach would enable

positive change within this complex arena and that the City would need to increase its commitment to resource conservation and efficiencies.

In 2017 the City of Cape Town adopted the Climate Change Policy. This was the first time that the city had in place a policy specifically dedicated to climate change. Before the adoption of the Climate Change Policy, the City's climate change response was governed by several different action plans and implementation strategies. The Energy and Climate Change Strategy was developed in 2003 and revised and adopted by the Council in 2006. Elements of this strategy were included in the Municipal Spatial Development Framework, the City Development Strategy, and the Integrated Development Plan (IDP). Also in 2006, the City adopted a Framework for Adaptation to Climate Change in the City of Cape Town which included a set of principles for adaptation action. The City of Cape Town reviewed its Climate Change Policy in 2019 and determined that the policy should be upgraded to a strategy in order to ensure that climate change is addressed and integrated at the highest level within the organisation. The City published its draft Climate Change Strategy for public comment on 01 September 2020.

In 2010, the City adopted an Energy and Climate Action Plan, focused on mitigation actions, and in 2011 seven sectoral Climate Adaptation Plans of Action (CAPAs) were also adopted. In parallel, the City undertook a comprehensive Disaster Risk Assessment, which identified climate change as high on the list of hazards. The assessment led to the development of 23 hazard plans, one of which was a 2012 climate change and coastal process hazards disaster risk management plan. The City adopted city-wide greenhouse gas mitigation targets across various sectors in 2015 under its Energy 2040 Program. These are now being superseded in new action plans by a mitigation target of city-wide carbon neutrality by 2050 in line with the City's commitment to the global C40 (Cities Climate Leadership Group) Deadline 2020 programme.

The City is currently in the process of developing an integrated Climate Change Action Plan, which will cover adaptation, mitigation, and governance issues, and will replace action plans that have previously been adopted. The City is involved in the implementation of numerous programmes and projects that directly or indirectly address climate change adaptation and mitigation.

Furthermore, the City's Resilience Strategy (2019) aims to put in place programmes and projects to address a set of prioritised chronic stresses and acute shocks, including climate change and related climate shocks and stresses, and therefore to increase Cape Town's overall resilience and reduce vulnerability well into the future.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

There are numerous initiatives both within the mitigation and adaptation work areas that could be highlighted, with the City currently being in the planning phase for many programmes of action. The City's New Water Programme is the most ambitious climate change response programme currently being implemented by the City of Cape Town and is notable for the urgency and scale of the challenge, as well as the cost of addressing it. The New Water Programme was developed following the severe drought that affected Cape Town between 2015 and 2017. The committed interventions that are part of the New Water Programme over the next ten years are comprise of management interventions, groundwater abstraction, reuse and desalination, as well as additional surface water supply.

Furthermore, the City Climate Data Management Framework is an energy efficiency project implemented in municipal facilities since 2009. Following the grant funds used for these projects, the City is required to conduct detailed measuring and verification assessments to verify electricity savings post-implementation. To make the case for additional funds and enable monitoring across all facilities, the City initiated the rollout of a smart electricity metering programme in partnership with the electricity department. The City has about 1,300 immovable property assets registered, and by 2015,

the City had installed about 500 smart electricity meters within municipal facilities, but found it challenging to manually extract, analyse and monitor all the data from these meters monthly for reporting purposes.

Through a partnership with several internal departments, the city identified isolated sub-systems within the City's IT infrastructure that needed to be integrated and automated for intelligent data analysis and interpretation. A web-based data application, called SmartFacility, was developed that integrates all required data related to municipal facilities and their consumption. This application interprets the facility's electricity consumption data in a friendly, accessible manner, illustrating the data on several dashboards easily accessible to facility managers and management staff for proactive monitoring and management of municipal facilities consumption. The purpose of this project was to develop a data-driven online application that could assist with automating the data analytics required for various purposes including tracking and monitoring electricity savings achieved through the implementation of energy efficiency and renewable energy interventions, automating data collection for annual emissions inventory reporting and related carbon research, and summarising data required to drive evidence-based decision making, policy, and strategy development. The tool has realised significant benefits which enable the City to identify energy efficiency opportunities, ranking and benchmarking facilities in the public sector and data-led, evidence-based project and programme development and implemented, policy and strategy development to align with climate mitigation goals and targets

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

One of the most important opportunities in addressing climate change in Cape Town is job creation and economic development. This takes place either directly, through green jobs created by the City, or indirectly through new economic opportunities created by incentives put in place by the City. Additionally, a large number of economic opportunities are created through the private. Green jobs created to address climate change include, among others, those related to invasive species clearing in catchment areas, coastal dune rehabilitation in areas at high risk of erosion and sea-level rise, restoration of biodiversity in priority climate change corridors, and maintenance of rivers and wetlands to improve ecosystem health and reduce flooding.

Furthermore, a Special Economic Zone (SEZ) has recently been established in Atlantis, an economically depressed area in the far north of the city. The SEZ has been established as a green-tech manufacturing hub. One of the ways that the City supports the SEZ is through the Atlantis land bank programme (a form of biodiversity offset) which proactively conserves land of high conservation value outside of the urban edge so that land of low conservation value within the urban edge can be fast-tracked for industrial development.

The private sector has responded to the City's Climate Change Policy as well as climate-related events and public demand by increasingly making available green products and services that support climate change mitigation and adaptation. For example, during the "Day Zero" crisis, many companies in the plumbing sector brought out innovative and new water-saving technologies that were widely adopted by residents, businesses, and government. Solar water heating and solar power sectors are also growing in the city as these technologies increasingly become more cost-effective. This is supported by the City's Small Scale Embedded Generation process.

The City of Cape Town has partnered with several different organisations to collaborate on climate change action. The City is a member of C40 and ICLEI (Local Governments for Sustainability) and has also signed on to the Global Covenant of Mayors for Climate and Energy. The City was also a member of the 100 Resilient Cities programme. Membership of these organisations has proven valuable in informing the City's climate change action planning by allowing the City to learn from other cities and how they have managed similar challenges. This has been integrated into the drafting of the Climate Change Action Plan in many different adaptation and mitigation work areas. One example of this is in the area of adaptation

to heat; as a member of the C40 Cool Cities Network, the City of Cape Town has had the opportunity to learn from other members about the development of cooling centres, tree planting, and other shading initiatives, and the development of heat monitoring and early warning systems.

Local partnerships exist with many key academic institutes (including the University of Cape Town's Energy Research Centre, African Climate and Development Initiative, African Centre for Cities, the Climate Systems Analysis Group, the Cape Peninsula University of Technology, and the University of Stellenbosch), NGOs (including Sustainable Energy Africa and others), and business groups (including Accelerate Cape Town, the Cape Chamber of Commerce, the Cape Town Partnership, and the City-run Commercial Energy Efficiency Forum).

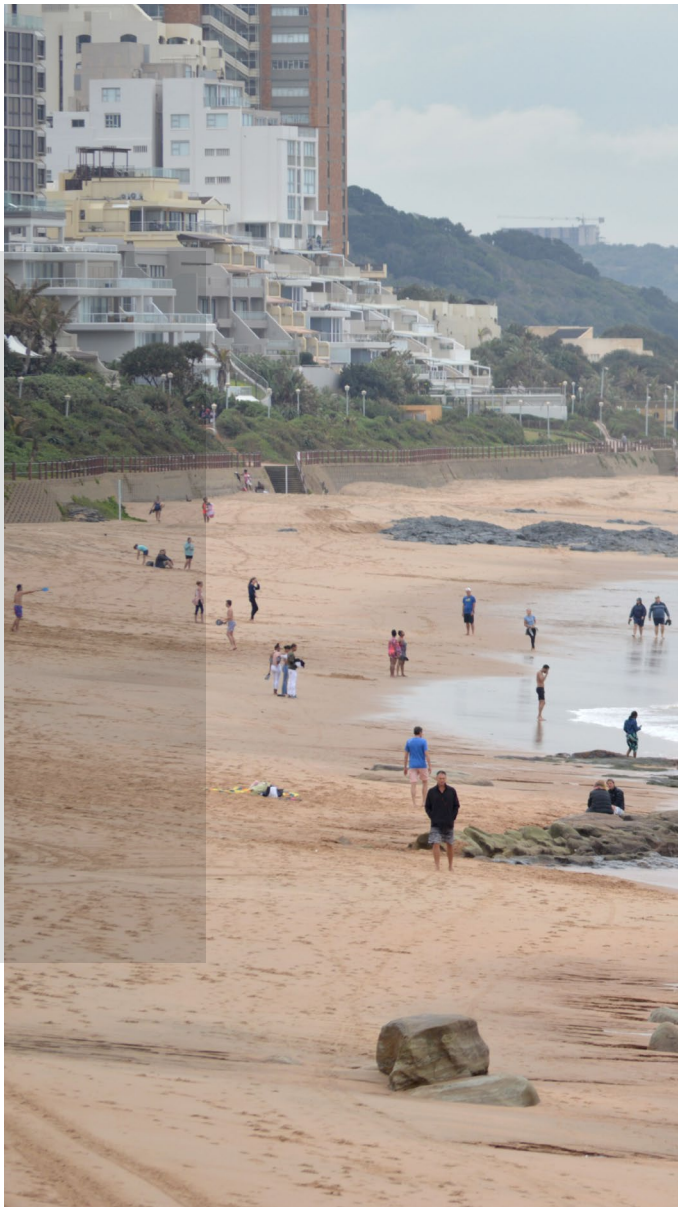
NEXT:

CITY OF eThekwini METROPOLITAN MUNICIPALITY

03

CASE STUDY

CITY OF eThekwini METROPOLITAN MUNICIPALITY



1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

Durban is a port city that is situated on the east coast of South Africa. Managed by the eThekwini Municipality, the city is home to a population of approximately 3.4 million people. Between 2001 and 2011 the population of Durban grew at an average annual percentage of 1.13%. Migration is a significant contributing factor to population growth in Durban, with most migrants to the city being drawn from the province of KwaZulu-Natal. This inward movement of people to the city could in the future be exacerbated by negative climate change impacts on rural livelihoods that will further promote rural to urban population migration. The eThekwini Municipality governs an area of 2 297 km2 that includes urban and rural communities. The Municipality is under the political governance of the African National Congress (ANC). Durban is responsible for approximately 5.2% of South Africa's total GHG emissions and less than 0.1% of global GHG emissions but will still experience impacts of global climate change.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

The Durban Climate Change Strategy (DCCS) states an average annual temperature increase between 1.5°C and 2.5°C by 2065, and an increase between 3°C and 5°C by 2100. Furthermore, temperatures for the hottest days are expected to increase more rapidly than the current average. With increasing temperatures, evaporation rates go up. This can range between a 3% to 6% increase, resulting in the frequency of dry years increasing to up to three times every 10 years, instead of once. Currently, there is a dry year with less than 700mm of precipitation once every 10 years. Accordingly, climate change could decrease a dry year by 38mm, making dry years drier.

