Durban Climate Change Strategy 2022

Purpose of Report: The purpose of this report is to summarise the draft contents of the revised Durban Climate Change Strategy.

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The project will be implemented from August 2019 to August 2022.

Version Control

Version	Date	Notes
1	17/06/2020	The first version of the report.
2	19/07/2020	Updated based on comments from DCCS PSC and Sub-Committee
3	12/11/2020	Updated based on the second round of stakeholder comments
4	12/04/2021	Updated based on the internal sector prioritisation meetings
5	01/09/2021	Included section on just transition and proofread
6	02/03/2022	Adjusted in response to a gender review of the document
7	14/03/2022	Approved gender review changes and updated programme targets

Report Version Approval

Version	Date	Approved by

Executive Summary

The eThekwini Municipal Council adopted the Durban Climate Change Strategy (DCCS) in 2015. The DCCS was the first multi-sector climate change strategy developed for Durban. Since the strategy's adoption, there has been progress in some of the key goals outlined in the DCCS including the development of climate change structures within eThekwini Municipality and the implementation of key climate change response programmes. The DCCS also made provision for a five-year review process to ensure that the strategy is updated regularly.

This document is the first revision of the DCCS. It considers new and rapidly improving climate science and the changing international and national climate policy environment. The revised strategy also builds on lessons learnt from the implementation of climate change programmes over the past five years for the future roll-out of the strategy.

Climate change in Durban

Durban is projected to experience increased temperatures, increased periods of drought, more intense storms and flooding, and sea level rise due to climate change [1]. The severity of these impacts is dependent on global greenhouse gas emissions. Historically, Durban's annual average temperatures have steadily increased [2]. Different climate models project that Durban's average temperature will increase between 0.8 °C and 1.6 °C by 2050 under the lowest and highest emission scenarios respectively. As a result of the projected increase in average temperature, Durban may also experience increased evaporation rates. The projected increase in average temperature combined with increases in the evaporation rate pose notable risks for Durban, including water supply insecurity, increased frequency of floods and droughts, increased heat stress exposure, reduced water quality, increased vector-borne and water-borne diseases, loss of biodiversity, changes in species migratory patterns, and impacts on food production [3]. These impacts could be compounded by other drivers unrelated to climate change like inappropriate management of built and natural infrastructure, poor planning and poor governance.

Durban's contribution to climate change

Total greenhouse gas emissions (GHG) recorded for Durban in 2017 was 29,025,638 tonnes of carbon dioxide equivalent (tCO_2e).[4] Total emissions have increased steadily from 27,066,285 tCO_2e since 2010 (the first year a GHG emissions inventory was completed for Durban). These increases have been attributed to a combination of improved data collection and an increase in carbon-intensive processes taking place in Durban. The sectors with the highest emissions are

[1] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[2] EThekwini Municipality.
[3] Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.
[4] *Tonnes of carbon dioxide equivalent (tCO_2e): A measure to describe how much global warming a given type and amount of greenhouse gas may cause, using an equivalent amount of carbon dioxide (CO_2) as the reference (i.e. CO_2e)* (eThekwini Municipality 2014, viii).

transportation (40.77%) and industry (33.45%). The eThekwini Municipality as an institution accounted for 4.35% of Durban's total emissions [5].

Vision

The vision of the revised DCCS is summarised as follows:

To achieve inclusive climate resilience with net-zero greenhouse gas emissions by 2050

Mission statement

The people of Durban will collectively build governance, social, environmental and economic adaptive capacity and resilience to climate change while achieving net-zero greenhouse gas emissions by 2050.

Structure of the revised strategy

A key revision from the 2015 DCCS is the inclusion of enabling themes as part of the strategy structure. Previously, the DCCS was structured according to sectors clustered into climate change mitigation, adaptation and "cross-cutting" themes. However, over the past five years, it has become apparent that higher-level interventions are needed for implementation at the sectoral level to be effective. As a result, a new enabling theme, which includes the legislation, policy and planning; governance; research, communication and capacity building; and finance sectors is included in the revised strategy. The themes in the revised DCCS are summarised in the diagram below.

[5] EThekwini Municipality Energy Office, 'EThekwini Greenhouse Gas Emissions Inventory 2017 Summary Report'.

There are now four themes in the revised strategy with each split into sectors. The sectors are where the details reside. For example, the adaptation theme includes the biodiversity, food security, health, sea level rise and coastal protection, and water and sanitation themes. Each sector has targets, with associated programmes and projects.

Targets

The following short-term targets for 2025 have been identified for each theme and sector

Enabling Theme Short-term Targets

01) Legislation, Policy and Planning

- Municipal policies, sectoral and strategic plans updated to be climate change responsive

02) Governance

- A monitoring and evaluation systems set up that can track the effectiveness of climate change actions being taken by the Municipality.
- Stakeholder and institutional structures set up to meet requirements of the Climate Change Act

03) Research, Communication and Capacity Building

- Climate change communication framework established and implemented with participation from schools, wards, businesses and civil society groups to increase climate change awareness.
- Local climate change research is coordinated on an ongoing basis through the establishment of an appropriate transdisciplinary research body.

04) Climate Finance

- Appropriate revenue protection and financing models that take climate change impacts into account are implemented
- Climate financing is sourced from opportunities external to the eThekwini Municipality

Cross Cutting Theme Short-term Targets

05) Economic Development

- Short term economic development projects are implemented that can contribute towards a climate sensitive transition in Durban
- The eThekwini Municipality's Economy is low carbon, socially responsible and environmentally sustainable

06) Risk Management

- 100% of municipal infrastructure in high climate-risk areas is identified with plans being implemented to protect or relocate.
- Institutional and policy alignment achieved between disaster management and climate change resilience
- Vulnerable wards in Durban have transitioned to climate resilience

Adaptation Theme Short-term Targets

07) Biodiversity

- Biodiversity planning and management practices have identified climate change risks and opportunities, and are implemented accordingly.

08) Food Security

- A food security policy that takes climate change impacts into consideration has been developed and implemented

09) Health

- No increase in urban heat levels in Durban compared with 2005-20215 average temperatures.
- Number of cases of water- and vector borne diseases linked to predicted climate change impacts in Durban does not increase above base levels

10) Sea Level Rise and Coastal Protection

- All existing municipal infrastructure located in high-risk coastal zones is identified and plans to either relocate or protect are implemented timeously.
- Durban's Coastal Management Line includes climate change impacts and is approved and gazetted.

11) Water and Sanitation

- 500km transformed municipal-owned riverine corridor land to be climate-resilient, clean, safe and healthy
- Climate change impacts upon water demand are quantified and incorporated into Durban's water demand actions.
- Existing, relevant Municipal strategies, legislation, spatial frameworks, spatial plans, and standards in which flood-lines have been updated to adequately reflect projected climate change risks
- Increase in alternative water-supply capacity to meet the projected increases in demand for water that result from climate change impacts in Durban

Mitigation Theme Short-term Targets

12) Energy

- 10% of all Municipal infrastructure in Durban is transformed to a net-zero carbon footprint
- 10% of electricity purchased by the eThekwini Municipality that is produced from renewable energy sources
- 10% of private electricity demand in Durban that is supplied through self-generated renewable energy
- 10% reduction in electricity consumption across residential, commercial, municipal, and industrial consumers in Durban compared to an agreed-upon baseline

13) Waste and Pollution

- 10% of waste disposal is diverted from landfill sites
- 20% of greenhouse gas emissions from waste reduced compared to a 2020 baseline

14) Transport

- 10% increase in the use of NMT infrastructure
- 15% reduction in existing private car trips
- 20% of TOD Built Environment Performance Plan targets achieved
- 5% of low-carbon vehicles registered in Durban
- 5% of road freight shifted to rail compared to an agreed-upon baseline

Coordinating implementation

A strong focus of the strategy is the establishment of cross-sector stakeholder structures to support the strategy's implementation. The eThekwini Municipality will play a key coordinating role within these stakeholder structures. Coordinating the enabling theme will be assigned to the Climate Change Department, currently being established within the eThekwini Municipality. The implementation of many of the programmes and projects in the enabling theme will be the responsibility of the Climate Change Department. However, the coordination and implementation of some of the programmes, particularly in the adaptation and mitigation themes, will be the responsibility of relevant line departments within the municipality. Departments will be assigned these responsibilities as part of eThekwini Municipality's Integrated Development Plan.

Way forward

Having reviewed the DCCS, the focus now shifts to developing the implementation plan. A detailed implementation plan, monitoring and evaluation framework with a reporting tool and communication plan are currently being developed to ensure that implementation takes place and progress is tracked over the next five years.

The DCCS is for all the residents of Durban, and everybody is encouraged to play their part in this process so that together we can transform Durban's governance, social, developmental and economic systems to effectively respond to climate change.

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1 Durban's climate change context

1.1 Overview

Durban is one of South Africa's largest cities and falls under the management of the eThekwini Municipality. The eThekwini Municipality covers an area of approximately 2,555 square kilometres (km^2), of which 68% is classified as rural. It is home to an estimated 3.99 million people [6]. With the busiest port in southern Africa, Durban is a key trade gateway between southern Africa and the rest of the world, making a critical contribution to the economy and employment in the region [7]. Transport, logistics, and manufacturing are important economic sectors for Durban and the city has a competitive advantage over others in the country [8]. Durban has the fourth-largest economy of South African cities, but like other major cities in South Africa, currently experiences very low economic growth rates [9]. Key statistics for Durban are contained in Figure 1 [10]:

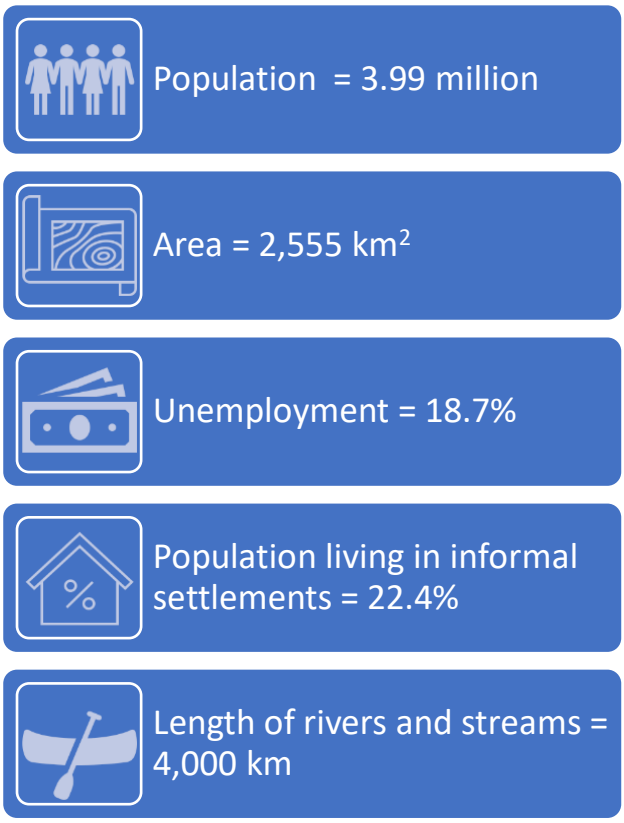

Figure 1: Key statistics for Durban

1.1.1 Spatial form

Durban's sprawling spatial form is a key developmental challenge. The layout of Durban results in inefficient service provision and energy consumption and affects the quality of life of residents, especially those people living in poverty, who are the most negatively impacted. Like other South African cities, Durban has a highly fragmented, segregated, and sprawled spatial footprint, a legacy of apartheid policy and planning. However, since 1994, Durban has continued to sprawl outwards with affordable land on the outskirts of cities targeted for low-cost housing developments [11]. At the same time, disinvestment in inner-city areas has resulted in the development of "edge cities" consisting of wealthy estates and business parks.

[6] Thaver, 'EThekwini Municipality: Global Insight 2020'.
[7] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'; EThekwini Municipality EDGE, 'State of the EThekwini Economy and Mega Trends'.
[8] EThekwini Municipality EDGE, 'State of the EThekwini Economy and Mega Trends'.
[9] EThekwini Municipality EDGE.
[10] Thaver, 'EThekwini Municipality: Global Insight 2020'.
[11] Sustainable Energy Africa, 'State of Energy in South African Cities'.

Durban's urban sprawl drives up the cost of transport and the time required for commuting. This disproportionately impacts the poor, who are reliant on public transport. Delivering infrastructure and services over such a large area is also more costly, and energy-intensive than if Durban was a city with greater density. Transport-associated greenhouse gas emissions in a sprawling city like Durban are high, and with inadequate public transport, the increased use of private cars also contributes to increased emissions and congestion [12]. Durban's Integrated Public Transport Network (IPTN) system, *Go!Durban*, currently being developed, will assist in the reduction of congestion and emissions, however, it will require densification along transit corridors and a behaviour shift from private to public transport use to realise its full benefits.

1.1.2 Employment and income

Durban's unemployment rate in 2019 was 18.7% [13]. According to Statistics South Africa's 2017 Living Conditions Survey,[14] approximately 60% of households earned less than R38,400 per annum [15], and the 2011 Census estimated that 18% of households in Durban did not receive any form of income at all [16]. It is estimated that over half of Durban's residents (about 2,1 million people) live below the upper boundary of the poverty line of R1,227 per person per month [17].

Poor households are particularly vulnerable to the impacts of climate change. Although eThekwini Municipality has made significant advances in delivering services to the poor since 1994,[18] Durban remains highly unequal with a Gini coefficient of 0.62, similar to that of other major cities in South Africa [19]. Internationally, a Gini coefficient of higher than 0.4 is regarded as having serious political and socioeconomic implications [20].

Poverty intersects with gender inequality too. According to the Living Conditions Survey, which was undertaken by Statistics South Africa in 2014/2015, adult women in South Africa experienced higher levels of poverty than adult men, regardless of the poverty line that was used [21]. The Living Conditions Survey stated that approximately 40% of South Africans were living below the upper-bound poverty line (UBPL) in 2015 [22]. (The UBPL is the highest of South Africa's three official national poverty lines[23] [24].) At the household level, Living Conditions Survey reported that 49.9% of female-

[12] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[13] Thaver, 'EThekwini Municipality: Global Insight 2020'.
[14] Data for the Living Conditions Survey was collected from October 2014 to October 2015.
[15] EThekwini Municipality EDGE, 'State of the EThekwini Economy and Mega Trends'.
[16] Statistics SA, 'Census 2011 Statistical Release'.
[17] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review'.
[18] According to the 2016 Stats SA Community Survey (cited in eThekwini Municipality EDGE 2017), eThekwini Municipality made the greatest advance in reducing poverty, out of the eight South African metropolitan municipalities, since 2011.
[19] SACN, 'State of South African Cities Report 2016'; Thaver, 'EThekwini Municipality: Global Insight 2020'.
[20] SACN, 'State of South African Cities Report 2016'.
[21] Statistics SA, 'Men, Women and Children: Findings of the Living Conditions Survey 2014/15'.
[22] Statistics SA.
[23] In 2015, the upper-bound poverty line was R992 per person per month, the lower-bound poverty line was R647 per person per month, and the food poverty line was R441 per person per month.
[24] Statistics SA, 'Men, Women and Children: Findings of the Living Conditions Survey 2014/15'.

headed households lived below the UBPL, while the proportion of male-headed households living below the UBPL was much lower (33%) [25]. In Durban, in 2020, it was estimated that 42.1% of households were headed by women [26] and that 45% of female-headed households were living in poverty compared to 25% of male-headed households [27].

1.1.3 Settlements

It is estimated that 22.4% of Durban's population (approximately 800,000 people) live in informal settlements within and on the outskirts of Durban's urban areas, often located on environmentally-sensitive land [28]. High rates of in-migration from rural areas, other provinces and other countries, coupled with the unavailability of affordable formal accommodation in well-located areas contributes to the growth of this informality. It is estimated that unemployment in Durban's informal settlements is about 60% [29]. Durban's urban areas continue to experience further pressure on urban infrastructure and services from the increasing population and the growth of informal settlements [30].

Durban's rural areas are also experiencing population growth and densification as they offer affordable land and services. This impacts negatively on the existing infrastructure, as water, sanitation and other services in the rural parts of Durban areas, were not planned for increased population sizes [31]. This increased urban development and demand for services places increased pressure on Durban's natural resources and ecological infrastructure.

1.1.4 The need for a just transition

South Africa must tackle the challenge of climate change within a society that is yet to shake off the imprint of apartheid and the deep structural inequality that has persisted into the democratic era. The social, economic and racial dimensions of this are defining features of Durban, the province of KwaZulu-Natal and much of South Africa.

The vision of a prosperous society, of shared growth and opportunity for all, remains out of reach. The recent events of July 2021, characterised by violent social and political upheaval and the destruction of important economic infrastructure, goods, services and livelihoods highlighted, most profoundly, the difficult path South Africa must still tread and the significant challenges that lie ahead. Addressing climate change cannot take place in a vacuum in a society such as ours.