The potential increase in rainfall by 2065 is expected to rise to 500mm by 2100, while the northern parts of the Municipality are expected to experience an increase of 20% in long-duration rainfall (one day and longer). The outer-western areas are predicted to experience increases in short duration rainfall which may lead to localised increases of up to 30% in flooding. Furthermore, an estimated 30% to 100% increase in the year-to-year rainfall variability is expected, which may result in increased erosive capacity, increasing numbers of heatwaves and rising sea levels are expected to be greater than the current rate of 2.7 (+/- 0.05) mm/year. Moreover, Durban is likely to experience the urban heat island effect, seeing that the densely urbanised city centre, as well as the coastal belt of the city, are already experiencing temperature differences of as high as 6°C compared to nearby vegetated lands.

As a result of these changes, there are some risks that Durban may face in the future. These include changes from year to year in water availability, potential damage to infrastructure, threats to biodiversity and ecosystems, impacts on agriculture and food security, higher energy consumption, and health impacts. Durban is projected to experience an increase in the frequency and intensity of extreme weather events, including flash floods, droughts, and an increase in the number and severity of coastal storms - which will be exacerbated by sea-level rise. The urban poor is likely to be the most at risk. These impacts are likely to be compounded by indirect or non-climate change-related risks, such as population growth rate. Notably, different sectors experience different levels of vulnerability as a result of climate change, the key vulnerabilities have been noted in the Climate Action Plan (CAP) and the risk assessment. As the impacts are crosscutting with the potential of affecting social, environmental and economic sectors. This notion of crosscutting impact can be seen in the way that the CAP and the Durban Climate Action Plan for the eThekwini Municipality has been developed. This has taken on a thematic area approach. However, as a result of recent environmental events the flooding and water quality and security has to be seen as areas requiring immediate attention for the municipality.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

Recognising the risk posed by climate change to the city's future economic growth and to its communities, the Municipal Climate Protection Programme (MCPP) was developed in 2004 with the aim of as-

sisting the municipality in adapting to and mitigating climate change. The programme placed emphasis on the importance of mainstreaming climate actions into all aspects of work undertaken by the municipality. As a result, the MCPP was included in the City's Integrated Development Plan in 2006 and the Climate Protection Branch was formed within the Environmental Planning and Climate Protection Department in 2007. The Branch is tasked with driving the climate adaptation agenda for the City. The Energy office was established in 2008, with an iinitial focus on improving electricity usage efficiency in municipal infrastructure. The mandate for mitigation was only afforded to the Energy Office in 2009 ahead of Durban hosting the United Nations Framework Convention on Climate Change (UNFCCC) 17th Conference of the Parties (COP17) in 2011.

To address the challenge of climate change, the eThekwini Municipality has developed the Durban Climate Change Strategy (DCCS) as part of its Municipal Climate Protection Programme. The DCCS lays out a city-wide approach to adapting to climate change and mitigating Durban's contribution to climate change. The development of the DCCS was initiated by the Environmental Planning and Climate Protection Department (EPCPD) and the Energy Office (EO) of the eThekwini Municipality as a first step in aligning and ensuring synergy between the adaptation and mitigation work being undertaken in the city. Since climate change is expected to affect all sectors of society in Durban, the responsibilities outlined in this strategy represents a Durban-wide response, which seeks to create an enabling environment for partnerships across different sectors and stakeholders.

At a more detailed level, the eThekwini Municipality has an Energy Strategy (eThekwini Municipality, 2008) which provides a framework for improving energy performance in the city. The DCCS builds on the content of this strategy and will ultimately replace the Energy Strategy once it is formally adopted. In addition to the Energy Strategy, a set of Municipal Adaptation Plans have been devised for the Health, Water and Disaster Management units of the eThekwini Municipality. Since the DCCS is intended to provide a framework strategy that guides and enables all sectors of society to respond to climate change, these sector-specific Adaptation Plans will remain in place and be supplemented with additional plans as more municipal sectors address the challenge of climate change. The adaptation content of the DCCS has been aligned with these early pilot strategies.

Climate change is also listed as one of the key development challenges facing Durban in the eThekwini Municipality's Integrated Development Plan (IDP), and the impacts of climate change on development are emphasised. The IDP states that climate change adaptation needs to become a top priority for the city. eThekwini Municipality has also developed a resilience plan for Durban. The purpose of the resilience plan is to better prepare Durban for the wide range of changes (both positive and negative) that cities of the 21st century will experience. Climate change is one of the key stresses addressed by the Resilience Strategy of 2019. eThekwini Municipality's first Resilience Strategy is a product of a four-year consultative process with a broad and diverse group of stakeholders. The Resilience Strategy was formally adopted by the eThekwini Municipality Council in August 2017.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

A few of the notable developments in the City's response action include the Durban Climate Action Plan, The Durban Climate Change Strategy, Durban's Transformative River Management Programme (TRMP), and The Energy Office Solar (EOS) project. The aforementioned is a pilot project that culminated in the eThekwini Municipality installing 300 kWp (kilowatt peak) of rooftop Photovoltaic on 5 municipal-owned rooftops. This pilot project was undertaken in part to test the regulations and processes that the Municipality has put in place for the private sector to adhere to when installing Rooftop PV. The EOS project has its roots in the DCCS. The DCCS was approved by the eThekwini Municipal Council in 2015. It was developed by adopting a consultative and participatory approach that focuses on thematic areas. One of the thematic areas is Energy, the first objective of this theme is "40% of Durban's electricity consumption is to be supplied from renewable energy by 2030 in line with the national long-term mitigation

targets". One of the specific responses is to "Implement viable small-scale renewable energy generation such as micro-hydro power, rooftop solar photovoltaic and anaerobic digesters within municipal assets".
The aim of the DCCS is the successful implementation of an integrated mitigation and adaptation climate change response. This implementation framework was developed and approved in 2017 and consists of three themes: governance, implementation and strategic development. The themes are based on guidance developed during the Durban Adaptation Charter (DAC) Implementation Guidance Workshop, held in March 2013.

The Municipality is also one of the first municipalities in the world to develop a project for funding through the CDM. The project entails the enhanced collection of landfill gas (methane) at three landfill sites (Bisasar Road, Mariannhill, and La Mercy) owned by the Municipality and the use of this recovered gas to produce electricity. It is a 7-year project aimed at reducing CO_2 equivalent emissions by more than 3 million tonnes, generating as much as $15 million in revenue to help offset the project's price of $40 million.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

To ensure that the Municipality is at the forefront and continuously developing a sustainability agenda, the Mayor plays a significant role in many of the global networks. Some strategic partnerships developed at a global level are the African Forum for Urban Safety, UN-Habitat, United Cities and Local Governments (UCLG), C40 Cities Climate Change Leadership Group (C40), Cities Fit for Climate Change, and Local Government for Sustainability (ICLEI). The City has also been able to leverage opportunities provided by its partners, namely those provided with the C40 Leadership Group, through provision of technical support and capacity building opportunities. The Municipality participates as one of the megacities within the African region of the C40 Network consisting of a network of 96 cities globally. C40 supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change. One of the core C40 engagements with the city has been linked to the development and implementation of the Durban CAP through the Deadline 2020 special programme. The Municipality is the first African city to develop a Climate Action Plan that is compliant with the Paris Agreement. The Durban CAP was adopted by Municipal Council in July 2019.

Through its involvement in ICLEI, the eThekwini Municipality has initiated several campaigns which directly or indirectly impact on climate change reduction attempts. These include a GHG inventory that is undertaken at regular intervals, energy audits conducted for municipal buildings, and waste minimisation and recycling projects.

NEXT:
CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY

04

CASE STUDY

CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY

1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

The City of Johannesburg is a Category A municipality, with a land area of 1,645 km2, situated in the Gauteng Province. With a population of 5,635,127, and growing at a pace of 3.16% per year, the City is the biggest urban centre of the country. This makes the city the 40th most populous urban area in the world and the largest not be situated on a river, a lake or a coastline. The City also drives the economic performance of the Gauteng province, which alone contributes to 33% (R 674.9 billion) of the national Gross Domestic Product (GDP), and stands as the centrepiece of South Africa's economy. However, the City is amongst the biggest emitters of greenhouse gases in South Africa, which emanate mainly from industrial activity, transport and residential areas.

The City of Johannesburg currently experiences an average annual temperature of 25 in summer and 17 in winter. The current rainfall conditions for the regions indicate an annual average rainfall amount of up to 713mm. Humidity levels at the present range between 30% and 50%. Like most other South African cities, Johannesburg demonstrates high levels of social, spatial and economic inequality, but its citizens are subject to greater inequality than those in other regions. Along with the Gauteng Province in which it is situated, the City is governed by the African National Congress.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

Johannesburg has relatively limited exposure to the most severe consequences of climate change. This is mainly because it is not located on a coastline nor is it in an area heavily affected by major weather-related natural disasters such as hurricanes or typhoons. Despite this, the projected impacts on the City may be significant and substantial. Climate change is generally seen as one of many significant pressures

experienced in the City, although not necessarily the most important in the short term. In some instances, the City's climate change vulnerabilities arise from serious issues that already exist, such as urban flooding, which may potentially be exacerbated by relatively moderate changes in climatic conditions. Increased temperatures will result in more heat waves, poor air quality, decreased economic activity and output, increased risk of heat, related mortality and chronic illnesses. Changes in the biosphere have already affected soil fertility and biodiversity in general.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

The City's commitment to climate change adaptation and mitigation is to be found in the Growth and Development Strategy 2040, which envisions a resilient, liveable and adaptive society that provides sustainability for all its citizens. The first Growth and Development Strategy was launched in 2006, its purpose being to reshape the City's future development as a way of turning the challenges posed by migration, climate change, increased capital mobility and resource scarcity into opportunities. The City's approach to this is that of mainstreaming climate action into normal City processes, such as land-use planning and decision making, infrastructure roll-out and service delivery. The Climate Change Strategic Framework is the means to integrate and leverage on the work of key sectors such as the Planning Department, the Transportation Department, and some key entities such as City Power, Joburg Water, and Pikitup, etc. These sectors are encouraged to implement projects and programmes that benefit carbon reduction and build resilience in the City.

In 2009, the City of Johannesburg developed a Climate Change Adaptation Plan aimed at addressing the adaptation requirements of the municipality and its residents. Guided by international law and policies such the United Nations Framework Convention on Climate Change (UNFCCC) and the National Climate Change Response Strategy, the City has effectively taken necessary actions to address climate change. The City is also involved in climate change adaptation projects, such as the sustainable human settlements project, which addresses the issue of food security and the promotion of self-reliant communities. These include the adaption of a

multi-pronged approach which actively supports and provides incentives for small-scale farmers to supply fresh produce from urban food systems. Johannesburg's Climate Action Plan (CAP) is the City's strategic plan to prioritise evidence-based transformational actions to transition the City towards an emission neutral, climate-resistant city by 2050. It is envisaged that the CAP will be a City-wide action plan or a public plan to be actioned by the City administration (including the City's Municipal Entities), the private sector, civil society, the youth etc. The expected outputs of the CAP project are separated into various work packages that will indicate the project milestones, scenario modelling and target setting, action and implementation and stakeholder engagement and reporting.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

The City has initiated a new policy formulation process related to a "Green Building" Policy which will be led by Department of Development Planning with strong support from the Department of Environment and Infrastructure Services and various other departments (e.g. City Power, Joburg Water and Pikitup), as well as C40 South Africa, which forms part of a global network committed to addressing climate change. This will be a 2-year policy and bylaw formulation process. It forms part of a broader programme aimed at reducing the City's carbon footprint.

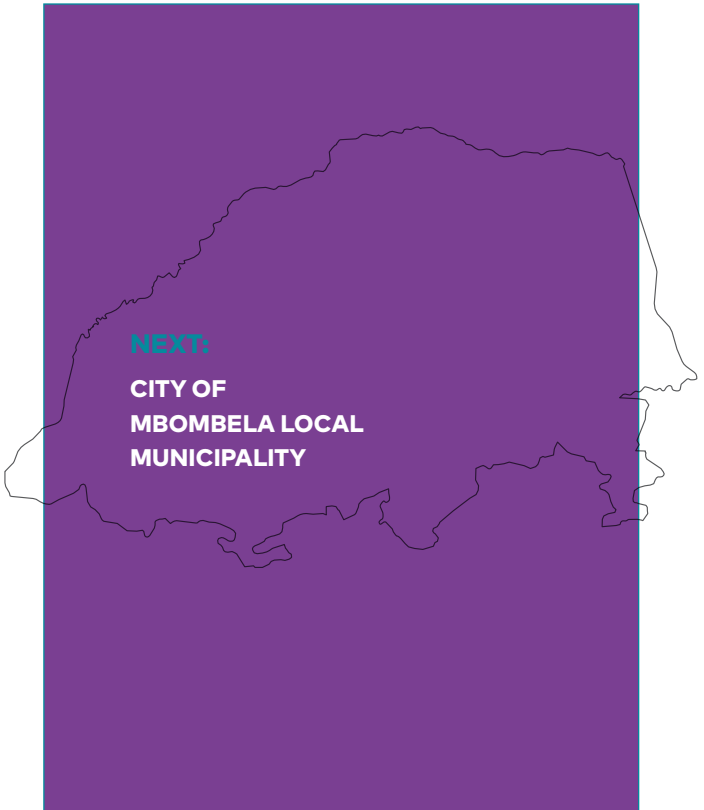
In 2012 the City developed a Greenhouse Gas Emission Inventory (GHGEI) for the 2007 baseline year by applying the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). In 2015, the Local Government for Sustainability (ICLEI) developed the City's 2014 Greenhouse Gas Emissions Inventory. Overall, a comparison of the two inventories shows that the City's emissions reduced by 5.3% between 2007 and 2014.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

In addition to making its policy commitments, the City of Johannesburg is part of the international C40 initiative, in which officers in charge of environmental policies from 40 of the largest cities in the world co-operate in addressing climate change and

sustainability issues. At the Tokyo C40 Conference on Climate Change in October 2008 the City committed itself to the following joint actions, among others, which relate either directly or indirectly to climate change adaptation: keeping cities cool – urban development to save energy and reduce waste heat, the promotion of the prevention of water leakage and the provision of related technical information, sharing information on activities to expand the reuse of wastewater, the promotion of flood control measures to adapt to the effects of climate change, establishing evacuation and information delivery systems for disasters; appealing to central governments about worldwide food issues, and developing heatwave plans for urban areas.

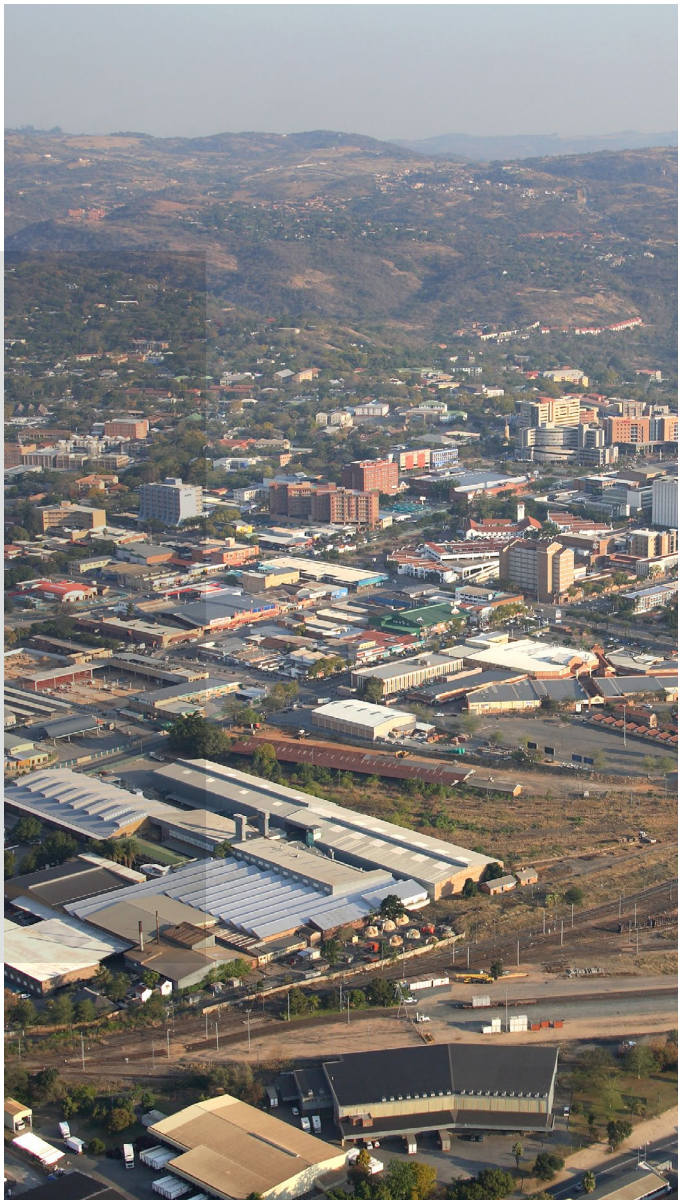
The City has formed partnerships with several big organisations to host events that will provide platforms for local government to investigate climate change and the challenges cities face. The partners include C40, the International Council for Local Environmental Initiatives and the South African Cities Network. The City is a co-signatory of The Global Cities Covenant on Climate (referred to as "The Mexico City Pact"), an agreement signed between mayors at the World Mayors' Summit on Climate (WMSC) in Mexico City on November 21st, 2010, with the purpose of undertaking firm mitigation and adaptation actions in the face of climate change.



05

CASE STUDY

CITY OF MBOMBELA LOCAL MUNICIPALITY



1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

The City of Mbombela, previously known as Nelspruit, is in the north-eastern part of South Africa. It is situated in the Mpumalanga Province and forms part of the Ehlanzeni District. It has a category B Municipality and is one of the four municipalities in the district. Mbombela is the most concentrated economic district and the main contributor to the district's economy. It has a population of 734 482 and boasts an area coverage of 3 451km². Approximately 87% of the municipal area is classified as natural vegetation or forestry and 6% is classified as agricultural land (commercial and subsistence). The City is also home to the National Botanical Gardens, which are set in 154 hectares of land along the eastern bank of the Crocodile River and containing no fewer than 512 plant species indigenous to the area.