[25] Statistics SA.
[26] COGTA, 'EThekwini Metropolitan - Profile and Analysis: District Development Model'.
[27] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review'.
[28] EThekwini Municipality, 'Durban's Resilience Strategy 2017 (Long Version)'.
[29] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review'.
[30] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'; EThekwini Municipality, 'Durban's Resilience Strategy 2017 (Long Version)'.
[31] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.

Without significant social and economic progress, mitigation and adaptation will be limited. At the same time the significant threat that climate change poses will be exacerbated in the absence of decisive leadership and inclusive action deepening inequality and the social and economic divide.

The notion of a 'just transition' acknowledges that should South Africa move rapidly away from the use of fossil fuels, in particular coal, as our primary source of fuel for the generation of electricity, the implications for communities and households dependent on the coal economy for their livelihoods is potentially devastating.

A transition to clean energy in the form of renewables must be accompanied by a meaningful and inclusive strategy that takes vulnerable communities along with it, providing alternative employment and livelihoods and leaving none behind. This has particular implications for Mpumalanga province where the majority of South Africa's coal mining industry and coal-fired power stations are located. South Africa is one of several coal-dependent emerging economies that must rapidly transition away from fossil fuels to align with the Paris Agreement's temperature goals. There is a growing realisation that this transition must be adequately managed and supported to deal with both the localised and systemic socioeconomic disruption it will bring (Renaud et al. 2021).

1.1.5 COVID-19

Durban's climate change response must also be seen in the context of the international Coronavirus Disease 2019 or COVID-19 pandemic. Since 2020, the global impacts of COVID-19 have been dramatic and are likely to continue for some time into the future. COVID-19 has many parallels with the impacts and potential responses to climate change. It highlights the need for strong governance, the importance of adaptive capacity and the disproportionate impact on already vulnerable communities. However, the global response to COVID-19 has also demonstrated that it is possible to do things differently and through large-scale behaviour change and impactful public interventions.

1.1.6 Gender

Durban's climate change response must also take a lead in addressing the vulnerability of people at increased risk of climate change impacts in combination with non-climate change risks (e.g. women at risk from gender-based violence, and how climate change can exacerbate these risks [32].

In particular, it should be noted that women and men are differently impacted by climate change because of the different roles that they play in society as well as by existing levels of marginalisation and exclusion. For instance, gender inequality intersects with poverty in Durban. In 2020, 42.1% of households in eThekwini were headed by women [33]. These women-headed households are disproportionally impacted by poverty as 45% of female-headed households in Durban are living in

[32] Dazé and Church, 'Toolkit for a Gender-Responsive Process to Formulate and Implement National Adaptation Plans (NAPs)'; NAP Global Network, 'Addressing Gender Equality in Climate Change Adaptation. From Principles to Practice.'
[33] COGTA, 'EThekwini Metropolitan - Profile and Analysis: District Development Model'.

poverty compared to 25% of male-headed households[34]. Since poor households are particularly vulnerable to the impacts of climate change it can be expected that women-headed households will be particularly impacted by climate change.

The strategy should ensure that Durban's response to climate change does not exacerbate existing inequalities between men and women and it should also seek to reduce the impacts of climate change on the most vulnerable members of society. The DCCS implementation plan does provide opportunities that have been shown over the past decade to be predominantly taken up by women from poor households. Examples include the city's Community Reforestation Programme (treepreneurs) and the Sihlanzimvelo Community Stream Cleaning project.

1.2 A brief history of climate change work within the municipality

The eThekwini Municipal Climate Change Adaptation Branch (previously, the Climate Protection Branch) was established in the Biodiversity Management Department (previously the Environmental Planning and Climate Protection Department) in 2007. The Climate Change Adaptation Branch was tasked with driving the climate change adaptation agenda for the municipality. In 2008, eThekwini Municipality's Energy Office was established. The initial focus of the Energy Office was to improve the energy efficiency (electricity usage) of municipal infrastructure. The mandate for climate change mitigation was added to the responsibilities of the Energy Office in 2009 ahead of Durban hosting the United Nations Framework Convention on Climate Change's (UNFCCC) Seventeenth Conference of the Parties (COP17) in 2011. More recently, the municipality established a Climate Change Department, consisting of these two branches, responsible for overseeing the implementation of the DCCS. The department will be located within the Development, Planning, Environment and Management Unit.

The Durban Climate Change Strategy (DCCS), developed in partnership by the Climate Change Adaptation Branch and the Energy Office, was approved by the eThekwini Municipal Council in 2015. The first iteration outlined a municipal-wide approach to integrating climate change mitigation and adaptation responses into municipal functions and operations.

A sector-based approach was adopted for the development of pilot implementation plans for the DCCS in two parallel processes, with the Climate Change Adaptation Branch leading the adaptation focused theme while the Energy Office led the mitigation theme. The process to develop the implementation plans for the adaptation theme started with an assessment of what climate change adaptation work programmes were already being implemented in municipal line functions, and what gaps existed. This resulted in the development of the Implementation Guidance Document for the DCCS. This was followed by the development of pilot implementation plans for the Sea Level Rise and Water (flooding) themes.

The Implementation Guidance Document for the DCCS outlined an implementation framework which also included a proposed governance framework for implementation of the DCCS. This

[34] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review'.

included the establishment of two governance structures, one being a political oversight committee and the other an administrative body to drive and coordinate the implementation of the Strategy. A governance theme has been included in the revised DCCS and is described below in more detail.

Acknowledging the urgency of responding to climate change, the eThekwini Municipality has recently been part of a programme facilitated by the C40 Cities Climate Leadership Group to develop a Climate Action Plan (CAP) for Durban. The Durban CAP builds upon the Durban Climate Change Strategy but adopts a more ambitious approach to ensure that Durban plays its part in limiting average global temperature increases due to anthropogenic climate change to below 1.5 degrees Celsius (°C) [35]. The CAP sets a goal for Durban to transition to carbon neutrality and climate resilience by 2050 while leaving no one behind. It also seeks to help Durban to achieve an 80% reduction of its greenhouse gas emissions by 2050 compared to 2015 baseline levels [36]. The CAP also had a specific focus aligning Durban's climate change path with the need to limit the global temperature increase to 1.5°C as outlined in the Intergovernmental Panel on Climate Change (IPCC) Special Report, *Global Warming of 1.5°C* [37].

1.3 Projected changes in Durban's climate and associated impacts

Durban is projected to experience increased temperatures, increased periods of drought, more intense storms and flooding, and sea-level rise due to forecasted climate change [38]. The severity of these impacts is dependent on the greenhouse gas emissions reductions that are made globally. The IPCC has developed four different Representative Concentration Pathways (RCPs) which model the future concentrations of greenhouse gases globally. This modelling is based on changes in greenhouse gas emissions. To understand the possible future climate change impacts for Durban[39], the highest emissions scenario (RCP 8.5, – previously representing a 'Business-as-usual' scenario) and the lowest emissions scenario (RCP 2.6 – representing a scenario where emissions are reduced as per the Paris Agreement) have been compared [40].

Figure 2 demonstrates the different Representative Concentration Pathways and highlights the highest emissions scenario using an industry symbol, and the lowest emissions scenario through using solar and wind energy symbols. In the sections and chapters that follow, these symbols will be used to indicate the difference in impacts according to the highest or lowest emissions pathways.

[35] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[36] EThekwini Municipality.
[37] IPCC, 'Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.'
[38] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[39] An interactive website has been developed for Durban to highlight these predicted changes and it can be accessed at the following link: https://ethekwini.maps.arcgis.com/apps/MapSeries/index.html?appid=4c59620219d343a1aec468b87aa0ffc5.
[40] Lutz, 'Updated Climate Change Projections for EThekwini Municipality'; EThekwini Municipality, 'Durban Climate Action Plan 2019'; Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.

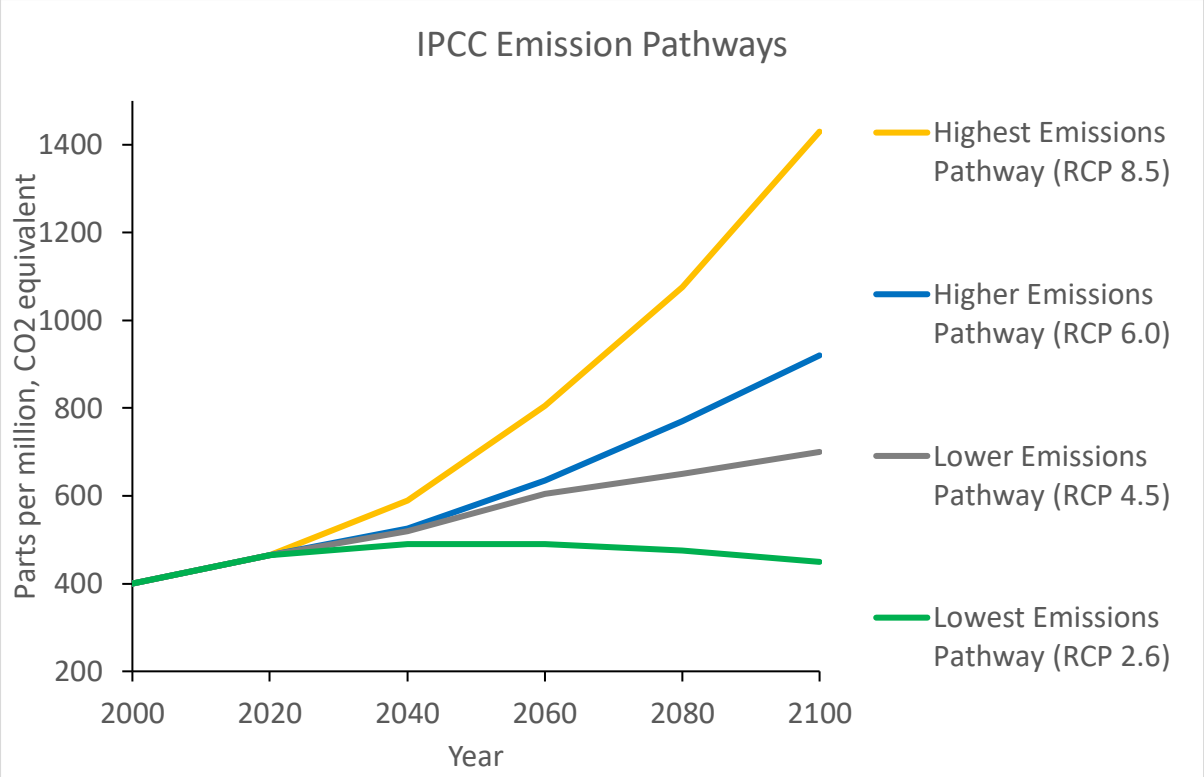

Figure 2: IPCC greenhouse gas emissions pathways

1.3.1 Increasing temperatures

Historically, Durban's annual average temperatures have been steadily increasing [41]. The different climate models project that Durban's average temperature will increase between 0.8 °C and 1.6 °C (degrees Celsius) by 2050 under the lowest and highest emission scenarios respectively. Also, it is projected that on its hottest days, Durban will experience higher temperatures by 2050 of between 1.2 °C under the lowest emissions scenario and 2.2 °C under the highest emissions scenario [42].

As a result of the projected increase in average temperature, Durban may also experience increased evaporation rates. The projected increase in average temperature combined with increases in the evaporation rate pose several notable risks for Durban, including water supply insecurity, increased frequency of floods and droughts, increased heat stress exposure, reduced water quality, increased vector-borne and water-borne diseases, loss of biodiversity, changes in species migratory patterns, and impacts on food production [43]. As higher amounts of energy are required for cooling during very hot periods, power outages may be extremely harmful, especially for essential services like hospitals. A lack of cooling water may also increase the occurrence of power outages [44].

[41] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[42] EThekwini Municipality.
[43] EThekwini Municipality; Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.
[44] EThekwini Municipality, 'Durban Climate Action Plan 2019'; Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.

It is important to note that these climate projections have been developed from global models. As the spatial scale is reduced (from international to national to provincial to local), the uncertainty related to the projections increases. This, together with uncertainty around whether future global emissions will be successfully reduced, means that we must plan for a range of potential scales of severity in Durban's climate change impacts, including flooding, drought and sea level rise. These are described further below:

1.3.2 Increased storms and flooding

Different global climate models show differences in future rainfall projections and therefore there is more uncertainty around future changes in rainfall for Durban [45]. However, Durban may experience more frequent and severe extreme rainfall events in the future resulting in higher flood-related risks such as flash floods [46].

Key risks posed by these extreme rainfall events include threats to lives and livelihoods, damage to and loss of property (public and private) and stormwater management systems, decreased water quality, increases in erosion and siltation of rivers and dams, and the overflow of sewage systems [47].

1.3.3 Drought

Future projections for Durban around rainfall and periods of drought are uncertain, however, some of the models indicate that Durban may experience more severe droughts and an increase in dry years [48].

Increased periods of drought pose key risks for Durban, including water insecurity, decreased water quantity and quality, increased vector and water-borne diseases, loss of biodiversity, increased food insecurity, and may negatively affect crop yields and industries that rely on high volumes of water to operate. Durban may also experience more frequent water restrictions and increased power outages (due to a lack of water for cooling), which may have negative impacts on critical services and increase heat stress exposure [49].

1.3.4 Sea level rise

Sea level rise is already occurring along Durban's coastline. According to global and municipal projections by Mather and Stretch [50], future sea level rise may range from 0,3 to 1 metre for Durban by the year 2100 depending on the low (RCP 2.6) or high (RCP 8.5) emissions scenario [51]. Also,

[45] Lutz, 'Updated Climate Change Projections for EThekwini Municipality'.
[46] Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[47] Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.
[48] EThekwini Municipality, 'Durban Climate Action Plan 2019'; Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.
[49] Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[50] 'A Perspective on Sea Level Rise and Coastal Storm Surge from Southern and Eastern Africa'.
[51] Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'.

Durban is predicted to experience an increase in the intensity and frequency of coastal storm surges [52].

Some of the key risks for Durban from increased coastal storms and sea level rise include threats to coastal infrastructure, owned by both eThekwini Municipality and privately, which may negatively affect tourism and threaten coastal communities; threats to the shipping industry in Durban's harbour; the displacement of people and loss of lives; and the loss of ecological infrastructure and ecosystem goods and services on the coastline [53].

1.4 Durban's greenhouse gas emissions

A fundamental part of eThekwini Municipality's climate change response has been the development of annual greenhouse gas inventories for Durban since 2010. Understanding the sources of Durban's greenhouse gas (GHG) emissions is critical to developing appropriate responses to reduce GHG emissions.

The most recent GHG inventory compiled for Durban was for the 2019 calendar year. The total amount of greenhouse gas emissions recorded was 29,175,112 tonnes of carbon dioxide equivalent (tCO_2e)[54] [55]. Total emissions have increased from 27,066,285 tCO_2e in 2010 (the baseline year). The increases have been attributed to a combination of improved data collection and increased carbon-intensive processes in Durban [56].

1.4.1 Emissions by Scope

International GHG reporting standards require inventories to be categorised as follows:

- Scope 1 – Direct emissions that result from the combustion of raw materials such as coal to generate energy and combustion of diesel or petrol for transport.
- Scope 2 – Indirect emissions that result from the production of purchased electricity and steam.
- Scope 3 – All other indirect emissions.

The total GHG emissions in Durban for the 2019 calendar year for each Scope category are shown in Table 1 and Figure 3. Scope 1 and Scope 2 emissions account for the vast majority of the total GHG emissions emitted in Durban [57].

[52] Climate Adaptation Services and FutureWater; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[53] Climate Adaptation Services and FutureWater, 'Climate Impact Atlas - Climate Projections and Risk Assessment for EThekwini Municipality'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[54] *Tonnes of carbon dioxide equivalent (tCO_2e) is a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using an equivalent amount of carbon dioxide (CO_2) as the reference (i.e. CO_2e)* (eThekwini Municipality 2014, viii).
[55] EThekwini Municipality Energy Office, 'EThekwini Greenhouse Gas Emissions Inventory 2019 Technical Report'.
[56] EThekwini Municipality Energy Office.
[57] EThekwini Municipality Energy Office.

Table 1: Durban's Total GHG emissions by Scope for 2019

Emissions Scope	Total Emissions (tCO_2e)	Contribution of Total Emissions
Scope 1	12,793,243.3	43.85%
Scope 2	11,697,743.4	40.09%
Scope 3	4,684,125.7	16.06%
Total	**29,175,112.4**	**100.00%**

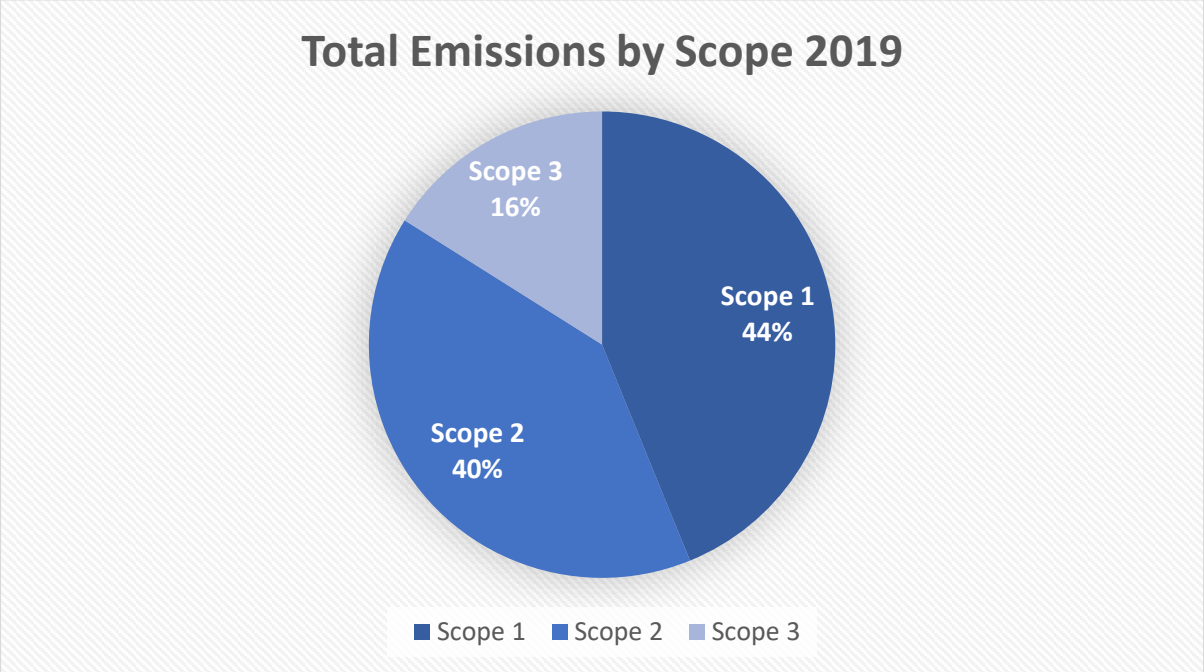

Figure 3: Durban's Total GHG Emissions by Scope for 2019

1.4.2 Emissions by sector

Another useful way to analyse emissions is to look at them by sector or source. This helps to guide mitigation actions that are developed. GHG emissions by sector in Durban for the 2019 calendar year are shown in Table 2. Sectors with the highest emissions are the transportation (41%) and industrial (31%) sectors [58]. The eThekwini Municipality as an institution accounted for 5% of total emissions [59].

Table 2: Durban's emissions by sector for 2019

Sector	Contribution of Total Emissions
Transportation	41%
Industrial	31%
Residential	13%
Commercial	8%

[58] EThekwini Municipality Energy Office, 'EThekwini Greenhouse Gas Emissions Inventory 2019 Summary Report'.
[59] EThekwini Municipality Energy Office.

Sector	Contribution of Total Emissions
Municipality	5%
Other	2%
Total	**100%**

2 Strategy overview

2.1 Introduction

The Durban Climate Change Strategy (DCCS) was approved by the eThekwini municipal council in June 2015 [60]. This was followed by the approval of the Durban Climate Action Plan (CAP)[61] in October 2019. The eThekwini Municipality intends to develop a set of fully integrated implementation plans for the DCCS (and the CAP), to take the DCCS from "planning to implementation". The process of developing implementation plans for the DCCS will include several components:

1. Reviewing and updating the DCCS.
2. Developing implementation plans across different sectors.
3. Developing a monitoring and evaluation framework and reporting tool.
4. Developing a communication plan.

This initial draft of the revised DCCS and the sector implementation plans will be finalised in 2021. The implementation plans will then be updated on an annual basis to align with eThekwini's municipal reporting systems.

This document is an initial draft of the revised DCCS.

2.2 Our problem in a nutshell

In the future, Durban is likely to experience severe impacts and be presented with unique opportunities as a result of climate change. The negative impacts will greatly exacerbate already existing social, economic, and environmental stresses as well as existing gender inequalities, while the opportunities offer the potential to leapfrog traditional developmental phases.

Durban, like most cities in the world, is not yet fully prepared for climate change. The appropriate stakeholder structures, policies, businesses, financial and social systems still need to be put in place. This is not to say there has been no action in Durban. The eThekwini Municipality is regarded as a leader in terms of its research and policy development in response to climate change [62]. In the next five years, this foundation must be urgently built upon, to prepare Durban for the dramatic changes that are predicted to occur.

[60] EThekwini Municipality, 'Durban Climate Change Strategy'.

[61] http://www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/CAP/Pages/default.aspx

[62] Roberts, 'Thinking Globally, Acting Locally — Institutionalizing Climate Change at the Local Government Level in Durban, South Africa'; Mokwena, 'Municipal Responses to Climate Change in South Africa'; Mather and Roberts, 'Climate Change and the Coasts of Africa. Durban Case Study'; Leck and Roberts, 'What Lies Beneath'; Leck and Simon, 'Local Authority Responses to Climate Change in South Africa'; EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2020/2021 Review'; EThekwini Municipality, 'Durban: A Climate for Change - Transforming Africa's Future - A Selection of Durban's Climate Change Projects 2011/2012'.

2.3 What are we going to do?

Climate change affects everyone in Durban, and, as a result, we all have a role to play in responding to climate change. We also need to regard climate change as an issue that impacts all sectors of society; it is not just an environmental problem. The following vision for climate change response in Durban is therefore proposed:

Achieve inclusive climate resilience with net-zero greenhouse gas emissions by 2050

2.4 How are we going to do it?

Different levels and types of interventions need to occur to adequately prepare for climate change. Typically, climate change strategies are split into mitigation and adaptation themes. Mitigation includes actions that reduce greenhouse gases, while adaptation include actions that help prepare for the inevitable impacts of climate change. The original 2015 DCCS included a third cross-cutting theme that addressed vulnerable communities and the economy.

However, there are also strategic "enabling conditions" that need to be in place for effective synergies between adaptation and mitigation measures [63]. One of the key revisions to the 2015 DCCS is the inclusion of an enabling theme as part of the strategy's structure. Previously, the DCCS was structured according to sectors clustered into climate change mitigation, adaptation and "cross-cutting" themes. However, over the past five years, it has become apparent that higher-level interventions must be put in place for implementation at the sector level to be effective. Thus, a new enabling theme with the sectors of legislation, policy and planning; governance; research, communication and capacity building and finance is included in the revised strategy. These are summarised in Figure 4:

[63] Duguma et al., 'A Systematic Analysis of Enabling Conditions for Synergy between Climate Change Mitigation and Adaptation Measures in Developing Countries'.

Figure 4: Themes in the revised version of the DCCS

There are now four themes in the revised strategy, each split into detailed sectors. For example, the Adaptation Theme includes biodiversity; food security; health; sea level rise and coastal protection; and water and sanitation sectors. Each sector has targets, with associated programmes and projects. It is within the projects of the Economic Development, adaptation and mitigation themes that the City's best opportunities for stimulating the green economy lie, particularly in projects that support sustainability and sustainable livelihoods in the city's most in-need communities, including the opportunity of addressing economic and gender inequalities.

There are also several supporting documents that accompany this strategy. The documents include a detailed implementation plan, a communication plan, and a monitoring and evaluation framework. The supporting documents contain detailed information for different projects and programmes and are intended to be updated more frequently than the strategy.

3 Enabling theme

3.1 Legislation, policy and planning sector

The first sector of the strategy outlines the climate change legislative, policy, and planning environment that eThekwini Municipality operates in. A key responsibility of the eThekwini Municipality is to implement national legislation and develop and enforce municipal by-laws and policies. If the eThekwini Municipality can create and enforce legislation that coordinates and facilitates stakeholder action on climate change, responds to the needs of residents that are most vulnerable to climate change and recognises that women and men are impacted differently by climate change, it creates a strong foundation to drive the climate change agenda. Implementation of the DCCS will, therefore, be strongly vested in the development of partnerships.

The following section reviews the current legislation, policy and planning environment that the eThekwini Municipality occupies. Based on this context, targets, programmes and projects have been identified to ensure that eThekwini Municipality has a strong legislative and planning foundation to respond to climate change.

3.1.1 International climate change policy

The Paris Agreement, an outcome of the United Nations Framework Convention on Climate Change (UNFCCC) 21st Conference of the Parties (COP) meeting in 2015, represents a commitment by almost all of the globe's nation-states to reduce their emissions (climate change mitigation) to assist in limiting global temperature increases to below 2 °C, and to prepare for the impacts of climate change (climate change adaptation) [64]. All signatories must prepare Nationally Determined Contributions outlining how they will reduce their emissions to contribute to the global emissions goal, and how they will adapt to climate change. This was the first time that adaptation was explicitly included in a COP agreement [65].

In 2018, the IPCC published a special report on the impacts of global warming of 1.5 °C in the context of increasing global adaptive capacity. The IPCC noted that to limit global warming to 1.5 °C transitions are needed in energy, land, urban infrastructure (including transport and buildings), and industrial systems [66]. These transitions must be rapid, far-reaching and unprecedented in scale. All sectors require deep emissions reductions, multiple climate change mitigation options and a substantial increase in the financing of these options [67]. To achieve the required reductions in emissions to limit global warming to 1.5 °C, additional global annual average energy-related investments of about United States Dollars (USD) 830 billion are required [68]. All transitions must

[64] UN, 'Paris Agreement'.
[65] UN.
[66] IPCC, 'Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.'
[67] IPCC.
[68] IPCC.

overcome environmental, technological, financing, socio-economic, and institutional barriers [69]. The four transitions are briefly overviewed [70]:

- The energy system transition requires that 70% to 85% of electricity is generated using low-emission renewable energy options by 2050 and that electricity demand is reduced (through increased energy efficiency measures and faster electrification of energy end-use).
- The transition of global and regional land-use systems projects increases in land covered by forests decreases in pasture land, and an increase or a decrease in non-pasture agricultural land for food and feed crops by 2050 (relative to 2010). The projected changes have a magnitude of millions of square kilometres globally.
- Changes in land and urban planning are required for the transition of urban and infrastructure systems as well as increased energy efficiency measures to implement deep emissions reductions. For the transport sector, the share of "low-emission final energy" must increase by between 35% and 65% by 2050 from less than 5% in 2020.
- For industrial systems, energy and process efficiencies are insufficient to limit global warming to 1.5 °C, so new and existing practises and technologies (for example, hydrogen; carbon capture, utilisation, and storage; and electrification.) need to be combined to achieve the required emissions reductions of 65% to 90% by 2050 (relative to 2010).

3.1.2 National climate change policy

The South African government released the *National Climate Change Response White Paper* (NCCRWP) in 2011 followed by the *Climate Change Bill* in 2018 and the *Carbon Tax Act* (No. 15 of 2019) [71].

The NCCRWP marked a turning point for climate change response in South Africa, as both mitigation and adaptation are prioritised [72] with the national government demonstrating admirable foresight in elevating (and championing) the issue of climate change adaptation. The NCCRWP has resulted in the development of climate response strategies for different spheres of government in South Africa, including the provincial and local spheres.

The *Carbon Tax Act* (No. 15 of 2019) came into effect on 1 June 2019 and aims to support the reduction of GHG emissions in South Africa and to meet its international agreements and targets. The act adopts a phased approach: the first phase will only apply to certain GHG emitters with allowances made until 31 December 2022. Companies are effectively taxed per tonne of carbon that they emit (at a rate of R 120 per tonne of carbon dioxide equivalent) to encourage them to reduce their emissions [73].

The *Climate Change Bill*, published for comment in 2018, aims to guide the development of a coordinated and integrated response to climate change for all spheres of government in South Africa

[69] IPCC.
[70] IPCC.
[71] DEA, 'National Climate Change Response White Paper (NCCRWP)'; Republic of South Africa, Draft Climate Change Bill, 2018; Republic of South Africa, Carbon Tax Act, No. 15 of 2019.
[72] DEA, 'National Climate Change Response White Paper (NCCRWP)'.
[73] Republic of South Africa, Carbon Tax Act, No. 15 of 2019.

and focuses on both climate change adaptation and mitigation [74]. When legislated, this will provide the legal framework underpinning South Africa's climate change response as a country and will assign clear responsibilities to different spheres of government.

The *Disaster Management Amendment Act* (No. 16 of 2015) focuses on disaster risk reduction and climate change responses [75]. It has resulted in disaster management plans and forums being developed at all spheres of government that include climate response actions [76].

As part of its international agreements, South Africa submitted its first Nationally Determined Contribution report to the UNFCCC in 2015 and an updated version of this report was submitted to the UNFCCC in 2021. In addition, South Africa's Third National Communication to the UNFCCC was submitted in 2018 [77]. Furthermore, South Africa published its National Climate Change Adaptation Strategy, a requirement of the Paris Agreement, in 2020 [78]. The Climate Change Bill was tabled in South Africa's parliament in February 2022. Once enacted this bill will become the Climate Change Act.

3.1.3 Municipal climate change policies

As outlined, the Durban Climate Change Strategy (DCCS) was approved by eThekwini municipal council in 2015. The DCCS includes sector-specific targets and projects for the medium to long term for Durban. This document is the first revision of the DCCS and includes recent climate science and considers lessons learnt from the implementation of the DCCS over the five years since it was approved.

The eThekwini municipality does not have other formal climate change policy documents and there are no specific climate change by-laws in place yet. However, work is being undertaken by the municipality to develop green building by-laws and review other by-laws to ensure they are climate change responsive.

3.1.4 Municipal planning context

The eThekwini municipality has taken the lead in integrating its climate change response into its strategic documents, including the Integrated Development Plan (IDP) and the Spatial Development Framework (SDF) as well as into the work of various departments within the municipality.

A key project that has assisted with climate change integration and collaboration between the eThekwini's departments is the Climate Resilience Implementation Spatial Plan (CRISP) tool. The municipality received funds from GIZ in the 2016/17 municipal financial year to develop the CRISP tool through the Cities Fit for Climate Change Programme. The municipality has used the CRISP tool to integrate climate change into its SDF and lower-order plans. The SDF now guides eThekwini

[74] Republic of South Africa, Draft Climate Change Bill, 2018.
[75] Republic of South Africa, Disaster Management Amendment Act, No. 16 of 2015.
[76] Republic of South Africa.
[77] DEA, 'South Africa's Third National Communication under the United Nations Framework Convention on Climate Change'.
[78] DEFF, 'National Climate Change Adaptation Strategy'.

municipality's departments on potential climate change actions that align with the 2015 DCCS and promotes a collaborative approach between municipal departments [79].

Many of eThekwini municipality's departments have developed research reports and strategic plans that contribute to the climate change response. A key example of these cross-departmental documents is *Durban's Resilience Strategy* which focuses on two important resilience-building options:

1. Collaborative informal settlement action; and
2. Integrated planning in traditional authority areas.

Climate change poses a significant risk to these areas of work and is a key consideration in the development of the implementation plan for *Resilience Building Option 1 Collaborative Informal Settlement Action* and to ensuring that informal settlements are sustainable and climate-smart.

Similarly, *Durban's Strategic Environmental Assessment* also flags climate change as a driver of environmental change, spatially represents biophysical hazard areas (many of which will be exacerbated by climate change) and advocates for improved environmental quality and the protection of natural assets, which are also essential in the climate change response.

Durban's Strategic Renewable Energy Roadmap also provides guidance on achieving 100% renewable energy by 2050 [80]. Departmental work includes climate change action plans by key municipal departments such as the Water and Sanitation Unit and sector-specific adaptation plans for health and disaster management.

3.1.5 Legislation, policy and planning summary

There is well-developed international and national climate change policy environment. Once the national Climate Change Bill is enacted, there will be a clear framework in which eThekwini Municipality can respond to climate change. Within the municipality, some by-laws and policies can be reviewed or developed to create a more climate-sensitive legislative and policy environment. This review should ensure that the needs of the most vulnerable residents of Durban are addressed as well as the different ways in which women and men are impacted by climate change. In terms of planning, eThekwini Municipality has shown leadership by integrating climate change into municipal planning processes. The way forward is to ensure that these are mainstreamed throughout the municipal strategic planning environment and that plans are adhered to.

3.1.6 Legislation, policy and planning targets

The following targets are proposed for the legislation, policy and planning sector.

Table 3: Proposed targets for the Legislation, Policy and Planning sector

[79] EThekwini Municipality, 'Durban Climate Change Strategy Annual Report 2018/19'.
[80] ARUP for eThekwini Municipality, 'Durban Strategic Renewable Energy Roadmap 2019'.