Mbombela has a humid subtropical climate with mild winters and hot summers. Due to its low situation, the summers are hot and somewhat humid and are accompanied by heavy precipitation. Winters in the city are dry, with relatively warm temperatures during the day and chilly temperatures at night. The eastern part of Mbombela is characterised by high levels of poverty, low literacy levels, limited infrastructure, and limited economic growth, whereas western Mbombela experiences high economic growth, high literacy rates, and good infrastructure (Adams and Moila, 2004). High unemployment levels are experienced in the rural villages and townships, the rate officially ranging from 25% to 41%, but estimated to far exceed this in the deep rural areas (Mayoral Report, 2002). The urban towns experience relatively low levels of unemployment rates of less than 10%. The City is governed by the African National Congress (ANC), which won a majority of 69 seats on the council in 2016.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

Mbombela is likely to experience the impacts of higher temperatures and changes to precipitation patterns (climate change variables). Climate changes that could be experienced include more frequent heat waves, an increased frequency of droughts which will lead to water scarcity, increased humidity, an increased number of flooding events, more intense rainfall events, and an increase in the prevalence of tropical diseases. These changes could have a major impact on the municipality's ability to provide basic services and address matters such as water supply, disaster management, public health, electricity supply, waste and sanitation, food security, human settlements, and local economic development. As a result of these changes and challenges, some key economic activities that drive the economy are at risk from the effects of climate change. These include agriculture, tourism, forestry, industry, transportation, and commerce.

The Mpumalanga Province is a water-scarce area, and the scarcity is worse in the Lowveld part of the Province where the City of Mbombela is located. The City is home to important river systems which include the Crocodile and the Sabie-Sand catchments. The catchments play a vital role in ensuring that the authorities supply water services to the citizens of the municipality for domestic and commercial uses, and agriculture. Hence, the municipality has faced challenges to supply water to all its citizens partly due to population growth and partly as a result of the reduction in rainfall and the frequency of intense heat waves. This situation is having an impact on the river system and the wetlands are drying out. As a result, the dam levels dropped to below 50%, some less than 20% during the dry season in 2019.

Furthermore, the Municipality has areas of diverse biodiversity (both fauna and flora) including Protected Areas, Critical Biodiversity Areas (CBA), Ecological Support Areas (ESA), and other natural areas. The increased frequency of droughts is prejudicial to the biodiversity as it results in water scarcity as well as a lack of forage for fauna as a result of the paucity of the growth of vegetation as well as the encroachment of bush, which is promoted by a large amount of carbon dioxide in the atmosphere. The change

in temperatures may have an impact on flora as well as a pollinator of some plant species may be affected by the climate, subsequently affecting the animal species.

The economy of the City of Mbombela relies significantly on the tourism sector. The Municipality offers various tourist attractions which include game reserves such as the well known Kruger National Park, hotels, lodges, and cultural heritage sites. These sites play an important role in job creation and add value to the Gross Domestic Product. The Kruger National Park has already experienced the impacts of climate change several times, the impacts including heavy rain which resulted in flooding as well as a severe drought which caused some rivers in the park to dry-out.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

In 2014, Mbombela initiated the process of compiling a Climate Change Response Strategy. This led to the development of a Climate Change Policy, Strategy, and Implementation Plan to inform and guide the making of an appropriate and meaningful response to the challenges of climate change for the Municipality. This includes the planning and management of future development in the municipality, current and future sectoral activities, and the making of green investments.

Moreover, it is recognised that climate change cuts across sectors and departments and that there is a collective responsibility to respond to the challenges and opportunities of climate change. As such, four implementation clusters have been developed that relate to the overall policy objectives. These clusters are made up of 10 projects, which are based on the priority response actions that have been identified for the Municipality. The projects are aimed to be financially feasible, resource-efficient, and undertaken in the short term. The 10 projects identified for this strategy include mainstreaming climate change into the "Vision 2030", building a responsive and resilient International Development Plan, greenhouse gas and energy assessment, climate change vulnerability assessment, updating the Disaster Management plan, a tool to support the making of decisions regarding climate change and EIAs, and LED Strategy update, water conservation project, buildings retrofit and upgrade, and a climate change forum.

The aforementioned projects have led to the establishment of a City of Mbombela Climate Change Response Strategy, Air Quality Management Plan (AQMP), Disaster Management Plan, Wetland Inventory and Ecological Integrity Assessment, Integrated Waste Management Plan (IWMP), Spatial Development Framework (SDF), Climate Change Policy, and Integrated Transport Plan, amongst others.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

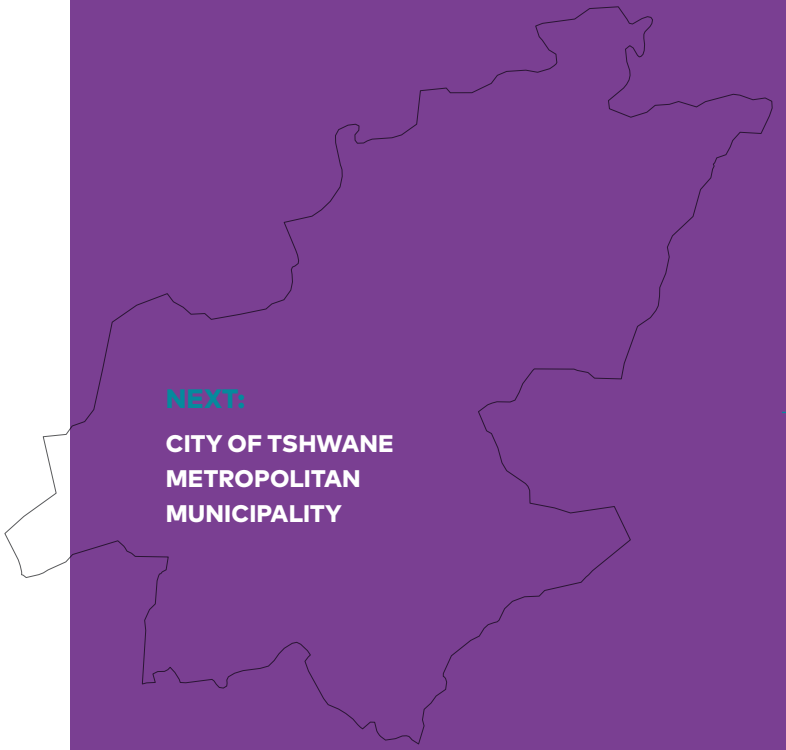
One of the key opportunities that arose as a result of the need to address climate change includes a gas-to-energy conversion project at the Municipality's regional landfill site which may give the Municipality some mileage in its attempt to transition towards a green economy. Generally, municipal landfill sites generate noxious pollutants that pose a threat to public health as well as the environment. The greenhouse gases generated at landfill sites contribute to global warming and subsequently result in climate change.

Various outstanding climate change response measures have been established by the City, but one specifically worthy of mentioning is the Wetland Inventory and Ecological Integrity Assessment. This entails compiling an inventory of wetlands in the City and the identification of priority wetlands for rehabilitation. The project aims to improve the management of wetlands in the city, to improve agricultural practices in wetland catchments, promote crop diversification and resilient agricultural practices, provide for small scale water storage and detention facilities, rehabilitate degraded catchment areas for improved land productivity, and restore and manage wetland hydrology and the associated river corridors. The prioritised wetlands include degraded wetlands upstream of flood-prone areas, wetlands extensively used for subsistence cultivation, wetlands downstream of wastewater treatment works and other pollution hotspots, wetlands, and rivers affected by sand mining, wetlands of high conservation value, degraded wetlands affected by poor water quality and providing important sediment trapping functions, and catchments identified as important for water resource management.

Another key measure is the Floodline Determination Programme which entails the determination of 1:100-year flood line for all rivers and streams in the municipal area. The reason for this is because the Municipality is faced with a huge challenge of land invasion throughout the city. To prevent disaster risks during prolonged rainfall events, the flood-line determination programme was initiated in 2013 to alert the Council of the magnitude of the problem and provide information on all structures in risk zones.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

The City of Mbombela partners with a variety of important stakeholders to reinforce its efforts on climate change. These include, amongst others, the National Department of Environment, Forestry, and Fisheries (DEFF), the Provincial Department of Environment (DARDLEA), the South African National Biodiversity Institute, the Ehlanzeni District Municipality, the United States Agency for International Development (USAID), the Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ), the University of Mpumalanga, Halls, and Sons, Lafarge Karino, Coca Cola, the SAPPI Ngodwana Mill, Barberton Mines and the South African Forestry Companies Limited (SAFCOL). The Municipality is also a member of the Local Governments for Sustainability (ICLEI).