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Mainstream climate change into all municipal policy and planning processes	Municipal policies, sectoral and strategic plans updated to be climate change responsive	Municipal policies, sectoral and strategic plans updated to be climate change responsive	Municipal policies, sectoral and strategic plans updated to be climate change responsive

3.1.7 Legislation, policy and planning programmes and projects

The following section summarises programmes and projects proposed for the Legislation, Policy and Planning sector. The details of these projects are provided in the accompanying implementation plan.

Programme Title	Programme and Projects
1) Mainstream climate change into all municipal policy and planning processes	To successfully respond to climate change, the policy and planning environment of eThekwini Municipality must take climate change into account. The purpose of this programme is to incorporate climate change into all municipal planning and to ensure the policy environment related to climate change in eThekwini Municipality is strengthened and addresses the concerns of women and men who are most vulnerable to climate change. The projects included in this programme are: 1.1) Strengthen eThekwini Municipality's climate change policy environment 1.2) Coordinate the integration of climate change risks and opportunities into Municipal sectoral and strategic plans

3.2 Governance sector

The second enabling sector of this strategy focuses on existing stakeholder structures. To effectively take forward climate change action in Durban, stakeholder structures that include representation from women and men that are most vulnerable to climate change are needed to ensure that efforts are coordinated and complementary. This section reviews the stakeholder structures that are currently in place and identifies targets, programmes and projects to ensure that eThekwini Municipality has a strong governance foundation to respond to climate change.

3.2.1 Context

The eThekwini Municipality was one of the first South African municipalities to develop dedicated municipal structures with dedicated staff for climate change [81]. Currently, the Climate Change Department is responsible for the coordination and integration of eThekwini's climate responses into municipal functions and operations.

Several committees have been formed to ensure the implementation of the Durban Climate Change Strategy [82]. These committees and their responsibilities are summarised in Figure 5.

[81] EThekwini Municipality, 'Durban Climate Change Strategy Annual Report 2018/19'.
[82] EThekwini Municipality.

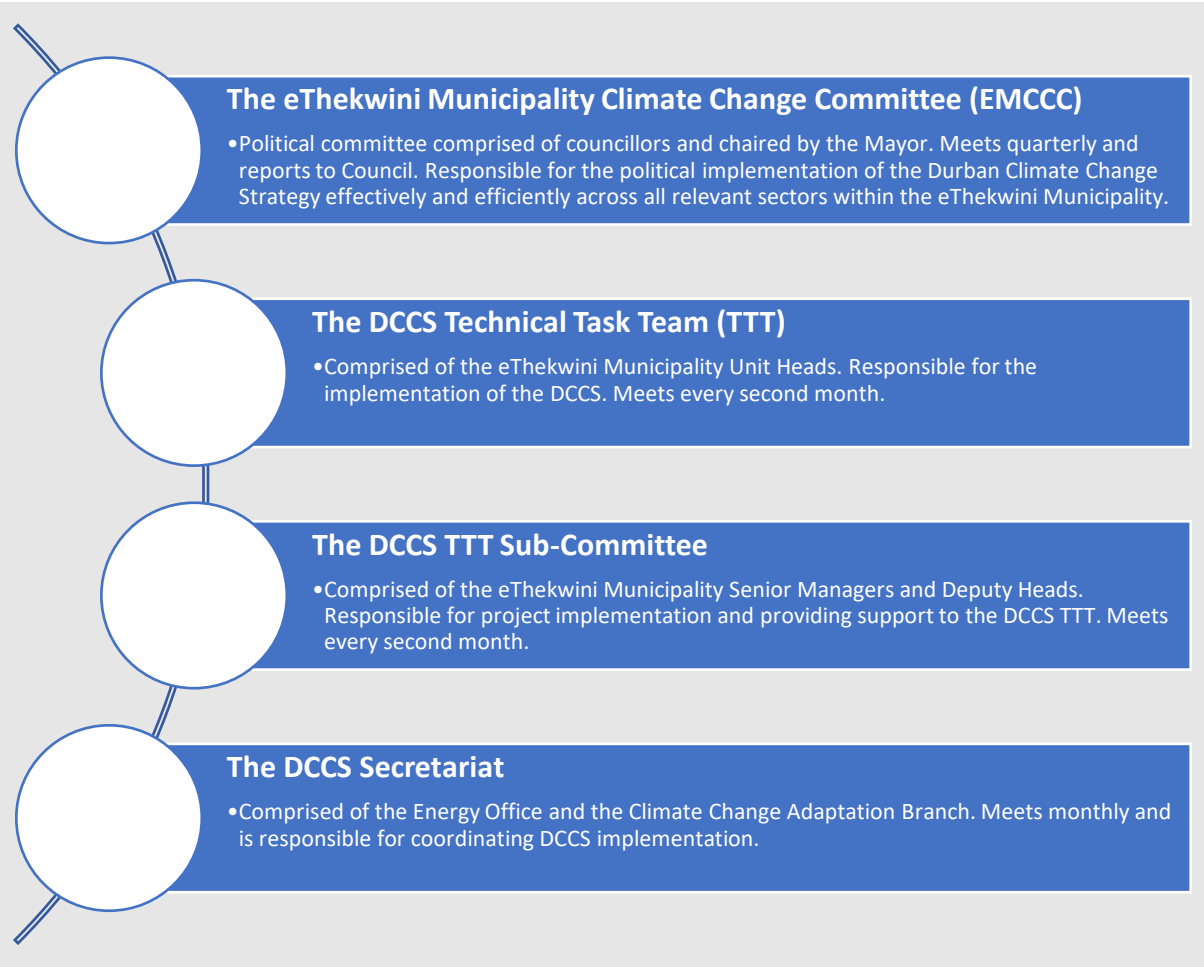

Figure 5: Committee structures in the eThekwini Municipality for the implementation of the DCCS

The DCCS Secretariat, comprised of staff from the EO and the Climate Protection Branch, assists with coordination and communication between these committees to meet the objectives of the DCCS. The DCCS TTT Sub-Committee reports to the DCCS TTT, and the chair of the DCCS TTT reports to the EMCCC. The chair of the DCCS TTT also reports to the Strategic Management Forum comprised of eThekwini's deputy city managers.

In terms of the *Disaster Management Amendment Act* (No. 16 of 2015), the eThekwini Municipality has a Disaster Management Advisory Forum consisting of different departmental representatives to focus on disaster risk reduction and climate interventions. The DCCS is represented in this forum by the Senior Manager: Climate Protection Branch.

Outside the municipal environment, several civil society organisations, businesses and research institutions are actively involved in climate change response work. However, there is no formal stakeholder structure that allows these different groups to work collectively towards a climate change vision for Durban.

3.2.2 Governance summary

The eThekwini Municipality has a well-defined multi-departmental structure to deal with climate change. Its establishment was a key success following the adoption of the first DCCS in 2015.

However, there is no multi-stakeholder structure in Durban with representatives from non-municipal sectors to coordinate a climate change response. In 2011, the Durban Climate Change Partnership was initiated, but this proved unsustainable as the municipality was unable to maintain its funding contribution due to a conflict between being the funder and being represented on the board of the Partnership.

3.2.3 Governance targets

The following targets are proposed for the stakeholder sector:

Table 4: Proposed targets for stakeholder structures

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Set up appropriate stakeholder and institutional structures in Durban to adequately respond to climate change	Stakeholder and institutional structures set up to meet requirements of the Climate Change Act	Stakeholder and institutional structures set up to meet requirements of the Climate Change Act	Stakeholder and institutional structures set up to meet requirements of the Climate Change Act
2) Monitor, evaluate and revise the municipal climate change response in Durban	A monitoring and evaluation systems set up that can track the effectiveness of climate change actions being taken by the Municipality.	A monitoring and evaluation systems set up that can track the effectiveness of climate change actions being taken by the Municipality.	A monitoring and evaluation systems set up that can track the effectiveness of climate change actions being taken by the Municipality.

3.2.4 Stakeholder structure programmes and projects

The following section summarises key programmes and projects that are proposed for the stakeholder sector. Details of these projects are provided in the accompanying implementation plan.

Table 5: Proposed programmes and projects for stakeholder structures

Programme Title	Programme and Projects
1) Set up appropriate stakeholder and institutional structures in Durban to adequately respond to climate change	To successfully respond to climate change eThekwini Municipality must integrate its efforts with national and provincial government and promote cooperation between stakeholders in Durban. The purpose of this programme is to align the functions of eThekwini Municipality's climate change structures with provincial government and the requirements of national legislation. The programme also aims to ensure appropriate stakeholder structures are set in place to facilitate multi-stakeholder engagement and clear lines of responsibility for climate action. These stakeholder structures should seek to engage both women and men who are most vulnerable to climate change to ensure that the multiplicity of experiences of climate change is represented. The projects included in this programme are: 1.1) Align the DCCS Implementation Framework with the Climate Change Act and National and Provincial legislation and policy 1.2) Set up and/or facilitate multi-disciplinary, multi-stakeholder climate change forum (preferably within existing stakeholder structures).

Programme Title	Programme and Projects
2) Monitor, evaluate and revise the municipal climate change response in Durban	An effective response to climate change requires the monitoring and evaluation of mitigation and adaptation efforts. The purpose of this programme is to establish and implement a monitoring and evaluation system to track the effectiveness of climate change actions taken by the Municipality. The projects included in this programme are: 2.1) Coordinate and implement a climate change response monitoring and evaluation framework for the eThekwini Municipality

3.3 Research, communication and capacity building

The third enabling sector of this strategy outlines the research, communication, and capacity-building efforts made by the eThekwini Municipality. Research is required to ensure that stakeholders have the best available knowledge on climate change and how it will impact differently on women, men and vulnerable communities to guide decision-making and action. In addition, communication and capacity building is essential to ensure that stakeholders understand the implication of climate change and have the capacity to respond.

The following section reviews the research initiatives and communication and capacity-building efforts that are currently in place. Based on this context, targets, programmes and projects have been identified to ensure that eThekwini Municipality has a communication and research base to respond to climate change.

3.3.1 Context

Climate change has been recognised as a significant global challenge. However, there is still uncertainty regarding some of the projected risks and impacts of climate change at the global, regional, national and municipal levels. In addition, research is still underway to develop an understanding of the best approaches to effectively reduce GHG emissions and adapt to climate change impacts. It is, therefore, critical to conduct research and generate new knowledge on climate change impacts and the most effective and appropriate responses to climate change. It is also important to share this knowledge and to facilitate understanding of climate change amongst decision-makers, civil society, non-government organisations and businesses so that they too can respond appropriately to the challenges associated with climate change.

The eThekwini Municipality is already contributing to knowledge generation through the Durban Research Action Partnership established with the University of KwaZulu-Natal in 2011 to promote local research on climate change adaptation [83]. Also, eThekwini Municipality actively communicates on climate change knowledge annually through the Sustainable Living Exhibition, articles in its ezaseGagasini Metro newspaper and by providing content to local newspapers and radio stations [84]. After the 2018/19 financial year, the Climate Change Department produced the first in a series of annual climate change progress reports. This will become a useful tool to communicate progress implementing the DCCS.

[83] EThekwini Municipality.
[84] EThekwini Municipality.

3.3.2 Research, communication and capacity building summary

The Durban Research Action Partnership to promote local climate change adaptation research has been functioning for several years and eThekwini Municipality has taken active steps to communicate climate change information. Going forward continued research efforts are required to better understand climate change in Durban and how it will impact differently on women, men and vulnerable communities. In addition, expanded efforts are required in the communication of climate change to build the capacity of Durban's residents to respond to climate change. In particular, communication information should be accessible to the women and men who are most vulnerable to the impacts of climate change.

3.3.3 Research, communication and capacity building targets

The following targets are proposed for the research, communication and capacity building sector.

Table 6: Proposed targets for research, communication and capacity building

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Build capacity in all stakeholder groups to adequately respond to climate change	Climate change communication framework established and implemented with participation from schools, wards, businesses and civil society groups to increase climate change awareness.	Climate change communication framework established and implemented with participation from schools, wards, businesses and civil society groups to increase climate change awareness.	Climate change communication framework established and implemented with participation from schools, wards, businesses and civil society groups to increase climate change awareness.
2) Ensure local climate change research outcomes are integrated into municipal policies, planning processes and programmes.	Local climate change research is coordinated on an ongoing basis through the establishment of an appropriate transdisciplinary research body.	Local climate change research is coordinated on an ongoing basis through the establishment of an appropriate transdisciplinary research body.	Local climate change research is coordinated on an ongoing basis through the establishment of an appropriate transdisciplinary research body.

3.3.4 Research, communication and capacity building programmes and projects

The following section summarises key programmes and projects that are proposed for the research, communication, and capacity building programmes sector. Details of these projects are provided in the accompanying implementation plan.

Table 7: Proposed programmes and projects for research, communication and capacity building

Programme Title	Programme and Projects
1) Build capacity in all	Stakeholders and municipal staff require knowledge about climate change to effectively respond to it. The purpose of this programme is to build the capacity of stakeholders in

Programme Title	Programme and Projects
stakeholder groups to adequately respond to climate change	Durban by implementing a climate change communication framework with audience-appropriate education and awareness-raising materials. The programme will also promote knowledge sharing with other municipalities. The projects included in this programme are: 1.1) Implement the climate change communication framework for Durban 1.2) Facilitate and participate in an inter-municipal knowledge sharing structure for climate change
2) Ensure local climate change research outcomes are integrated into municipal policies, planning processes and programmes.	To effectively respond to climate change ongoing research is needed to understand its impacts, how it will impact differently on women, men and vulnerable communities and how best to respond to it. The purpose of this programme is to coordinate local climate change research and address the research needs of thematic areas in the DCCS. The programme will also ensure that the research findings are integrated into municipal planning processes and municipal programmes and projects. The projects included in this programme are: 2.1) Coordinate a climate change research programme for the thematic areas of the DCCS 2.2) Update the eThekwini Municipality's Greenhouse Gas Emissions Inventory on an ongoing basis to determine where action needs to be taken 2.3) Conduct a Mitigation Potential Analysis and develop Desired Emission Reduction Outcomes for each sector and subsector of the economy in Durban

3.4 Climate Finance sector

The fourth enabling sector considers the challenge of securing finance for climate change efforts by eThekwini Municipality and other stakeholders. To ensure meaningful mitigation of GHGs and adaptation to climate change impacts, substantial financial resources will be needed.

The following section reviews existing sources of finance for climate change action in Durban. Based on this context, targets, programmes and projects have been identified to ensure that resources are unlocked to respond to climate change.

3.4.1 Context

The expected costs of climate change adaptation and mitigation for the eThekwini Municipality are not known. However, In *South Africa's Intended Nationally Determined Contribution*, the national government estimated that for South Africa as a whole, the total cost of **c**limate change adaptation for the period 2020 to 2030 was estimated at between USD 35.7 and USD 299.7 billion [85]. From *South Africa's Intended Nationally Determined Contribution*, incremental climate change mitigation costs for South Africa for the period 2020 to 2030 was estimated at USD 733.95 billion [86]. As South Africa's third-largest city, Durban is expected to shoulder a significant share of these costs.

An analysis of climate change-related spending revealed that eThekwini Municipality spent an estimated R1.33 billion on climate change adaptation and mitigation between 2000 and 2014 [87].

[85] DEA, 'South Africa's Intended Nationally Determined Contribution (INDC)'.
[86] DEA, 9.
[87] EThekwini Municipality, 'EThekwini Municipality Climate Change Spend Analysis: Towards a Credible Quantification of Municipal Investment into Climate Change Mitigation and Adaptation'.

Furthermore, between 2008 and 2014, climate change spending by the municipality was estimated to range between 0.33% and 1.12 % of the annual municipal budget [88]. The eThekwini Municipality has also secured international finance for climate change-related work in Durban from the C40 Cities Climate Leadership Group for the development of *Durban's Climate Action Plan*; from the 100 Resilient Cities programme for the development of *Durban's Resilience Strategy*; from the World Bank for the gas-to-energy project at the Bisasar Road landfill site; and USAID for mitigation activities in Durban between 2000 and 2006 [89].

Despite the municipality's successes in securing funding from international sources and the use of its own budget, it is anticipated that considerably more financing is required to respond to the scale of climate change adaptation and mitigation efforts required in Durban.

3.4.2 Climate Finance summary

The eThekwini Municipality has committed its own funds to climate change efforts and has also successfully secured external finance. However, the scale of finance required to mitigate GHG emissions and adapt to climate change impacts is considerable and additional effort is required to secure more finance. However, it should be noted that the bulk of international climate finance is in the form of loans, rather than grants. There will also be increased pressure on the availability of climate financing as priorities such as COVID-19 take centre stage in the next few years.

3.4.3 Climate Finance targets

The following targets are proposed for the climate finance sector.

Table 8: Proposed targets for the finance sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Develop capacity to secure climate funding from funding opportunities outside of municipal fiscal mechanisms	Climate financing is sourced from opportunities external to the eThekwini Municipality	Climate financing is sourced from opportunities external to the eThekwini Municipality	Climate financing is sourced from opportunities external to the eThekwini Municipality
2) Enhance the municipal finance system to compensate for climate change impacts on revenue and costs	Appropriate revenue protection and financing models that take climate change impacts into account are implemented	Appropriate revenue protection and financing models that take climate change impacts into account are implemented	Appropriate revenue protection and financing models that take climate change impacts into account are implemented

[88] EThekwini Municipality.
[89] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban's Resilience Strategy 2017 (Long Version)'; EThekwini Municipality, 'EThekwini Municipality Climate Change Spend Analysis: Towards a Credible Quantification of Municipal Investment into Climate Change Mitigation and Adaptation'.

3.4.4 Finance programmes and projects

The following section summarises key programmes and projects proposed for the finance sector. The details of these projects are provided in the accompanying implementation plan.

Table 9: Proposed programmes and projects for the finance sector

Programme Title	Programme and Projects
1) Develop capacity to secure climate funding from funding opportunities outside of municipal fiscal mechanisms	Responding to climate change will require considerable financial resources. The purpose of this programme is to create the capacity to access climate financing opportunities. The projects included in this programme are: 1.1) Create a dedicated climate change financing structure within the eThekwini Municipality
2) Enhance the municipal finance system to compensate for climate change impacts on revenue and costs	Municipal financing systems need to take into account climate change impacts on revenue and costs. The purpose of this programme is to ensure that the reduction of income from electricity and water sales is taken into account. These impacts should be included in budgets for large-scale infrastructure projects. The projects included in this programme are: 2.1) Ensure the projected impacts of climate change are budgeted for in large-scale infrastructure projects in Durban 2.2) Initiate the process of developing a funding model for the eThekwini Municipality that considers the reduction of income from electricity and water sales

4 Cross-cutting theme

The second theme focuses on the cross-cutting sectors, risk management and economic development. These sectors cut across many adaptation and mitigation sectors and must be addressed in the implementation of the DCCS. Since the impacts of climate change will not be felt equally across society, it is important to pay particular attention to the communities most vulnerable to climate change and the different ways that climate change impacts will be experienced by women and men. Since economic development is also a critical priority for Durban, implementation of the DCCS must contribute to Durban's economy and enhance sustainable development.

The following sections provide an overview of the communities most vulnerable to climate change in Durban, highlight key risks to infrastructure and provide a summary of the possible implications of climate change for Durban's economy. Based on this context, targets, programmes and projects have been identified that support risk management and contribute to economic development.

4.1 Risk management

4.1.1 Context

Risk management proactively manages climate change-related disasters and reduces the vulnerability of natural and human systems (including people and infrastructure) to climate change impacts [90]. Existing vulnerability to disaster risk is likely to be increased by climate change [91].

In South Africa, disaster risk reduction management is guided by the Disaster Management Amendment Act (No. 16 of 2015) and the National Disaster Management Framework (2005) [92]. The Disaster Management Amendment Act provides a legal mandate for municipal, provincial and national government to include climate change adaptation in all disaster management plans [93]. In addition, the Disaster Management Amendment Act specifically refers to the need for measures and investment in climate change adaptation, ecosystem-based adaptation and community-based adaptation [94]. The National Disaster Management Centre also works with municipal, provincial and national government to prevent and mitigate disasters [95].

Climate change is predicted to impact Durban in the following ways: increased temperatures, increased periods of drought, more intense storms and flooding, and rising sea levels [96]. While some level of climate change is now inevitable, it is possible to reduce the impacts and risks associated with climate change. However, to succeed we must act, and our responses must be timely,

[90] SALGA, 'Climate Change and Disaster Risk Booklet. Councillor Induction Program'; WCDEADP, *Western Cape Climate Change Response Strategy: 3rd Biennial Monitoring & Evaluation Report 2019/20*.
[91] DEA, 'South Africa's 3rd Annual Climate Change Report'.
[92] WCDEADP, *Western Cape Climate Change Response Strategy: 3rd Biennial Monitoring & Evaluation Report 2019/20*; SALGA, 'Climate Change and Disaster Risk Booklet. Councillor Induction Program'.
[93] WCDEADP, *Western Cape Climate Change Response Strategy: 3rd Biennial Monitoring & Evaluation Report 2019/20*.
[94] WCDEADP.
[95] WCDEADP.
[96] EThekwini Municipality, 'Durban Climate Action Plan 2019'.

sustained, and just. This includes making sure that the projected effects of climate change are included in municipal disaster management plans and projects. This will allow climate-related extreme events to be proactively prepared for and managed.

The importance of vulnerability and adaptive capacity has been emphasised in the societal aspects of climate change impacts for several years [97]. Vulnerability refers to the increased likelihood of being negatively affected by climate events and not having the ability to cope and adapt to these events or issues [98]. While climate change will negatively affect almost everyone, vulnerable communities are likely to be most affected as they have the least adaptive capacity, are limited by inequality, have limited access to municipal services and have a limited ability to cope due to a lack of resources [99]. Vulnerable groups include women, especially women with limited economic resources and rural women; people with disabilities; children, especially infants and child-headed families; the elderly; the sick; people with limited economic resources; people living in areas more likely to be impacted by extreme weather events (including low-lying areas or areas with steep slopes); and people living in informal settlements with limited access to municipal services [100].

Vulnerable communities are susceptible to severe shocks from climate-related hazards like floods and droughts. Often vulnerable communities live in dwellings that may not withstand the effects of extreme weather events [101]. People living in vulnerable communities are often heavily dependent on local ecosystem services and subsistence farming, both predicted to be negatively affected by the impacts of climate change [102].

The most vulnerable communities in Durban are those living in informal settlements [103]. Often such settlements are located in low-lying areas susceptible to flooding, or areas with steep slopes, unstable soils, or environmentally-sensitive areas [104]. It is estimated that between 20% and 25% of the population live in Durban's more than 550 informal settlements [105]. Rural areas and townships are also recognised as being home to vulnerable communities [106].

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[97] Demel et al., 'Developing a Socioeconomic Vulnerability Index Using Two Agricultural Communities Exposed to Climate Change: A Case Study in Wanathawilluwa in Puttlam District of Sri Lanka'.
[98] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 128.
[99] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[100] DEFF, 'National Climate Change Adaptation Strategy'; EThekwini Municipality, 'Durban Climate Change Strategy', 21–22.
[101] EThekwini Municipality, 'Durban Climate Change Strategy'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[102] EThekwini Municipality, 'Durban Climate Change Strategy'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[103] EThekwini Municipality, 'Durban Climate Change Strategy'; EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban's Resilience Strategy 2017 (Long Version)'.
[104] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban Climate Change Strategy'.
[105] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'; EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban's Resilience Strategy 2017 (Long Version)'.
[106] EThekwini Municipality, 'Durban Climate Action Plan 2019'.

The impacts of climate change are predicted to severely affect vulnerable communities in Durban, through increased risks related to loss of life, dwellings and possessions; increased water and food insecurity; and the decline of ecosystem goods and services and productive arable land which vulnerable communities often depend on [107].

In addition, it should be noted that some women and men may be impacted differently by climate change. This is a result of both the different roles women and men play in society and factors that result in the marginalisation and exclusion of women.

eThekwini Municipality is implementing several programmes and strategies to support vulnerable communities such as the Informal Settlement Upgrading Programme, the Provision of Incremental Services to Informal Settlements Programme, Durban's Resilience Strategy Resilience Building Option 1: Collaborative Informal Settlement Action Implementation Plan 2019-2022, The Zibambele Poverty Alleviation Programme, Sihlanzimvelo, Community-based Ecosystem Adaptation (CEBA) and other dedicated poverty-alleviation programmes [108]. The municipality is also developing a Poverty Alleviation Policy [109].

4.1.2 Risk management summary

eThekwini Municipality has several programmes to actively support vulnerable communities. However, a focused effort is required to ensure that these communities become climate-resilient.

4.1.3 Risk management target

The following targets are proposed for the risk management sector:

Table 10: Proposed targets for the risk management sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Facilitate the transition of communities (particularly, poor and previously disadvantaged communities) towards climate resilience	Vulnerable wards in Durban have transitioned to climate resilience	Vulnerable wards in Durban have transitioned to climate resilience	Vulnerable wards in Durban have transitioned to climate resilience
2) Integrate and align disaster management and climate change resilience	Institutional and policy alignment achieved between disaster management and climate change resilience	Institutional and policy alignment achieved between disaster management and climate change resilience	Institutional and policy alignment achieved between disaster management and climate change resilience

[107] EThekwini Municipality, 'Durban Climate Change Strategy'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[108] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[109] EThekwini Municipality.

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
3) Protect or relocate Municipal infrastructure currently located in high climate-risk areas	100% of municipal infrastructure in high climate-risk areas is identified with plans being implemented to protect or relocate.	100% of municipal infrastructure in high climate-risk areas is identified with plans being implemented to protect or relocate.	100% of municipal infrastructure in high climate-risk areas is identified with plans being implemented to protect or relocate.

4.1.4 Risk management programmes and projects

The following section summarises the key programmes and projects that are proposed for the risk management sector. The details of these projects are provided in the accompanying implementation plan.

Table 11: Proposed programmes and projects for the risk management sector

Programme Title	Programme and Projects
1) Facilitate the transition of communities (particularly, poor and previously disadvantaged communities) towards climate resilience	The potential impacts of climate change on communities in Durban may be considerable. The purpose of this programme is to transition communities in Durban towards climate resilience. This will be achieved by identifying and prioritising at-risk townships, traditional areas, and rural areas in Durban, conducting community vulnerability assessments, understanding the different ways in which women and men are impacted by climate change, piloting a project to build climate resilience in these vulnerable areas and if successful, rolling out the project to all vulnerable communities. Partnerships will also be established with vulnerable communities in the management of wastewater and stormwater in their areas, to facilitate the relocation of high-risk informal settlements to suitable, alternative, available sites. The projects included in this programme are: 1.1) Conduct community vulnerability assessments to identify and prioritise at-risk townships, traditional areas, and rural areas in Durban 1.2) Develop and implement a pilot project to build climate resilience in vulnerable communities of Durban 1.4) Facilitate incremental upgrading of informal settlements in Durban to ensure effective, quick responses to climate change-related impacts 1.5) Facilitate the relocation of high-risk informal settlements to suitable, alternative, available sites in Durban 1.6) Develop a policy for proper spatial land use management of residential areas situated near wastewater treatment works to minimise the spread of water-borne and vector-borne disease
2) Integrate and align disaster management and climate change resilience	Disaster management is at the frontline of climate change response as many of the impacts from severe storms driven by climate change necessitate a disaster management response. The purpose of this programme is to integrate climate change risks and related accountability into the disaster management plans and systems of Municipal line units. This will be achieved by facilitating meetings of eThekwini Municipality's multi-unit disaster management forums that prioritise climate change related-risks and extreme events in Durban, as well as ensuring that different ways in which women and men are impacted by climate-related disasters are considered. In addition, contingency plans and early warning systems will be developed for Durban. The projects included in this programme are: 2.1) Integrate climate change risks and related accountability into the disaster management plans of the eThekwini Municipality's line units 2.2) Facilitate the meetings of the eThekwini Municipality's multi-unit disaster management forums that prioritise climate change related-risks and extreme events in Durban

Programme Title	Programme and Projects
	2.3) Develop and implement an early warning system for extreme events in Durban 2.4) Develop contingency plans for Durban that responds to a number of climate change impacts (e.g., extreme and high-impact storms and flooding events)
3) Protect or relocate Municipal infrastructure currently located in high climate-risk areas	The eThekwini Municipality has direct control over its infrastructure and therefore must ensure that this infrastructure can withstand impacts from climate change. The purpose of this programme is to ensure the appropriate asset management systems take into account climate-related risks and to protect or relocate Municipal infrastructure currently located in areas of high flood and sea level rise risk. The projects included in this programme are: 3.1) Mainstream climate change in eThekwini Municipality's District Development Model (DDM) 3.2) Coordinate the revision of Municipal Asset Management Plans to ensure that they consider climate change impacts 3.3) Integrate climate change planning into the eThekwini Municipality's strategic planning for the Port of Durban 3.4) Relocate or protect existing Municipal infrastructure that is currently located in high climate-risk zones in Durban

4.2 Economic development

4.2.1 Context

Continued greenhouse gas emissions and related global warming are predicted to have negative impacts on economic development. Risks to human and food security as well as livelihoods are also predicted to be magnified and distributed unevenly depending on factors such as existing income levels, forms of housing and gender. In addition, economic development in coastal areas is expected to be highly impacted by predicted sea level rise and increases in the frequency and severity of climate-related hazards. Exposure to climate-related hazards is predicted to increase the risks to and reduce the resilience of human settlements and natural systems [110].

For the 2018/2019 municipal financial year, Durban's economy had (in constant 2010 prices) a gross domestic product of R301.3 billion (a decrease of 0.15% on the previous year); total trade of R201.2 billion (an increase of 1.99% on the previous year); a per capita income of R67,116 (an increase of 2.71% on the previous financial year); and a Gini coefficient[111] of 0.62 (no change), which is amongst the highest in the world [112]. Major economic sectors in Durban include the transport, communications, manufacturing, tourism, industry and financial services sectors [113]. Furthermore, for the 2018/2019 municipal financial year, the economically active population was estimated to be

[110] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; IPCC, 'Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.'
[111] The Gini coefficient measures the distribution of income in an economy among individuals or households (World Bank 2016). A Gini coefficient of 0 implies perfect equality, while 1 implies perfect inequality (World Bank 2016). Internationally, a Gini coefficient of higher than 0.4 is considered to have serious political and socioeconomic implications (SACN 2016).
[112] Thaver, 'EThekwini Municipality: Global Insight 2020'.
[113] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.

1,439,458 people, of which 1,015,477 people were employed in the formal sector and 207,427 in the informal sector. The unemployment rate was estimated to be 18.7% [114]. In eThekwini Municipality's Integrated Development Plan for 2021/2022, it is estimated that 45% of female-headed households and 25% of male-headed households in Durban are living in poverty [115]. Furthermore, high inequality and the spatial and economic marginalisation of vulnerable groups in Durban, such as the poor, women, and the youth, have been exacerbated as the majority of people living in informal settlements in Durban live far from economic nodes and spend a disproportionally large amount of their income on transport costs. [116].
It is predicted that climate change impacts will be detrimental to Durban's economic development. Higher temperatures are predicted to impact the health of the workforce; sea level rise and increases in the frequency and magnitude of climate-related hazards are predicted to directly impact Durban's economy and the provision of services, cause economic losses, and damage or destroy infrastructure as well as ecosystem goods and services [117]. However, climate change may also result in some economic development benefits for Durban, such as investments in ecosystem goods and services and the development of a green, climate-smart, low-carbon economy, renewable energy, energy efficiencies and waste beneficiation [118].

The eThekwini Municipality has implemented several programmes that incorporate economic development. These include the Municipal Climate Protection Programme, the Catalytic Projects Programme and the Urban Renewal Programme [119]. The eThekwini Municipality also participates in the international 'Cities Fit for Climate Change' project [120]. The municipality has developed related strategies and plans such as the eThekwini Municipality Energy Strategy, eThekwini Municipality's Green Strategy, the Durban Climate Change Strategy, Durban's Resilience Strategy and Durban's Climate Action Plan [121].

4.2.2 Economic development summary

eThekwini Municipality has taken initial steps to consider how climate change will impact Durban's economy. Additional work is required to understand how to transform Durban's economy to adapt to the challenges and opportunities of climate change.

4.2.3 Economic development targets

The following targets are proposed for the Economic Development sector.

[114] Thaver, 'EThekwini Municipality: Global Insight 2020'.
[115] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review'.
[116] EThekwini Municipality.
[117] EThekwini Municipality, 'Durban Climate Change Strategy'; EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[118] EThekwini Municipality, 'Durban Climate Change Strategy'.
[119] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[120] EThekwini Municipality.
[121] EThekwini Municipality.

Table 12: Proposed targets for the Economic Development sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Implement programmes that contribute to climate change responsive economic development that ensures opportunities for both women and men	Short term economic development projects are implemented that can contribute towards a climate-sensitive transition in Durban	Short term economic development projects are implemented that can contribute towards a climate-sensitive transition in Durban	Short term economic development projects are implemented that can contribute towards a climate-sensitive transition in Durban
2) Develop a climate-resilient, low-carbon economy that is socially responsible and environmentally sustainable and provides opportunities for both women and men	The eThekwini Municipality's Economy is low carbon, socially responsible and environmentally sustainable	The eThekwini Municipality's Economy is low carbon, socially responsible and environmentally sustainable	The eThekwini Municipality's Economy is low carbon, socially responsible and environmentally sustainable

4.2.4 Economic Development programmes and projects

The following section summarises key programmes and projects that are proposed for the economic development sector. The details of these projects are provided in the accompanying implementation plan.