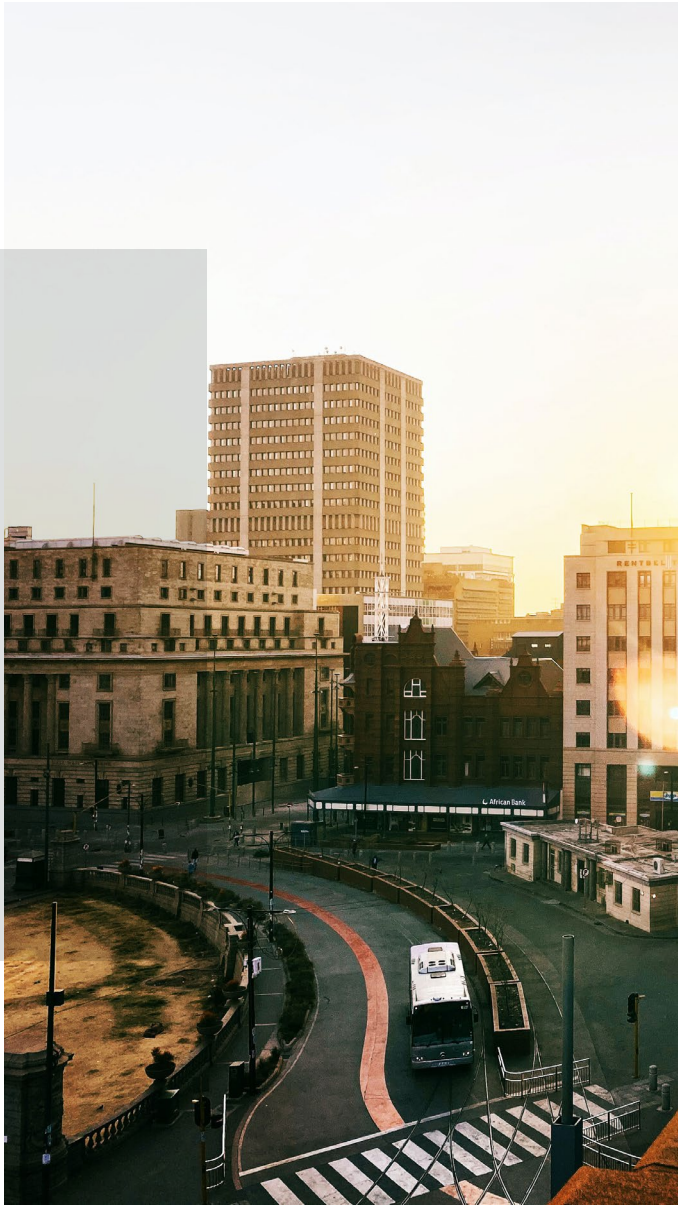
NEXT:

CITY OF TSHWANE METROPOLITAN MUNICIPALITY

06

CASE STUDY

CITY OF TSHWANE METROPOLITAN MUNICIPALITY



1. CITY BACKGROUND AND CLIMATE CHANGE CONTEXT

Tshwane, which is also known as Pretoria, is one of South Africa's three capital cities and serves as the seat of the executive branch of government and the host to all foreign embassies to South Africa. Pretoria has a humid subtropical climate with long, hot, rainy summers and short, mild winters. The city experiences the typical winters of South Africa with cold, clear nights and mild to moderately warm days. The population of Tshwane makes up more than 3 million of the total population in Gauteng, accounting for approximately 24% of the province's population.

The City of Tshwane is a Category A metropolitan municipality situated in the northern Gauteng Province. The metropolitan area is centred on the city of Pretoria, with surrounding towns and localities being included in the municipal area. In 2010, the City of Tshwane Metropolitan Municipality's land area increased from 2,198 km2 to 6,368 km2 after the incorporation of Motsweding. The Democratic Alliance (DA) won a plurality of 93 seats on the council, but no party won an absolute majority.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

Climate projections for the City of Tshwane region suggest that less rain over more hot days can be expected. Also, extreme weather-related events such as droughts, floods, hailstorms and heat waves are expected to increase in frequency and intensity, affecting especially the vulnerable population groups, as well as the provision of essential services. The most notable indicator is rising temperatures which results in heat stress. In the Tshwane region, these have been increasing significantly over recent decades – at about twice the global rate. Although there are as yet no significant changes in rainfall, there is a downward trend in the maximum number of consecutive

wet days per year.The most vulnerable sectors in the municipality include health sector impacts on quality of live and loss of lives due to increase in heat, ecosystem services such as water resources, natural ecosystem impacts due to drought, fires and increase in temperatures, energy sector due to increase in cooling demand (increase in heat) and growth in terms of the economy and population, and in the human settlements sector (due to losses based on increase exposure to natural hazards).

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

The City of Tshwane participated in the Cities for Climate Protection (CCP) sponsored by USAID and conducted by the International Council for Local Environmental Initiatives (ICLEI) in 2001. However, the City of Tshwane's commitment to addressing climate change started on the day that the City signed the former Compact of Mayors, now known as the Covenant of Mayors for Energy and Climate. Since then, the City has put all the essential building blocks in place to prepare a meaningful and well-informed response to climate change. This has included a Climate Risk and Vulnerability Assessment and a Greenhouse Gas Emissions Inventory (GHGEI) compliant with the Global Protocol for Community-Scale GHGEIs.

The City's institutional commitment to address climate change manifested in the establishment of a specialist unit in the Office of the Executive Mayor, known as the City Sustainability Unit, in January 2013, mandated to oversee the city transition towards a low carbon emission, resource efficient and climate resilient city. This unit interfaces with most of the administrative departments so as to mainstream climate action in the preparation of policies, plans and programmes.

Policy measures have included the development of the Green Economy Framework to respond to resource scarcity by stimulating the green economy; the Green Building By-law to support the uptake of green building principles; the Sustainable Financing Strategy to finance sustainable service delivery; and the Sustainable Procurement Strategy to seek greener alternatives to existing products and services procured by the City. The most recent addition

to the fold is the Climate Response Strategy which forms the foundation of the Climate Action Plan, a plan under development with support of the C40 Cities Climate Leadership Group.

The Climate Response Strategy is reflective of existing departmental policies that directly and indirectly support the measures required to address climate change. This approach will be embedded in the Climate Action Plan which is currently being drafted and will be adopted by Council early next year

The City published a Strategic Framework for a Transition to the Green Economy in 2013 that provides a strategic guide for low-carbon, equitable economic development that can enhance Tshwane's transition to a green economy and facilitate a path to sustainable development. Based on the objectives of climate change mitigation outlined in this Framework, the City undertakes to make an annual greenhouse gas inventory (with the official baseline being the GPC-compliant 2014/15 inventory) under the City of Tshwane Greenhouse Gas Inventory Management Plan, as well as a State of Energy study, which included an energy futures modelling exercise, and a Sustainable Energy Strategy.

The State of Energy report considered energy-related emissions only, whereas the GHGEI includes greenhouse gas emissions from energy as well as other sources such as waste. Furthermore, the City completed a Climate Risk and Vulnerability Assessment in order to identify climate risks and adaptation options. Together, these studies support evidence-based planning and have given rise to a City Sustainability Programme. The City has prepared a Bioregional Plan to inform land-use planning, environmental assessment and authorisations, and natural resource management by providing a map of biodiversity priority areas, which are referred to as Critical Biodiversity Areas and Ecological Support Areas, with accompanying land-use planning and decision-making guidelines. The updating of the Open Space Framework will be largely informed by the Bioregional Plan as will the Capital Planning System.

Lastly, it drives sustainability mainstreaming with a major focus on sustainable procurement whereby city procurement is encouraged to consider its ecological footprint and make provision for sustainability criteria in its procurement specifications. The Sustainable Procurement Programme is anchored in the Sustainable Procurement Strategy developed in 2016 after the City became a member of the Global Lead City Network on Sustainable Procurement in 2015.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE

The City is the first in South Africa to have a green building by-law that encourages the uptake of green building principles and design measures.

The City is also a member of the Green Building Council of South Africa and advocates the accreditation of green buildings. Apart from new buildings, the City also supports and demonstrates the retrofitting of existing buildings through the Building Efficiency Accelerator programme. The programme also addresses the thermal efficiency of dwellings, the risk of associated heat impacts where dwellings are excessively hot, and ways to mitigate these heat impacts. Hence, there is a strong link between green buildings and the adaptation programme.

The Green Building Policy developed by the City of Tshwane aims to improve the performance of the built environment to reduce environmental impacts and also to improve the quality of life in the city. The Green Building Development Policy is one of three related instruments that the municipality has developed to ensure, and encourage, the development of a more sustainable built environment. These instruments are the Green Building Development By-Law, which sets out the legislative status of the Green Building Development Policy, and the Green Building Development Incentive Scheme. The Green Building Development Policy sets out green building development standards that are either mandatory (must be complied with) or promoted. The Green Building Development Incentive Scheme has been developed to encourage new buildings to surpass green building development mandatory standards and adopt standards promoted.

5. CLIMATE CHANGE-RELATED PARTNERSHIPS AND OPPORTUNITIES

The city partners with several organisations from different background depending on its key mandate which are aligned to the city strategic climate change agenda. There are several key outcome based programs which are conceptualised to enhance the climate response which use utilised for the identification and management of the collaborative partnerships initiated. This programs are clusters according to key sectors – Waste, Transport, Energy and Green Building. Other programs which are cutting across include Tshwane Green Outreach Program, Sustainable Public Procurement,Tshwane Climate Finance etc.

There are also numerous requests by companies and entrepreneurs to present so-called green economy solutions. These are regarded as unsolicited bids and need to be handled carefully so as not to raise expectations. Common proposals include waste-to-energy solutions and solar products. There is now an innovation platform in the City which allows innovators to present their proposals to a committee which will then apply due diligence to the proposals and appoint those that meet all the criteria for unsolicited bids as per the Municipal Finance Management Act.

The Unit has also played a role stimulating green economy opportunities though with limited success. In 2013 it ran a RFP process whereby it asked the private sector to present capex neutral projects. After a due diligence process was applied, there were only a handful of projects which were mainly waste focused. The only one that made it through the due diligence was a project to establish a multi-purpose material recovery facility (processing of source separated waste, rubble crushing, tyre crumbling and composting). There was implementation of the first site and it collapsed financially because the municipality failed to supply source separated waste to the site as per the contractual arrangements.