Table 13: Proposed programmes and projects for the economic development sector

Programme Title	Programme and Projects
1) Implement programmes that contribute to climate change responsive economic development that ensures opportunities for both women and men	Climate change response can often be seen as long-term interventions. However, there are also some short-term risks and opportunities that can be responded to. The purpose of this programme is to implement several short-term economic development projects that contribute towards climate change responsive economic development in Durban. These include promoting resource efficiency, localised production and the "circular economy", online and virtual economic activities, the participation of women in climate change response, the establishment of low-carbon micro-scale organic food businesses, and waste and ecosystem services job-creation working groups within the climate change stakeholder structures for Durban. The projects included in this programme are: 1.1) Develop and implement a programme to promote the concepts of localised production, resource efficiency and the "circular economy" to businesses in Durban 1.2) Develop and implement a programme to promote online and virtual economic activities in Durban 1.3) Develop and implement a programme to promote and facilitate the establishment of low-carbon micro-scale organic food businesses 1.4) Create a waste working group within the multi-disciplinary, multi-stakeholder climate change forum, that is focused on the re-use of effluents, waste materials and other resources 1.5) Provide baseline information on existing municipal projects that respond to this ecosystem-services job-creation programme in Durban

Programme Title	Programme and Projects
2) Develop a climate-resilient, low-carbon economy that is socially responsible and environmentally sustainable and provides opportunities for both women and men	There are both economic risks and opportunities associated with climate change in Durban. The purpose of this programme is to support the development of a climate-resilient, low-carbon economy in Durban that provides opportunities for both women and men. This will be achieved through research into the relationships between economic growth scenarios and predicted climate change impacts for Durban, a green-economy sector development programme, integrating climate change responses into Local Economic Development interventions and strategies, and research economic incentives that contribute to reduced greenhouse gas emissions and enhanced climate change adaptation. The projects included in this programme are: 2.1) Conduct research into the relationships between potential economic growth scenarios and projected climate change impacts for Durban 2.2) Implement a sector development programme that focuses on the green economy in Durban 2.3) Integrate climate change responses into Local Economic Development (LED) interventions and strategies 2.5) Develop a policy for new positive economic incentives that can contribute towards reduced greenhouse gas emissions and enhanced climate change adaptation capacity in Durban 2.4) Conduct research on new positive economic incentives that can contribute towards reduced greenhouse gas emissions and enhanced climate change adaptation capacity in Durban

5 Climate change adaptation theme

The third theme of this Strategy focuses on responding to the projected impacts of climate change in the key sectors of biodiversity, food security, health, sea level rise and coastal protection, and water and sanitation.

The following sub-sections provide an overview of the projected impacts on the identified sectors. Based on this context, a number of targets, programmes, and projects per sector have been identified to ensure that appropriate adaptation to climate change occurs in each sector.

5.1 Biodiversity

5.1.1 Context

Globally, human activities continue to degrade ecosystems, leading to a loss of natural resources and biological diversity[122] [123]. The rate of this degradation has increased over the past 50 years and it is predicted that climate change will compound the progressive decline in biodiversity, ecosystem

[122] Examples of such human activities include land use changes and related habitat losses; soil erosion; pollution; the spread of invasive alien species and monocultures; salinisation of soils; overgrazing; and the over-extraction of organisms and resources.

[123] IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.

health and human health by exacerbating human-induced pressures and through predicted increases in the frequency and severity of extreme events [124].

Biodiversity is an important contributor to adaptation as intact ecosystems increase resilience and enhance adaptation efforts [125]. For instance, goods and services provided by ecosystems are particularly important for poor communities who are frequently the most vulnerable to the effects of climate change and are often dependent directly on ecosystem goods and services [126]. Intact ecosystems provide other services as well, for example, wetlands decrease the speed of flowing water (helping to reduce the severity of floods) and they can improve water quality resulting in a reduction in the costs associated with treating water and the effects of poor water quality on human health and well-being [127]. For climate change mitigation, intact ecosystems can act as natural carbon stores. Furthermore, the benefits derived from implementing climate change adaptation and mitigation efforts also benefit biodiversity conservation [128].

Biologically, Durban falls into the Maputaland-Pondoland-Albany region, one of 36 global biodiversity hotspots [129]. It contains a wide range of terrestrial and aquatic ecosystems that provide habitats for a diverse variety of organisms [130]. Approximately 53% of Durban has been irreversibly transformed by development and land-use changes [131]. Climate change may further adversely affect the functioning of ecosystems and the viability of some species in Durban. It may also negatively affect the natural production of ecosystem services which many people and businesses depend on. Healthy biodiversity and intact ecosystems can help to mitigate the predicted effects of climate change on Durban such as higher temperatures and precipitation levels, more frequent and severe

[124] IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.
[125] Campbell, Kapos, and Scharlemann, *Review of the Literature on the Links between Biodiversity and Climate Change*; IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.
[126] Campbell, Kapos, and Scharlemann, *Review of the Literature on the Links between Biodiversity and Climate Change*; IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.
[127] Campbell, Kapos, and Scharlemann, *Review of the Literature on the Links between Biodiversity and Climate Change*; IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.
[128] IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.
[129] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban State of Biodiversity Report: 2017/2018'.
[130] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban State of Biodiversity Report: 2017/2018'.
[131] EThekwini Municipality, 'Durban Climate Action Plan 2019'.

storms, and sea level rise. Healthy biodiversity and intact ecosystems contribute to the reduced severity of impacts; improvements in air and water quality; and the capture and storage of carbon [132].

To promote and encourage the management and protection of biodiversity in Durban, eThekwini Municipality publishes *Durban's State of Biodiversity Report* annually. Durban has a system of open spaces incorporating areas of high biodiversity value (on both private- and public-owned land) in the form of a spatial layer known as Durban's Metropolitan Open Space System (D'MOSS) comprising approximately 95,000 hectares of land (about one-third of Durban) [133]. However, in 2018 only about 8.2% of the area represented in the D'MOSS layer had some form of protection [134]. eThekwini Municipality is actively encouraging the integration of climate change considerations into environmental assessments [135].

5.1.2 Biodiversity summary

eThekwini Municipality has taken proactive steps to promote the protection of biodiversity in Durban. Going forward there is a need to extend these protection efforts to consider the climate change impacts on biodiversity in these protection efforts.

5.1.3 Biodiversity targets

The following targets are proposed for the biodiversity sector.

Table 14: Proposed targets for the biodiversity sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Integrate climate change into existing biodiversity management practices	Biodiversity planning and management practices have identified climate change risks and opportunities, and are implemented accordingly.	Biodiversity planning and management practices have identified climate change risks and opportunities, and are implemented accordingly.	Biodiversity planning and management practices have identified climate change risks and opportunities, and are implemented accordingly.

[132] EThekwini Municipality; EThekwini Municipality, 'Durban State of Biodiversity Report: 2017/2018'; IPBES, 'Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'; IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; MEA, *Ecosystems and Human Well-Being: A Framework for Assessment*.
[133] EThekwini Municipality, 'Durban State of Biodiversity Report: 2017/2018'.
[134] EThekwini Municipality.
[135] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.

5.1.4 Biodiversity programmes and projects

The following section summarises key programmes and projects that are proposed for the Biodiversity sector. The details of these projects are provided in the accompanying implementation plan.

Table 15: Proposed programmes and projects for the biodiversity sector

Programme Title	Programme and Projects
1) Integrate climate change into existing biodiversity management practices	Biodiversity plays a key role in providing ecosystem services and is an indicator of climate change impact and resilience. The purpose of this programme is to ensure that climate change risks and opportunities are clearly understood and defined in municipal biodiversity plans and practices. The projects included in this programme are: 1.1) Conduct research on the impacts of climate change on biodiversity and ecosystems in Durban 1.2) Implement recommendations from climate change and biodiversity research 1.3) Continue to update eThekwini Municipality's Systematic Conservation Planning processes to include climate change with biodiversity considerations 1.4) Support and integrate climate change aspect into the community "biodiversity leaders" project 1.5) Reporting on Durban's Community Ecosystem-Based Adaptation (CEBA) type projects to protect and support ecological infrastructure in Durban's Metropolitan Open Space System (D'MOSS) to enhance protection against projected climate change impacts

5.2 Food security

5.2.1 Context

Climate change is likely to have negative consequences for food security [136] as it is expected to increase the frequency, severity and impacts of climate-related hazards such as heatwaves, storms, floods and droughts [137]. Such climate-related hazards are likely to drive up food prices and increase food insecurity and hunger with a disproportionate impact on people living in poverty [138]. Modelling the negative impacts of climate change as a result of greenhouse gas emissions, under a 'business-as-usual' emission scenario, found that about 90% of the world's population will experience reductions in food production in both the agriculture and fisheries sectors [139].

[136] Connolly-Boutin and Smit, 'Climate Change, Food Security, and Livelihoods in Sub-Saharan Africa'.
[137] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Gray and Merzdorf, 'Earth's Freshwater Future'.
[138] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
[139] Thiault et al., 'Escaping the Perfect Storm of Simultaneous Climate Change Impacts on Agriculture and Marine Fisheries'.

In KwaZulu-Natal, over 20% of households are food insecure [140]. While similar statistics are not available for Durban, eThekwini Municipality has identified key challenges through its Farmer Eco-Enterprise Development Programme including high levels of hunger and food insecurity, shortages of arable and fertile land to undertake food production, high unemployment rates, inadequate safety nets and competing land uses [141]. Linked to food insecurity is the death of children under the age of five from severe acute malnutrition [142]. In 2018/2019, the death of children under five from severe acute malnutrition in eThekwini Municipality was 12.8 deaths per 100,000 children under five, lower than the South African average of 13.8 deaths per 100,000 children under five years and the average for KwaZulu-Natal of 13.5 deaths per 100,000 children under five years [143]. In addition, as more female-headed households (45%) are living in poverty in Durban than male-headed households (25%) [144], it follows that female-headed households are more impacted by food insecurity than male-headed households

Climate change is predicted to exacerbate food insecurity in Durban through increases in temperatures and severe climate-related hazards [145]. Impacts from climate-related hazards may include heat stress and loss of livestock; damage to, and loss of crops; reduced rain-fed agriculture (and related increases in demand for irrigation); reduced food quality and food safety; and damaged and disrupted food supply chains [146].

eThekwini Municipality is implementing several programmes to support local communities address issues associated with food access and food insecurity for women and men [147]. The municipality established the Agro-Ecology Unit responsible for seven agro-ecology hubs within Durban to facilitate food sovereignty for all residents [148]. The municipality is also implementing the Farmer Eco-Enterprise Development Programme which aims to transform the agricultural value chain in Durban. It is also rolling out food gardens in the rural parts of Durban [149].

5.2.2 Food security summary

eThekwini Municipality has several existing programmes to support food access and address food insecurity in Durban. These need to be extended and expanded to respond to the expected increases in food insecurity as a result of climate change.

[140] Statistics SA, 'Towards Measuring the Extent of Food Security in South Africa: An Examination of Hunger and Food Adequacy'.
[141] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review', 263.
[142] Massyn et al., 'District Health Barometer 2018/19'.
[143] Massyn et al.
[144] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2021/2022 Review'.
[145] EThekwini Municipality, 'Durban Climate Change Strategy'.
[146] EThekwini Municipality.
[147] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[148] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[149] EThekwini Municipality.

5.2.3 Food security targets

The following targets are proposed for the food security sector.

Table 16: Proposed targets for the food security sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Increase availability and access of food to respond to increased food insecurity, amongst vulnerable women and men, resulting from climate change	A food security policy that takes climate change impacts into consideration has been developed and implemented	A food security policy that takes climate change impacts into consideration has been developed and implemented	A food security policy that takes climate change impacts into consideration has been developed and implemented

5.2.4 Food security programmes and projects

The following section summarises key programmes and projects that are proposed for the food security sector. The details of these projects are provided in the accompanying implementation plan.

Table 17: Proposed programmes and projects for the food security sector

Programme Title	Programme and Projects
1) Increase availability and access of food to respond to increased food insecurity, amongst vulnerable women and men, resulting from climate change	Food security is a potentially significant future climate change related impact in Durban. The purpose of this programme is to increase the amount of locally produced food by integrating climate change into the food security and agricultural policy for Durban, promoting and encouraging locally grown food, supporting cooperatives and small-scale female and male farmers, and integrating food gardens into residential parks and other appropriate open spaces in Durban. The projects included in this programme are: 1.1) Integrate climate change into a food security and agricultural policy for Durban 1.2) Implement a programme to encourage local production of food by communities and cooperatives 1.3) Develop policy frameworks to guide the implementation and coordination of food waste management projects in Durban 1.4) Develop and implement mechanisms to promote the distribution of excess food around Durban 1.5) Develop and implement a project to facilitate access by informal female and male small-scale agricultural growers to formal trading nodes and markets in Durban 1.6) Design and implement a project to assist farmers to join appropriate commodity associations 1.7) Build the climate change capacity of eThekwini Municipality's Agro-Ecology and Agri-Business Unit staff 1.8) Develop and implement a forum for eThekwini Municipality's Agro-Ecology Unit to work with traditional communities and their leaders

5.3 Health

5.3.1 Context

Climate change is expected to negatively impact human health in numerous ways. More intense and frequent heatwaves and fires are expected to increase the risk of injury, disease, and death. In addition, climate change is expected to reduce food production contributing to increased risk of undernutrition. It is also expected to increase the risk of food-, vector- and waterborne diseases [150].

The total population of Durban is approximately 3.99 million people [151]. In 2011, it was estimated that children under the age of 15 made up just over 25% of Durban's total population, while the elderly (over 64 years) accounted for just under 5% of Durban's population [152]. In 2017, the total number of deaths in Durban was 19,910 and the top ten underlying natural causes of death were (in order): heart diseases, diabetes mellitus, tuberculosis, HIV, cerebrovascular diseases, ischaemic heart diseases, influenza and pneumonia, hypertensive diseases, malignant neoplasms of digestive organs and renal failure [153].

Durban is expected to experience more frequent and severe localised flooding events which result in loss of life and injury. In addition, higher temperatures could lead to more incidents of heat stress and higher incidences of heat-related vector-borne diseases, such as malaria, and water-borne diseases, such as cholera. The impacts of flooding, heat stress and water-borne diseases are of particular concern for the 226,000 households living in Durban's more than 550 informal settlements [154]. The impacts of these events will be felt differently by women and men, with the worst impacts falling disproportionately on women, especially those in women-headed households.

eThekwini Municipality has an Environmental Health Service and it complements national and provincial health services through the provision of clinics [155].

5.3.2 Health summary

There is an existing network of national, provincial and municipal health services operational in Durban. This needs to be prepared to respond to the expected health impacts of climate change.

5.3.3 Health targets

The following targets are proposed for the health sector.

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[150] Smith et al., *Chapter 11 - Human Health: Impacts, Adaptation and Co-Benefits. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Working Group II Contribution to the IPCC 5th Assessment Report [Final Draft]. Intergovernmental Panel on Climate Change (IPCC), 2014*.
[151] Thaver, 'EThekwini Municipality: Global Insight 2020'.
[152] Statistics SA, 'Census 2011 Statistical Release'.
[153] Statistics SA, 'Mortality and Causes of Death in South Africa: Findings from Death Notification - 2017'.
[154] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[155] EThekwini Municipality.

Table 18: Proposed targets for the health sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Maintain urban heat levels at 2005-2015 average temperatures	No increase in urban heat levels in Durban compared with 2005-20215 average temperatures.	No increase in urban heat levels in Durban compared with 2005-20215 average temperatures.	No increase in urban heat levels in Durban compared with 2005-20215 average temperatures.
2) Reduce water- and vector-borne diseases linked to predicted climate change impacts to zero	Number of cases of water- and vector borne diseases linked to predicted climate change impacts in Durban does not increase above base levels	Number of cases of water- and vector borne diseases linked to predicted climate change impacts in Durban does not increase above base levels	Number of cases of water- and vector borne diseases linked to predicted climate change impacts in Durban does not increase above base levels

5.3.4 Health programmes and projects

The following section summarises key programmes and projects that are proposed for the health sector. The details of these projects are provided in the accompanying implementation plan.

Table 19: Proposed programmes and projects for the health sector

Programme Title	Programme and Projects
1) Maintain urban heat levels at 2005-2015 average temperatures	Increasing urban temperatures are projected to impact human health, food production, energy use and general wellbeing in Durban. The purpose of this programme is to maintain urban heat levels in Durban at 2005-2015 average temperatures by developing relevant policy frameworks to guide the implementation of heat mitigation strategies in developments, urban design, and urban land use schemes. The projects included in this programme are: 1.1) Develop a policy framework to guide the implementation of heat mitigation strategies in Durban 1.2) Coordinate the development and implementation of a comprehensive heat mitigation programme for eThekwini Municipality
2) Reduce water- and vector-borne diseases linked to predicted climate change impacts to zero	With increasing temperatures and flooding events, the potential for water- and vector-borne diseases in Durban will increase significantly. The purpose of this programme is to reduce water- and vector-borne diseases linked to predicted climate change impacts to zero. This will be achieved by increasing the Municipality's capacity to manage vector-borne diseases and reducing stream and river contamination from sewage and industrial trade effluent. These efforts will be supported by increasing capacity to expand water quality monitoring points to include all large rivers and major tributaries, developing appropriate and efficient data capturing systems for local health services and determining and quantifying the current and potential health impacts associated with climate change in Durban. The projects included in this programme are: 2.1) Develop appropriate and efficient data capturing systems for health services in Durban that includes data on gender 2.2) Determine and quantify the type, nature, magnitude, gender dimensions and distribution of current and potential health impacts associated with climate change in Durban 2.3) Facilitate cooperation and information-sharing between community-based, private and public healthcare facilities in Durban to better respond to the health impacts associated with climate change

Programme Title	Programme and Projects
	2.4) Review the eThekwini Municipality's ability to deal with and manage vector-borne and climate-related diseases and its preparedness to deal with these diseases 2.5) Increase capacity in the department within the eThekwini Municipality's Health Unit responsible for managing vector-borne diseases to take climate change into account 2.6) Increase capacity in the eThekwini Municipality to expand the coverage of water quality monitoring points to include all large rivers and major tributaries in Durban

5.4 Sea level rise and coastal protection

5.4.1 Context

Global mean sea level rose by 3.6 millimetres per year over the period 2006 to 2015 and is projected to continue to rise as a result of thermal expansion, melting of glaciers and ice sheets and changes in land water storage [156]. The projected extent of the rise in global mean sea level by 2050 varies between 0.17 metres to 0.32 m under the lowest emission scenario (RCP 2.6) and between 0.23 m to 0.40 m under the highest emission scenario (RCP 8.5) [157].

Durban is a coastal city with an extensive coastline of 97 kilometres, a significant port and numerous coastal developments. These are at risk in the event of sea level rise and increases in the frequency and severity of coastal storms, both predicted climate change impacts. Like the rest of the world, Durban is experiencing a rise in sea levels; the most recent calculation in 2007 found the rise to be 2.7 mm per year (Mather 2007). Based on global projections it is expected that Durban's sea levels will continue to rise. However, it should be noted that sea level rise varies globally, with regional differences of as much as 30% [158].

eThekwini Municipality has adopted a Coastal Management Strategy (Mather and Barnett 2012) and a Coastal Management by-law [159] setting out its approach to coastal protection and management. The municipality has also conducted research to understand the potential scale of sea level rise and its possible impacts on Durban and identify hazard zones. When development applications are received for hazard zones, developers are required to take additional steps to ensure the protection of their development. In addition, eThekwini Municipality is implementing a policy of relocating infrastructure inland that is damaged during coastal storms (Mather 2020). KwaZulu-Natal's provincial government is expected to gazette Coastal Management Lines in the next few years, to replace the hazard zones identified by eThekwini Municipality.

5.4.2 Sea level rise and coastal protection summary

eThekwini Municipality has taken active steps to understand the projected hazard to coastal development as a result of sea level rise. Going forward there is a need to ensure that coastal developments comply with provincial Coastal Management Lines once they are gazetted and

[156] Oppenheimer et al., 'Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities'.
[157] Oppenheimer et al.
[158] Oppenheimer et al.
[159] EThekwini Municipality, 'EThekwini Municipality: Coastal Management By-Law'.

published. In addition, steps are needed to further protect at-risk infrastructure and relocate it if possible.

5.4.3 Sea level rise and coastal protection targets

The following targets are proposed for the sea level rise and coastal protection sector.

Table 20: Proposed targets for the sea level rise and coastal protection sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Identify, inform, and regulate all developments located within the hazard zone and Coastal Management Lines	Durban's Coastal Management Line includes climate change impacts and is approved and gazetted.	Durban's Coastal Management Line includes climate change impacts and is approved and gazetted.	Durban's Coastal Management Line includes climate change impacts and is approved and gazetted.
2) Set up systems to protect or relocate existing Municipal infrastructure located in high-risk coastal areas	All existing municipal infrastructure located in high-risk coastal zones is identified and plans to either relocate or protect are implemented timeously.	All existing municipal infrastructure located in high-risk coastal zones is identified and plans to either relocate or protect are implemented timeously.	All existing municipal infrastructure located in high-risk coastal zones is identified and plans to either relocate or protect are implemented timeously.

5.4.4 Sea level rise and coastal protection programmes and projects

The following section summarises key programmes and projects proposed for the sea level rise and coastal protection sector. The details of these projects are provided in the accompanying implementation plan.

Table 21: Proposed programmes and projects for the sea level rise and coastal protection sector

Programme Title	Programme and Projects
1) Identify, inform, and regulate all developments located within the hazard zone and Coastal Management Lines	The purpose of this programme is to identify, inform, and regulate all developments in Durban located within the hazard zone and KwaZulu-Natal's Coastal Management Lines by compelling coastal developments to comply with these, developing a coastal planning scheme and a setback policy for Municipal and private developments located within the Coastal Management Lines, determining and enforcing coastal erosion and setback lines, developing guidelines to modify and retrofit Municipal infrastructure and developments in high-risk coastal zones, and integrating Transnet's emergency contingency plans for sea surges in the Port of Durban with the Municipality's strategic plans The projects included in this programme are: 1.1) Manage and enforce the Coastal Management Lines in eThekwini Municipality 1.2) Develop a coastal planning scheme to manage private and Municipal developments located in the coastal zone in Durban 1.4) Develop guidelines for modifying and retrofitting municipal infrastructure and developments in high-risk coastal zones in Durban
2) Set up systems to protect or relocate	There are several municipal sites on or close to the coastline. Many of these have infrastructure that is potentially vulnerable to increasing coastal storm impacts and sea level rise. The purpose of this programme is to prepare existing Municipal infrastructure for the risks associated with coastal storm surges and sea level rise. The projects included

Programme Title	Programme and Projects
existing Municipal infrastructure located in high-risk coastal areas	in this programme are: 2.1) Analyse coastal storm and sea-level rise projections in Durban 2.2) Identify options and develop a database of relocation options for Municipal infrastructure located in high-risk coastal areas in Durban 2.3) Conduct research to guide the development of a project to protect and support coastal ecological infrastructure in Durban

5.5 Water and sanitation

5.5.1 Context

The global water cycle will continue to be affected by climate change [160]. Climate change affects rainfall patterns and temperatures and these changes are predicted to increase the frequency, severity (magnitude) and impacts of extreme water-related events like floods and droughts [161]. Climate change is also likely to affect the security of the supply of water and increase the competition for water resources [162].

The eThekwini Municipality has a high reliance on catchment areas outside its municipal boundaries for its water [163]. In 2007 demand for water in Durban was already more than the reliable yield of Durban's water resources [164]. Increasing demand for water has been caused by population growth, industry and urban demand due to improved living standards and related expectations of water supply [165]. While many residents of Durban have access to water, some do not as backlogs for water and sanitation infrastructure exist [166]. Other water issues include ageing water infrastructure, inadequate maintenance, water losses, and declining water quality. In addition, parts of Durban are prone to flooding [167].

For Durban, climate change is predicted to increase the variability of rainfall (within and between years) and the amount of rainfall; extend the rainy season; increase the frequency, severity and

[160] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
[161] IPCC; Gray and Merzdorf, 'Earth's Freshwater Future'; DEA, 'Long Term Adaptation Scenarios, Phase 1 - Technical Report - No 1 of 6 - Climate Trends and Scenarios for South Africa'.
[162] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Gray and Merzdorf, 'Earth's Freshwater Future'; DEA, 'Long-Term Adaptation Scenarios, Phase 1 - Technical Report - No 2 of 6 - Water Sector In South Africa'.
[163] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[164] Schulze et al., 'Durban Climate Change Strategy – Water Theme Report: Draft for Public Comment'.
[165] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban Climate Change Strategy'; Schulze et al., 'Durban Climate Change Strategy – Water Theme Report: Draft for Public Comment'.
[166] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[167] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban Climate Change Strategy'; Schulze et al., 'Durban Climate Change Strategy – Water Theme Report: Draft for Public Comment'.

impact of extreme events such as floods and droughts; increase evaporation levels; increase the frequency of water shortages; exacerbate the risk of declining water quality linked to rising water temperatures, eutrophication and algae blooms and add further to the uncertainty inherent in water resource management and planning [168]. Water and sanitation infrastructure is expensive to repair or relocate and is vulnerable to more frequent and severe storms and sea level rise, predicted to increase as a result of climate change [169].

To reduce the impacts of climate change on the water sector, eThekwini Municipality has promoted the diversification of water supply options; prepared 1-in-100-year flood lines; released a Water Conservation and Water Demand Management Strategy and Business Plan for 2017 to 2027; developed guidelines and policies for stormwater management systems; prepared a Water Services Development Plan for the sustainable, economical and efficient supply of water services; and is developing a Forecast Early Warning System [170]. The Water and Sanitation Unit is also developing projects in: drought mitigation; optimisation and augmentation of current water supply; alternative water supply options; sanitation; financial management; education and training; and energy and carbon [171].

The eThekwini Municipality frames much of its climate change response in the water sector within a Community Ecosystem-based Adaptation (CEBA) approach. The CEBA approach acknowledges that natural environments provide a buffer to extreme weather events and the management of such ecosystems provides much-needed income for vulnerable communities. The municipality has a growing number of CEBA projects creating thousands of employment opportunities. One example is the Sihlanzimvelo Stream Cleaning Programme to clean streams in township areas to address stormwater management in the face of climate change. The municipality contracts local cooperatives to cut grass, clear blockages and remove litter in streams. This successful project will be replicated in future municipal financial years with external funding [172]. This is a good example of the different co-benefits of climate change-related projects. In this case, benefits include employment of previously disadvantaged individuals, improved stormwater management and the improved management of open spaces.

[168] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'; EThekwini Municipality, 'Durban Climate Change Strategy'; Schulze et al., 'Durban Climate Change Strategy – Water Theme Report: Draft for Public Comment'.
[169] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Durban Climate Change Strategy'; Schulze et al., 'Durban Climate Change Strategy – Water Theme Report: Draft for Public Comment'; DEA, 'Long Term Adaptation Scenarios, Phase 1 - Technical Report - No 1 of 6 - Climate Trends and Scenarios for South Africa'; DEA, 'Long-Term Adaptation Scenarios, Phase 1 - Technical Report - No 2 of 6 - Water Sector In South Africa'.
[170] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'; EThekwini Municipality, 'Durban Climate Change Strategy'; Schulze et al., 'Durban Climate Change Strategy – Water Theme Report: Draft for Public Comment'.
[171] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[172] EThekwini Municipality, 'Durban Climate Change Strategy Annual Report 2018/19'.

5.5.2 Water and sanitation summary

eThekwini Municipality has extensive programmes to improve water security and promote protection from flooding through CEBA. These efforts need to continue and expand.

5.5.3 Water and sanitation targets

The following targets are proposed for the water and sanitation sector.

Table 22: Proposed targets for the water and sanitation sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Coordinate and Implement the Transformative River Management Programme (TRMP)	500km transformed municipal-owned riverine corridor land to be climate-resilient, clean, safe and healthy	2000km transformed municipal-owned riverine corridor land to be climate-resilient, clean, safe and healthy	3600km transformed municipal-owned riverine corridor land to be climate-resilient, clean, safe and healthy
2) Develop and implement municipal climate change actions that responds to potentially amplified flood risks due to climate change	Existing, relevant Municipal strategies, legislation, spatial frameworks, spatial plans, and standards in which flood-lines have been updated to adequately reflect projected climate change risks	Existing, relevant Municipal strategies, legislation, spatial frameworks, spatial plans, and standards in which flood-lines have been updated to adequately reflect projected climate change risks	Existing, relevant Municipal strategies, legislation, spatial frameworks, spatial plans, and standards in which flood-lines have been updated to adequately reflect projected climate change risks
4) Increase alternative water supply capacity to meet 100% of the projected increase in demand for water from climate change impacts	Increase in alternative water-supply capacity to meet the projected increases in demand for water that result from climate change impacts in Durban	Increase in alternative water-supply capacity to meet the projected increases in demand for water that result from climate change impacts in Durban	Increase in alternative water-supply capacity to meet the projected increases in demand for water that result from climate change impacts in Durban
5) Reduce water demand	Climate change impacts upon water demand are quantified and incorporated into Durban's water demand actions.	Climate change impacts upon water demand are quantified and incorporated into Durban's water demand actions.	Climate change impacts upon water demand are quantified and incorporated into Durban's water demand actions.

5.5.4 Water and sanitation programmes and projects

The following section summarises key programmes and projects proposed for the water and sanitation sector. The details of these projects are provided in the accompanying implementation plan.

Table 23: Proposed programmes and projects for the water and sanitation sector

Programme Title	Programme and Projects
1) Coordinate and Implement	Transformative river management has proved to be a cost-effective climate change response in Durban. The purpose of this programme is to develop and implement

Programme Title	Programme and Projects
the Transformative River Management Programme (TRMP)	transformative riverine management options to protect and support ecological infrastructure in riverine areas throughout Durban. The projects included in this programme are: 1.1) Formulate a business case and fine-scale implementation plan for the Transformative Riverine Management Programme (TRMP) in Durban 1.2) Secure financing and develop an institutional framework to implement Durban's TRMP
2) Develop and implement municipal climate change actions that responds to potentially amplified flood risks due to climate change	Flooding is a key climate change risk that Durban will face in the future. The purpose of this programme is to adopt and enforce a risk-averse approach to controls for spatial, land-use, and infrastructure planning and development in Durban that responds to potentially amplified flood risks due to climate change. The projects included in this programme are: 2.1) Develop master drainage plans for all river catchments in Durban 2.2) Update research to include the latest rainfall and runoff projections and climate system models for Durban 2.3) Implement a project to identify and manage public open spaces in Durban that can play strategic roles in flood attenuation and cooling services 2.4) Design and implement a project to ensure that all of eThekwini Municipality's lower-order plans have allocations of at least 10% for public green open spaces 2.5) Implement public awareness campaigns in Durban to raise awareness of the benefits of stormwater-runoff reduction techniques and other flood-protection measures 2.6) Update and enforce Municipal legislation to control urban drainage and to limit stormwater runoff in Durban
4) Increase alternative water supply capacity to meet 100% of the projected increase in demand for water from climate change impacts	With increased demand for water as a result of population growth and the decreasing availability of water as a result of climate change, future water supply is a key risk for Durban. The purpose of this programme is to increase alternative water supply capacity to meet the projected increase in water demand due to climate change by investing in new infrastructure and partnerships, promulgating a water services by-law, developing and implementing alternative water supply options, and implementing a drought monitoring and mitigation plan for Durban. The projects included in this programme are: 4.1) Promulgate a water services by-law to regulate climate change response measures in Durban 4.4) Develop and implement water reuse projects at KwaMashu and Northern wastewater treatment works 4.5) Coordinate water remix programme at wastewater treatment works in Durban 4.2) Develop and implement remix water demonstration plant at central wastewater treatment works 4.6) Design and implement a project to harvest rainwater and stormwater in Durban and to store the water on-site 4.3) Develop and implement a new water recycling public private partnership project at Southern Wastewater Treatment Works.
5) Reduce water demand	Water demand in Durban is relatively high as a result of historically poor demand-side management practices and significant losses in the distribution system. With a projected reduction in water supply resulting from climate change, there is a need to intervene in how water is used. The purpose of this programme is to reduce water demand throughout Durban by developing an overarching water use strategy for Durban, reducing non-revenue water losses and supporting catchment management activities in upstream catchment areas. The projects included in this programme are: 5.1) Develop an overarching water use strategy for Durban 5.2) Implement projects to reduce non-revenue water losses in Durban 5.3) Develop and implement projects to support catchment management activities in upstream municipalities in which Durban's water source areas are located

6 Climate change mitigation theme

The final theme focuses on mitigating Durban's contribution to climate change through the emission of GHGs in the energy, waste and pollution and transport sectors. The following sections provide an overview of the contribution of these sectors to GHG emissions in Durban. Based on this context, a number of targets, programmes, and projects per sector have been identified to ensure appropriate mitigation projects.

6.1 Energy

6.1.1 Context

Energy is a leading contributor to greenhouse gas emissions globally. Between 2000 and 2010, the IPCC found that 35% of GHG emissions were released by the energy supply sector [173]. Energy use can be broken down into two distinct components, namely transportation and stationary applications. Stationary applications include, for example, electricity to operate an office or diesel consumption to run manufacturing equipment.

In Durban, energy for stationary applications accounts for 55% of GHG emissions [174]. Most energy for stationary applications is electricity supplied by the municipality and generated by Eskom outside of Durban. However, a significant portion of stationary energy use in Durban is generated from stationary fuel combustion. Users of energy for stationary applications include residents, industry, offices and the municipality itself [175].