The Gauteng Infrastructure Finance Agency funded a feasibility study on alternative waste treatment solutions and the outcome was a proposal to build an incinerator for residual waste supported by five Integrated Waste Management Facilities (IWMF) (these have the same functionality as the multi-purpose material recovery facility). However, the cost of the incinerator is prohibitive and will require a PPP which requires a stable political, institutional and financial environment, which is not currently the case in Tshwane.

A project that has attracted a great deal of attention is the Bio2Watt Biogas Digester in Bronkhorstspruit which produces power from organic waste and this power is purchased by BMW as it responds to the global imperative of switching from fossil fuel derived power to sustainable sources. The power is wheeled through the City grid and a nominal wheeling fee is charged. There is some ambivalence towards this project in the City due to the financial losses which are said to be around R3 million per month.

The reality is that electricity sales have dropped dramatically over the last couple of years as more and more commercial buildings, particularly shopping centres, have turned to solar installations thus threatening the financial viability of the municipality.

The Unit developed a Sustainable Procurement Strategy in 2017 and two strong examples of sustainable procurement is the procurement of a fleet of electric vehicles (EVs)(10 Nissan leafs) and a photovoltaic system at the Tshwane Leadership and Management Academy. The idea is to present the notion of cost savings through reduced operational costs thereby justifying the investment in the technology and serving as a market stimulus. The uptake of EVs is being tackled holistically with Department of Trade and Industry and UNIDO leading the charge in this regard.

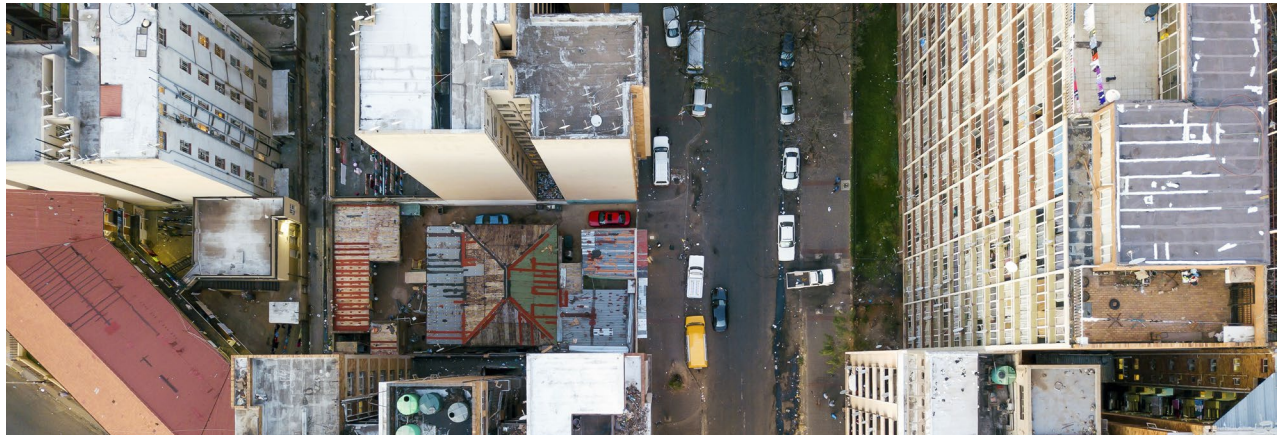
Under the leadership from its Executive Mayor, the City is also aligning its climate-change response with its international peers, having signed the Compact of Mayors' Declaration in 2014 (now known as the Covenant of Mayors for Climate and Energy) and having become a member of the C40 Cities Climate Leadership Group (C40), an international group of megacities committed to addressing climate

change. As a signatory of the Compact of Mayors' Declaration and a member of C40, the City may be recognised as a leader in addressing local climate change. In doing so, the City must comply with the organisations' planning and reporting requirements, and develop a climate change response strategy aimed at responding to the findings of both its annual Greenhouse Gas (GHG) Emissions Inventory ("carbon footprint") and its Climate Change Vulnerability Assessment (2015).

Currently, the City is a member of the Green Building Council's Green Leadership Network, the Building Efficiency Accelerator and the Global Lead City Network on Sustainable Procurement. Each of these programmes supports the City in achieving a sustainability objective and such memberships are regarded as key to implementing The City's partners in cleaner mobility include WWF-SA (Earth Hour City Challenge), UNIDO and SANEDI (electric vehicle charging stations), C40 and GIZ (NMT design), KfW (Urban safety programme in Mamelodi).

"Our generation's greatest challenges – in environment, demography, poverty and global politics – are also our most exciting opportunity. Ours is the generation that can end extreme poverty, turn the tide against climate change and head off a massive, thoughtless and irreversible extinction of other species. Ours is the generation that can, and must, solve the unresolved conundrum of combining economic wellbeing with environmental sustainability. We will need science, technology and professionalism, but most of all we will need to subdue our fears and cynicism."

Jeffrey Sachs, Director, Earth Institute
(Columbia University) (2008)



07

CASE STUDY

EKURHULENI METROPOLITAN MUNICIPALITY

1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

The City of Ekurhuleni is a Category A Municipality and forms the local government of the East Rand region of the Gauteng Province. The African National Congress (ANC) has the most seats in the Council, closely followed by the Democratic Alliance (DA). The Municipality is known as a sizeable sub-urban region east of Johannesburg and covers an area of approximately 1,975 km2. Ekurhuleni falls within the summer rainfall region of South Africa, and it is normal for the City to experience hot and wet summers and cold, dry winters. More than 80% of the rainfall occurs from October to April. The average rainfall for the region is between 715 mm to 735 mm annually, and the region is prone to extreme rainfall events in terms of thunderstorms. The population of the Ekurhuleni Municipality is estimated at 3,178,470, with a population density of approximately 1 400 km2. Population density is high in the City, especially in the former "township" and informal residential areas.

Approximately 22% of the population resides in informal and inadequate housing. Notwithstanding having a large percentage of the population of working age, unemployment is high in Ekurhuleni, at approximately 40%. Being a conglomeration of nine previously separate municipalities, the Municipality, has no identifiable "core" and also has an interesting equity profile since low development densities with historically disadvantaged communities are situated on the urban periphery. About 24% of the population lives in poverty. There is a significant housing backlog with an estimated 135 000 shacks in informal settlements and 36 000 backyard shacks.

Ekurhuleni is regarded as the manufacturing and industrial hub of Gauteng, which thus positions the City as a large emitter of Green House Gasses. Furthermore, Ekurhuleni is home to the largest airport in South Africa, namely OR Tambo International Airport, and has positioned itself to be the first "Aerotropolis City" in Africa. This means that the heart of the region constitutes a transport and logistics nexus that leads to freight movement and associated emissions related to the transport sector. Therefore, the issue of climate change appeared on the City's agenda as early as 2007, and Ekurhuleni recognises the five most imminent risks or threats posed by climate change in its area as flash flooding, intense storms, the "urban heat island effect", water security, and drought.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

In the City of Ekurhuleni, infrastructure and buildings, particularly those in informal settlements, as well as flood-prone areas, are deemed to be the most vulnerable sectors. Other vulnerable sectors are municipal infrastructure, vulnerable communities, biodiversity, and the service delivery functions of the City. These sectors are at a high risk of being subjected to the impacts of climate change. For example, the heavy rainfall in the area, which can lead to substantial flooding, is a climate event that can cause significant damage to both livelihoods and infrastructure. Buildings, roads, infrastructure, and other paved areas prevent rainfall from infiltrating into the soil, and so produce excessive runoff. Heavy or prolonged rainfall produces very large volumes of surface water in any city, which can easily overwhelm the drainage systems in Ekurhuleni.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

The Ekurhuleni Municipality has established numerous key developments as part of its response action to climate change. The Municipality developed a Climate Change and Energy Plan in 2007, aimed at supporting the social, economic, and environmental well-being of the City, as well as, inter alia, reducing the harmful effects of energy use, such as pollution and global warming, by promoting cleaner and renewable energy sources. Climate change was included in the Ekurhuleni Municipality's Environmental Policy in 2013. The issue was added as a Key Performance Indicator (KPI) in the Integrated Development Plan (IDP) so that the actions of the various departments in the Municipality would be tracked. The City also required the development of several plans by internal departments, such as Energy, Waste, Water, Parks, Transport, Stormwater, and Roads.

In 2015, the Ekurhuleni Climate Change Response Strategy was developed by the Environmental Resource Management Department to aid the organisations in dealing with the issues and impacts related to the changing climate. The Strategy was approved by the Council in 2017. It included all departmental response plans directed at climate change, action plans for the various departments, and guidelines for its implementation as annexures to the Strategy. The various municipal departments were subjected to training related to climate change.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

The City has undertaken numerous climate change initiatives and projects in response to climate change.

One of the particularly noteworthy responses from the Ekurhuleni Municipality is the Feasibility Study for a Climate-Friendly Park, which was prepared for the Department of Environmental Resource Management. This project would be one of the projects developed through a workable and tested Climate Change Adaptation Project Framework (CCAPF) system that creates a network of a connected ecosystem through parks surrounded by houses throughout the Ekurhuleni Metropolitan Municipality. Under the project, the linked ecosystems envisioned in the feasibility study will be able to provide multiple benefits in the form of supporting a green economy, improving the quality of life, protecting biodiversity, and enhancing the ability of ecosystems to deliver services such as disaster risk reduction, water purification, air quality, space for recreation and climate change mitigation and adaption.

Pilot projects such as these will allow the City of Ekurhuleni to test the workings of the feasibility study and identify the shortcomings of the projects, and will enable the City to fine-tune a model that will ensure that the CCAPF is a workable solution. The ultimate goal is that the project will be upscaled and realised throughout the City of Ekurhuleni, based on the available funding. During this process, the focus will be placed on specific communities in the City that are at the highest risk to the effects of exposure to climate change.

Another significant project is the City of Ekurhuleni's implementation of renewable energy sources to improve energy supply management. In this regard, the City is focusing on transitioning to solar energy. It has installed several photovoltaic systems on the rooftops of buildings, such as the library and the finance department building, as well as in their parking areas. Additionally, the City provided solar water geysers to communities and Solar Home Kits in informal settlements, and installed Solar High Masts. To mitigate the increased risk of disasters in the area, Ekurhuleni has implemented disaster and vulnerability planning and mapping measures. These measures are focused on floods, droughts, and intense storms, amongst other risks. The City has also set up a "Disaster Early-Warning SMS Service" as a precautionary measure in the event of an anticipated disaster. Ekurhuleni has also engaged in stabilising its riverbanks in flood prone areas, and rehabilitating its wetlands, particularly by removing invasive alien species. Notably, a detailed Geographic Information System (GIS) mapping project was conducted by the City to identify hazards and areas that are at risk.

The City of Ekurhuleni has also initiated several projects aimed at "greening" the City. A primary effort in this regard is its development of a Green Building Framework that evaluates new buildings, renovations and refurbishments. Additionally, the City is concerned with urban landscaping, rain-water harvesting pilot projects, recycling and waste diversion, establishing bulk walk-in recycling centres in informal settlements, and developing a sustainable urban drainage system.

A final significant project worth mentioning is the recent benchmarking review of the "Ekurhuleni+ Challenge 2030" included in the City's Climate Change Response Strategy of 2017. The targets determined in the Ekurhuleni+ Challenge is aimed at building a more secure, sustainable and resilient City. The purpose of the benchmarking initiative was to test whether the targets are comparable to those of other cities, and in line with best practice. This initiative was conducted at the hand of the Council for

Scientific and Industrial Research (CSIR), and was funded by National Treasury.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

Ekurhuleni is involved with various local government institutions and organisations. Since 2008, the Ekurhuleni Metropolitan Municipality has been a member of the ICLEI (Local Governments for Sustainability). In 2017, the City hosted the ICLEI Local Solutions for Africa congress. Ekurhuleni has been involved with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Oxfam International. The City has also partnered with the CSIR; National Treasury; the Department of Environment, Forestry and Fisheries; the Gauteng Province; as well as the City of Johannesburg, Tshwane and Cape Town. Lastly, Ekurhuleni has been involved with other institutions in various activities, such as leading the delegation for the South African Local Government Association at the 17th session of the Conference of the Parties (COP 17) of the United Nations Climate Change Conference in 2011. The Ekurhuleni Municipality recently obtained membership to the C40 Cities Climate Leadership Group.

NEXT:

MANGAUNG METROPOLITAN MUNICIPALITY

"... there are steps we have to take to change the legacy we will leave our children: adjustments to our growth path we have to make as a global community, as nations working together, as citizens of a shared humanity, in response to the challenge of climate change and environmental responsibility.
We are in these things together – the war on poverty, infrastructure development and financial stability, responding to global warming – we share these obligations: rich and poor, urban and rural, men and women, business and community organisations, labour and government."

Trevor Manuel, Budget Speech (2008)

08

CASE STUDY

MANGAUNG METROPOLITAN MUNICIPALITY

1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

Mangaung Municipality is a Category A municipality governing Bloemfontein and the surrounding towns in the Province of the Free State. The City covers 9 899 km² and has a population of approximately 787 930, which is distributed as follow: more than half of the population is concentrated in the Bloemfontein area (63%), followed by Botshabelo (24%), Thaba Nchu (9%), Dewetsdorp and Wepener (1.5%) each, with Soutpan (0.8%) and Van Stadensrus at (0.2%). Mangaung is located in the Highveld summer rainfall region with the annual rainfall averaging between 600mm and 750mm. Annual temperatures range from a maximum of approximately 35°C in mid-summer to a minimum of -5°C in mid-winter.

The ruling political party in Mangaung is the African National Congress (ANC). In terms of the socio-economic status of the City, the unemployment rate increased by 2.5% in the first quarter of 2019 from 29.7% in the final quarter of 2018, which the City considers worrying. Job seekers in the City increased from 68.7% in the fourth quarter of 2018 to 70.5% in the first quarter of 2019, and the number of economically active persons dropped by 0.8% from the 48.3% in the final quarter of 2018. Mangaung considers its vast areas of agricultural land, its water and sunshine as the major natural resources that are of particular relevance to their community.

The Municipality of Mangaung notes that, in the context of climate change adaptation, the area is prone to a myriad of extreme climatic events due to its location. Specifically, Mangaung suffers from extreme temperatures, weather and rainfall. Climate change has thus been included in the City's agenda since 2014, and the City has made significant strides in this regard. For instance, their Draft Climate Change Adaptation and Mitigation Strategy was developed in 2015 and accepted in 2017. The City identifies the "urban heat island effect"; droughts; flash floods; groundwater contamination; the degradation of biodiversity, including the loss of indigenous flora and fauna; and the invasion of flood lines as the most imminent risks and threats posed by climate change in the municipal area at this time.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

As with most other cities, due to the impact of climate change in the area, various sectors in the City have been rendered particularly vulnerable. The City considers the wetlands and watercourses in the municipal area to be an essential example, since no databases are cataloguing these natural resources, and none of the wetlands is classified. Invasive alien plant species are affecting the streams in the area and have caused them to be overgrown. The City's Climate Change Adaptation and Mitigation Strategy indicate several other vulnerable sectors, such as agriculture, human health, air quality, human settlements, agro-ecosystems, energy demand, water security, and biodiversity. Most worrying of all, there are no policies, by-laws or strategies in place to protect the already vulnerable wetlands and watercourses. However, the City reports that, at present, it is busy with data collection to filter into certain instruments, such as the Biodiversity Policy, bylaws and strategies. This is being done with the assistance of the Provincial Department of Environment, Forestry and Fisheries, and both the Central University of Technology and the University of the Free State.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

Since the inclusion of climate change in Mangaung's agenda, several key developments have formed a part of its response strategy. As briefly mentioned above, the adoption of the Climate Change Adaptation and Mitigation Strategy was the City's first response measure. This Strategy deals with integral aspects, such as climate change adaptation, mitigating climate change, stakeholder engagement and capacity building, and the monitoring and evaluation of the actions taken.

Additional key responses include the Alien and Invasive Species Strategy, internal Environmental Compliance Audits, the State of the Environment Re-

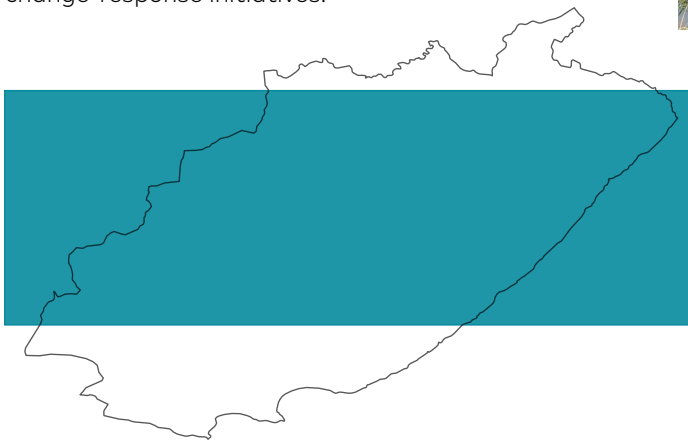
port, the Mangaung Open Space System (MOSS) and the Open Space Framework, and the Integrated Environmental Management Framework/Plan. Furthermore, all the departments of the Municipality have by-laws that regulate issues of environmental management, and all new building plans must have an element that addresses and lessens their detrimental effect on the environment (Hence, new structures must be environmentally friendly). The Mangaung Municipality also notes that a dedicated site exists for e-Waste recycling at the Central University of Technology, and that "waste buy-back centres" have been erected, both by private entities and by the City.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

One of the outstanding initiatives taken by the Mangaung Municipality is the Alien and Invasive Species Strategy, which seeks to address alien species affecting water resources in the area. However, this Strategy has not been approved by the Municipal Council yet. An additional stumbling block is that there are no funds available to implement the Strategy. Mangaung has developed other innovative approaches to tackle the climate change issue, such as running educational awareness programmes at local schools, partnering with local universities, and adopting Climate Change Adaptation and Mitigation strategies and programmes.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

To help strengthen their efforts, Mangaung Municipality has partnered with government departments, academia, the private sector, development agencies and networks. The Municipality has partnered with the Department of Environmental Affairs on both provincial and national level, and with the Department of Environment, Forestry and Fisheries on provincial level. It has gained research assistance, study material and programmes from the University of the Free State and the Central University of Technology. The Municipality also partnered with a German development agency called the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), as well as the One World Group and the South African Cities Network. Mangaung Metropolitan Municipality is also a member of both the ICLEI (Local Governments for Sustainability) and the C40 Cities Climate Leadership Group but has to date not partnered with these institutions on any climate change-response initiatives.



NEXT:

NELSON MANDELA BAY METROPOLITAN MUNICIPALITY

09

CASE STUDY

NELSON MANDELA BAY METROPOLITAN MUNICIPALITY

1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

Nelson Mandela Bay Municipality (NMBM) is located on the southern coast of South Africa, and occupies an area of 1959,02 km², with an estimated population of 1 263 051. NMBM has a temperate climate with both summer and winter temperatures averaging at 25° and 17° Celsius respectively. The annual rainfall in the Municipality varies between 500mm and 650mm, with most of the rainfall occurring between May and October. The City has been subject to some changes in climate, such as an overall increase in the maximum and minimum temperatures in all seasons, but climate change does not necessarily account for the frequent significant variation in annual precipitation. This is due to the fact that the Municipality is located in a transition zone between the winter and summer rainfall areas. Therefore, it is generally difficult for the City to identify long term trends with absolute certainty. However, the South African Weather Services has performed long-term, downscaled climate scenarios for the NMBM.

The Municipality initiated the dialogue on climate change and the mainstreaming thereof in 2009. Since then, the City has developed various guidelines, plans, and strategies in support of climate resilience. These include the adoption of an Integrated Environmental Policy (currently under review), a Disaster Management Plan, and an Enterprise Risk Management Policy. The Nelson Mandela Bay has thus positioned itself well to incorporate climate resilience interventions into its strategic plans and programmes as it continues to work towards both climate resilience and a green economy.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

In terms of the state of the climate vulnerability of the City, the 2015 NMBM Climate Change and Green Economy Action Plan identifies four top-ranked risks using eight climate variables. Accordingly, the City recognises the highest risk as an increase in drought and deems it as the greatest risk to human well-being and economic development. The Municipality links this risk to what it regards as its most vulnerable sector and reports that its greatest vulnerability is reflected in the social capital grouping, specifically the impact on the welfare of the people. The City notes that localities such as informal settlements and low-lying areas without storm-water infrastructure already experience socio-economic vulnerabilities, which are compounded by droughts and floods. It reports that the second greatest risk is changes in the pattern of rainfall, combined with an increase in unpredictability in terms of rainfall patterns and seasonality. The Municipality identifies the third-highest risk as a combination of temperature changes, flooding, and changes in wind patterns, with the fourth threat being linked to changes in fires and patterns of storm surges, especially where these are locality-specific and short-term in duration.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

The primary climate response measure initiated by the Municipality is the 2015 Climate Change and Green Economy Action Plan. However, the Municipality also recognises several additional projects as being responses to climate change. Often, these responses are related to resource challenges. Examples are, the uptake of domestic renewable technology due to load shedding, and the Waste Exchange project to reduce waste-to-landfill via the establishment of an online platform for the re-use or recycling of waste products before being disposed of, amongst others. The impetus of the FIFA 2010 World Cup and its Green Goals campaign induced the Municipality to establish sustainable methods of production (for stadiums and the associated infrastructure) and to streamline green initiatives in other municipal sectors. Additionally, the Go Green campaign by the NMBM was intended to be a platform for municipal projects that spoke to greening, sustainability, and in some cases, climate change. The basic focal areas of the Go Green campaign initially were air quality, water, energy, and waste, as well as environmental conservation (the end goal or intention of the projects being the conservation of the natural resource and resource efficiency).

In 2009 the NMBM hosted an Eastern Cape Provincial Climate Change Workshop, collaborating with the South African Local Government Association

and the Wildlife and Environment Society of South Africa (WESSA). At the same time, the municipal Electricity and Energy Directorate was rolling out the DORA-funded solar water heating programmes in low-income suburbs of the City. Other opportunities arising from the need to address climate change were the initiation of green procurement, the establishment of environmental management systems and responsible tourism campaigns, engagement in the 5-Biome City initiative, and various waste management initiatives. Post-2010, other opportunities, such as a multi-disciplinary project between the NMBM and its sister city Gothenburg in Sweden, have also led to the creation of climate-change responses across a range of municipal sectors. In 2014, a Greenhouse Gas Inventory was developed, which was a valuable tool for emissions-reduction actions/strategy. Currently, the NMBM has no bylaws specific to climate change. In terms of policies, climate change was mentioned in the 2012 Integrated Environmental Policy, and responsibilities were allocated to Directorates. However, firm commitments were not established for the reduction of carbon emissions. Commitments and goals were set as guidelines in the NMBM Climate Change and Green Economy Action Plan, but these were not necessarily taken up by the Directorates. This Action Plan became a strategic plan of the City's Integrated Development Plan in 2017 (IDP). It is therefore the City's main climate response document.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

Collaboration between directorates of Public Health, Electricity, and Energy gave rise to the Climate Change and Green Economy Action Plan as well as to a State of Energy Report, which the Municipality recognises as an outstanding climate change response measure. This response measure may be linked to various other projects, such as building energy audits and a retrofit of a community building via collaboration with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Local Government for Sustainability (ICLEI) that delivered energy efficiency and off-grid energy solutions. Nelson Mandela Bay was also the first municipality to explore small-scale embedded energy generation.

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

The City is a member of the ICLEI. It reports that this association has undoubtedly influenced the Compact of Mayors association and commitments as well as the development of other capacity building and climate tools. The City also forms part of City Support under the National Treasury for other mainstreaming and support projects. Most of the collaborative work on climate change has occurred via collaboration with the ICLEI. Other noteworthy associations have been with the WESSA and the GIZ. It has received external funding for projects from the Swedish International Development Cooperation Agency and in-kind contributions from the City of Gothenburg when collaborating on projects. Recently, National Treasury has created requirements for Built Environment Performance Plans to report on issues of climate risk and resilience, which the City's spatial vision and catalytic projects incorporate.

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CASE STUDY

SEDIBENG DISTRICT MUNICIPALITY

1. CITY INTRODUCTION AND CLIMATE CHANGE CONTEXT

Sedibeng Municipality, a Category C Municipality, is one of the District Municipalities of the Gauteng Province of South Africa and consists of three local municipalities, namely Emfuleni, Lesedi, and Midvaal. Sedibeng is situated on the southern tip of the Gauteng Province and is strategically located on the border of three other provinces, namely Free State, North West, and Mpumalanga. The Municipality covers an area of approximately 4,173 km2 and has an estimated population of 916,483, which is 7.47% of the province's total population. The population is youthful, with children under the age of 15 years making up 25.36% of the population. The age group between 15-64 years makes up 69.63% of the population, and the "65 years and older" age group makes up the remaining 5.01% of the population.

The local economy of Sedibeng has been stagnating for several years, and there has been a significant decrease in job opportunities. Some economic sectors, such as agriculture and tourism, do offer some opportunities for further local development and economic growth. According to the 2011 Census Data, the majority of the 279,750 households in the District Municipal Area are housed in formal dwellings. However, 14.27% of the households in the District Municipal Area live in informal dwellings, which is higher than the national average of 13.58%. Another 0.33% of the District Municipal Area's households live in traditional dwellings, which is lower than the national average of 7.89%.

The temperature in Sedibeng ranges from a high of 34°C in summer, to a low of 1°C in winter. On average, the Municipal area is partly cloudy throughout the year. Sedibeng District Municipality is situated within the Vaal Hydrological Zone, one of six hydrological zones in South Africa. The Vaal River, one of the Municipality's major natural resources, has been subjected to major pollution through untreated sewage flowing into the river for many years. The District is generally characterised by poor air quality, particularly in the western and central parts. The pollution in the Sedibeng District Municipal Area is attributed to the level of industrialisation, particularly in the areas in the Emfuleni and Midvaal Local Municipalities.

The Municipality has identified its key climate-change vulnerabilities as follows: agriculture, biodiversity, and the environment, human health, human settlements, and water. Although it is uncertain when climate change was included in the agenda of the Municipality, Sedibeng was still engaging with various drafts of its Climate Change Vulnerability Assessment and Response Plan in 2017.

2. STATE OF VULNERABILITY AND CURRENT THREATS TO LOCAL RESILIENCE

Some of the main threats and risks perceived in the Sedibeng Municipality as a result of climate change include, for instance, the change in sorghum production and increased risks to livestock, which affect agriculture in the region. In terms of biodiversity and the environment, the loss of high priority biomes, the increased impacts on threatened ecosystems, and the loss of priority wetlands and river ecosystems have been identified as threats of a high priority in Sedibeng. As far as human health is concerned, Sedibeng notes that increased storm events and occupational health issues are major risks. Threats to human settlements in the Sedibeng area include increased impacts on informal dwellings, increased migration to both urban and semi-urban areas, and decreased income from tourism. Finally, a significant threat to the community is the fact that less water is available for irrigation and drinking.

3. KEY CLIMATE CHANGE RESPONSE MEASURES AND MECHANISMS

The main climate change response measure was established by the City in the development of the Climate Change Vulnerability Assessment and Response Plan. This Plan considers certain vulnerability indicators and proposes certain priority responses for each vulnerable sector. For instance, as far as Agriculture is concerned, the Municipality has identified that some necessary responses are to educate emerging and subsistence farmers on the threats of climate change, to promote knowledge generation and sharing as well as stakeholder participation and

awareness-raising of sorghum production and other appropriate crop-management changes, and to conduct an awareness programme with farmers on the encroachment of their livestock on municipal infrastructure during periods of drought.

4. AN OUTSTANDING CLIMATE CHANGE RESPONSE MEASURE

The City identifies its Climate Change Vulnerability Assessment and Response Plan as the most ambitious climage change response measure it has developed to date. The Plan was developed through the Local Government Climate Change Support Program (LGCCSP). The LGCCSP is part of the International Climate Initiative (IKI), and is supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

5. CLIMATE CHANGE RELATED PARTNERSHIPS AND OPPORTUNITIES

Sedibeng has been a member of the ICLEI (Local Governments for Sustainability) since 2009. As mentioned above, the City has received climate change-related opportunities through the LGCCSP and the IKI to develop an appropriate climate change response plan. In this regard, Sedibeng has also partnered with the GIZ, BMUB, the South African Local Government Association (SALGA) and the Department of Environmental Affairs during the development of its key climate response measure.

"For me it's cities, and that's not only because I work in a city, it's because they are the one global-scale opportunity to effect transformative change in our development path. We've got no choice but to address the needs of cities as we are living through the most rapid period of urbanisation in our species' history. Cities are our largest social-ecological system, they concentrate people, power, economies and financial flows."

Dr Debra Roberts,
Head of the Sustainable and Resilient City Initiatives Unit, eThekwini Municipality (2016)

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