To address energy emissions, eThekwini Municipality has developed a renewable energy road map and allows customers to sell energy to it.

6.1.2 Energy summary

Energy use in Durban is a very significant contributor to GHG emissions. Extensive efforts are required to transform energy production and implement demand-side energy management to achieve the required significant reduction in GHG emissions from energy use.

6.1.3 Energy targets

The following targets are proposed for the energy sector.

Table 24: Proposed targets for the energy sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Ensure 100% of electricity purchased by	10% of electricity purchased by the	40% of electricity purchased by the	100% of electricity purchased by the

[173] IPCC, *Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
[174] EThekwini Municipality Energy Office, 'EThekwini Greenhouse Gas Emissions Inventory 2017 Summary Report'.
[175] EThekwini Municipality Energy Office.

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
the eThekwini Municipality is produced from renewable energy sources by 2050	eThekwini Municipality that is produced from renewable energy sources	eThekwini Municipality that is produced from renewable energy sources	eThekwini Municipality that is produced from renewable energy sources
2) Ensure 70% of private electricity demand in Durban is supplied by renewable energy generated locally (in Durban and KwaZulu-Natal) by 2050	10% of private electricity demand in Durban that is supplied through self-generated renewable energy	30% of private electricity demand in Durban that is supplied through self-generated renewable energy	70% of private electricity demand in Durban that is supplied through self-generated renewable energy
3) Reduce electricity consumption by 40% by 2050 across residential, commercial, municipal, and industrial consumers	10% reduction in electricity consumption across residential, commercial, municipal, and industrial consumers in Durban compared to an agreed-upon baseline	20% reduction in electricity consumption across residential, commercial, municipal, and industrial consumers in Durban compared to an agreed-upon baseline	40% reduction in electricity consumption across residential, commercial, municipal, and industrial consumers in Durban compared to an agreed-upon baseline
4) Transform eThekwini Municipality's infrastructure to a net-zero carbon footprint	10% of all Municipal infrastructure in Durban is transformed to a net-zero carbon footprint	50% of all Municipal infrastructure in Durban is transformed to a net-zero carbon footprint	100% of all Municipal infrastructure in Durban is transformed to a net-zero carbon footprint

6.1.4 Energy programmes and projects

The following section summarises key programmes and projects proposed for the energy sector. The details are provided in the accompanying implementation plan.

Table 25: Proposed programmes and projects for the energy sector

Programme Title	Programme and Projects
1) Ensure 100% of electricity purchased by the eThekwini Municipality is produced from renewable energy sources by 2050	Electricity usage is the second-highest source of GHGs in Durban. Currently, the bulk of this electricity is derived from fossil fuel sources. This electricity is distributed by the eThekwini Municipality, which purchases it from Eskom. The municipality has the opportunity and responsibility to demand less carbon-intensive electricity from its suppliers. The purpose of this programme is to ensure 100% of electricity purchased by the eThekwini Municipality is produced from renewable energy sources. This will be achieved by supporting independent power producers in Durban, creating an enabling environment for energy wheeling through eThekwini Municipality's electricity distribution grid, and lobbying the National Government to allow municipalities to actively participate in the generation, distribution, and purchase of renewable energy. The projects included in this programme are: 1.1) Develop and implement a support programme for independent power producers in Durban 1.2) Establish an Independent Power Producer Office within the eThekwini Municipality 1.3) Create an enabling environment for energy wheeling through eThekwini Municipality's electricity distribution grid by 2030 1.4) Develop communication material to lobby the National Government to allow

Programme Title	Programme and Projects
	municipalities to actively participate in the planning, generation, distribution, and purchase of renewable energy
2) Ensure 70% of private electricity demand in Durban is supplied by renewable energy generated locally (in Durban and KwaZulu-Natal) by 2050	The eThekwini Municipality is the primary distributor of electricity in Durban. Currently, electricity is mostly bought in bulk from Eskom, which primarily uses fossil fuels to generate it. The purpose of this programme is to ensure that 70% of private electricity demand in Durban is supplied by renewable energy generated locally or in KwaZulu-Natal. This will be achieved by developing a municipal by-law, using innovative financial instruments and embedded generation tariffs, capacitating a dedicated alternative energy department, piloting alternative energy options, and rolling out a smart grid with bidirectional metering. The projects included in this programme are: 2.1) Implement recommendations from the Durban Strategic Renewable Energy Roadmap and Integrated Resource Plan 2.2) Develop and implement a Municipal by-law requiring 70% of the eThekwini Municipality's electricity purchases to be supplied by renewable energy sources by 2050. 2.3) Establish and capacitate a dedicated alternative energy department within the eThekwini Municipality's Electricity Unit 2.5) Design and implement residential, commercial, and industrial embedded generation tariffs 2.6) Pilot the implementation of a basket of alternative energy options in informal settlements and low- to middle-income households headed by both women and men 2.7) Roll out a smart grid across Durban by 2030 that includes bidirectional metering 2.8) Implement a project to reduce industrial-sector emissions in Durban by 70% by 2050
3) Reduce electricity consumption by 40% by 2050 across residential, commercial, municipal, and industrial consumers	Reduction of electricity usage is one of the most cost-effective climate change mitigation interventions. The purpose of this programme is to reduce electricity consumption in Durban by 40% by 2050 across all sectors. This will be achieved by enacting energy efficiency and carbon neutrality by-laws, encouraging the adoption of Energy Management Systems, developing innovative financing instruments and precinct-scale guidelines for energy efficiency, and expanding existing electricity saving awareness campaigns. The projects included in this programme are: 3.1) Develop and implement a project to achieve energy efficiency saturation in all existing industrial and commercial buildings in Durban by 2030 3.2) Develop and implement net-zero carbon regulations for new buildings by 2030 (C40 New Buildings Programme) 3.3) Implement a project to promote the widespread adoption of Energy Management Systems in Municipal and commercial environments in Durban 3.4) Implement a pilot project to develop an neighbourhood energy management model in Durban that can be scaled up and replicated 3.5) Expand the existing electricity-saving awareness campaigns in Durban and ensure that both women and men are targeted
4) Transform eThekwini Municipality's infrastructure to a net-zero carbon footprint	The eThekwini Municipality can play a leading and demonstrative role in transitioning infrastructure to a net-zero carbon footprint. The purpose of this programme is to transform the Municipality's infrastructure to a net-zero carbon footprint by conducting energy audits, implementing energy efficiency retrofits, and deploying small-scale embedded generation facilities on Municipal infrastructure. The projects included in this programme are: 4.1) Develop and implement a coordinated project to achieve carbon neutrality for all Municipal infrastructure in Durban 4.2) Develop and implement a solar panel installation project at various reservoir sites. 4.3) Develop and implement hydropower project along the Western Aqueduct.

6.2 Waste and pollution

6.2.1 Context

In urban areas, risks associated with air pollution are expected to increase due to climate change [176]. Predicted increases in temperatures due to climate change are forecast to decrease air quality and increase the speed at which waste breaks down [177]. Methane, a potent greenhouse gas that exacerbates climate change, is released from landfill sites and wastewater treatment works, but it can be captured and used for energy generation [178]. In addition, the management of waste and pollution (air, soil, water, light and noise) through recycling, re-use, reduction and energy recovery is important for climate change mitigation [179]. Some climate change mitigation measures may increase air pollution in Durban [180].

In Durban, waste management services are provided by the eThekwini Municipality and the Bisasar Road, Mariannhill, Illovu and Buffelsdraai landfills are the main solid waste disposal sites [181]. An increasing population, a growing middle class and increasing levels of consumption are increasing the levels of waste and pollution generated in Durban [182]. In addition, the waste management sector (solid waste and wastewater facilities) generates a small amount of Durban's greenhouse gas emissions [183]. Air pollution and greenhouse gas emissions are exacerbated in Durban through the significant release of air pollutants by many sectors, especially transport, industry, biomass burning and limited localised energy generation [184].

Predicted increases in temperature due to climate change are expected to accelerate the breakdown of waste and the release of methane and worsen air pollution in Durban [185]. Also, predicted increases in the frequency and severity of climate-related hazards could result in more waste being washed into rivers and the sea, and the damage or loss of waste and stormwater management infrastructure [186]. Sea level rise due to climate change may also damage waste and stormwater infrastructure.

Measures to improve efficiencies in the waste sector in Durban have been implemented by eThekwini Municipality including 23 recycling centres, waste awareness and education programmes,

[176] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
[177] Botes and McKenzie, 'Durban Climate Change Strategy – Waste and Pollution Theme Report'; EThekwini Municipality, 'Durban Climate Change Strategy'.
[178] EThekwini Municipality, 'Durban Climate Change Strategy'.
[179] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
[180] EThekwini Municipality, 'Durban Climate Change Strategy'.
[181] EThekwini Municipality, 'Durban Climate Action Plan 2019'; EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.
[182] EThekwini Municipality, 'Durban Climate Change Strategy'; EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[183] Botes and McKenzie, 'Durban Climate Change Strategy – Waste and Pollution Theme Report'.
[184] Botes and McKenzie.
[185] Botes and McKenzie.
[186] Botes and McKenzie.

gas-to-energy projects at the Bisasar Road and Mariannhill landfill sites, and a waste separation at source initiative [187]. The municipality has also developed an Integrated Waste Management Plan, a recycling and waste minimisation model, waste management and environmental pollution control programmes and promulgated a waste removal by-law [188].

6.2.2 Waste and pollution summary

The existing programmes to reduce waste and pollution in Durban require extensive expansion to achieve significant reductions in pollution and the amount of waste sent to landfill.

6.2.3 Waste and pollution targets

The following targets are proposed for the waste and pollution sector.

Table 26: Proposed targets for the waste and pollution sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Divert 50% of waste from landfill sites by 2023 and 90% by 2050	10% of waste disposal is diverted from landfill sites	50% of waste disposal is diverted from landfill sites	90% of waste disposal is diverted from landfill sites
2) Reduce 50% of greenhouse gas (GHG) emissions from waste by 2030 and 90% by 2050	20% of greenhouse gas emissions from waste reduced compared to a 2020 baseline	50% of greenhouse gas emissions from waste reduced compared to a 2020 baseline	90% of greenhouse gas emissions from waste reduced compared to a 2020 baseline

6.2.4 Waste and pollution programmes and projects

The following section summarises key programmes and projects that are proposed for the Waste and Pollution sector. The details of these projects are provided in the accompanying implementation plan.

Table 27: Proposed programmes and projects for the waste and pollution sector

Programme Title	Programme and Projects
1) Divert 50% of waste from landfill sites by 2023 and 90% by 2050	Methane emissions from waste contribute significantly to GHG emissions. The purpose of this programme is to divert waste from landfill sites, thereby reducing GHG emissions while achieving the national Phakisa Programme targets. This will be achieved by increasing recycling infrastructure, expanding the waste separation-at-source programme, encouraging waste avoidance, and reducing, reusing and recycling waste. The projects included in this programme are: 1.1) Expand the existing recycling infrastructure in Durban to scale up local recycling efforts 1.2) Expand the waste separation-at-source project across Durban 1.3) Implement a project to reduce consumer and manufacturing waste in Durban 1.4) Create an enabling environment project for cross-sectoral involvement in waste reduction in Durban

[187] EThekwini Municipality, 'Durban Climate Action Plan 2019'.
[188] EThekwini Municipality, 'Integrated Development Plan - 5 Year Plan: 2017/18 to 2021/22 - 2019/2020 Review'.

Programme Title	Programme and Projects
2) Reduce 50% of greenhouse gas (GHG) emissions from waste by 2030 and 90% by 2050	There are several interventions in the waste sector (over and above diverting waste from landfill) that can reduce GHG emissions. The purpose of this programme is to reduce GHG emissions from waste by 50% by developing a refuse collection optimisation model, constructing a new waste-to-energy facility, and establishing composting plants in Durban. The projects included in this programme are: 2.1) Construct a new landfill gas utilisation facility in Durban 2.2) Establish an organic waste treatment facility for biogas off-take and agricultural use 2.3) Develop and implement a refuse collection-optimisation model for Durban by June 2021 2.4) Establish composting plants at suitable landfill sites in Durban

6.3 Transport

6.3.1 Context

Transport is one of the most significant contributors to air pollution and greenhouse gas emissions, globally. In 2014 transport contributed 20.15% of the total global carbon dioxide equivalent emissions from fuel combustion [189]. As the global population, together with production and consumption grow, the rise in the demand for transport will result in a rapid increase in air pollutants such as carbon dioxide, methane, nitrogen oxides and other particulate matter [190].

In Durban, the transport sector is currently the most significant contributor to GHG emissions [191]. In 2017, the transport sector, which includes on-road and off-road vehicles as well as air and marine transport systems, was collectively responsible for 40% of the total emissions produced in Durban [192]. The large contribution of transport to GHG emissions is to be expected since Durban is a port city and transport is a key sector in Durban's economy and accounts for 16% of the total gross domestic product for Durban [193]. Furthermore, the legacy of apartheid spatial planning with its resulting urban sprawl means that most of Durban's residents must travel extended distances to access employment.

To address transport emissions, the eThekwini Municipality is implementing the Integrated Public Transport Network (IPTN) and has long-term plans to transform the municipal vehicle fleet to low-emission vehicles, with a focus on electric and hybrid vehicles [194].

[189] Ritchie and Roser, 'CO_2 and Greenhouse Gas Emissions'.
[190] Ritchie and Roser.
[191] EThekwini Municipality Energy Office, 'EThekwini Greenhouse Gas Emissions Inventory 2017 Summary Report'.
[192] EThekwini Municipality Energy Office, 'EThekwini Greenhouse Gas Emissions Inventory 2017 Technical Report'.
[193] EThekwini Municipality, 'Durban Climate Change Strategy'.
[194] EThekwini Municipality, 'Durban Climate Action Plan 2019'.

6.3.2 Transport summary

Transport in Durban accounts for a significant amount of Durban's GHG emissions. Extensive efforts are needed to reduce travel demand, increase the use of public transport and non-motorised transport, and initiate a shift to low-emission vehicles.

6.3.3 Transport targets

The following targets are proposed for the transport sector.

Table 28: Proposed targets for the transport sector

Programme Title	Short-term – 2025 Target	Medium-term - 2030 Target	Long-term - 2050 Target
1) Promote transit-oriented development (TOD) in line with the Built Environment Performance Plan targets	20% of TOD Built Environment Performance Plan targets achieved	50% of TOD Built Environment Performance Plan targets achieved	100% of TOD Built Environment Performance Plan targets achieved
2) Facilitate switching all vehicles registered in Durban to low-carbon vehicles	5% of low-carbon vehicles registered in Durban	20% of low-carbon vehicles registered in Durban	70% of low-carbon vehicles registered in Durban
3) Implement travel-demand measures to reduce existing private car trips by 50%	15% reduction in existing private car trips	55% reduction in existing private car trips	70% reduction in existing private car trips
4) Provide and maintain high-quality active mobility and non-motorised transport (NMT) infrastructure and increase their use by 30%	10% increase in the use of NMT infrastructure	30% increase in the use of NMT infrastructure	50% increase in the use of NMT infrastructure
5) Facilitate a freight shift from road to rail	5% of road freight shifted to rail compared to an agreed-upon baseline	30% of road freight shifted to rail compared to an agreed-upon baseline	50% of road freight shifted to rail compared to an agreed-upon baseline

6.3.4 Transport programmes and projects

The following section summarises key programmes and projects that are proposed for the transport sector. The details of these projects are provided in the accompanying implementation plan.

Table 29: Proposed programmes and projects for the transport sector

Programme Title	Programme and Projects
1) Promote transit-oriented development	Transit-oriented development (TOD) ensures that development within the city is concentrated around transport nodes and routes resulting in far fewer transport trips. The purpose of this programme is to promote TOD by making it a focus of the Integrated Public Transport Network in Durban, and by implementing Durban's Densification Strategy. The

Programme Title	Programme and Projects
(TOD) in line with the Built Environment Performance Plan targets	projects included in this programme are: 1.1) Review and amend land uses and schemes to align principles of transit-oriented development (TOD) with C3 corridor of the Integrated Public Transport Network (IPTN) in Durban 1.2) Implement a programme to ensure there are higher residential densities within transport corridors and nodes, starting with the C3 corridor of the Integrated Public Transport Network (IPTN) in Durban
2) Facilitate switching all vehicles registered in Durban to low-carbon vehicles	Already the international trend in vehicle manufacturing is towards electric and other low-carbon technologies. The purpose of this programme is to facilitate a transition of all municipal and privately-owned vehicles registered in Durban to low-carbon alternatives. This will be achieved by supplying low-carbon transport infrastructure, awareness-raising campaigns related to low-carbon advantages and fuel efficiency, training to enable small businesses to service zero- and low-emission vehicles, and developing communication materials to lobby the National Government. The projects included in this programme are: 2.1) Develop and implement a project to facilitate the transition of 100% of vehicle-based feeder trips in Durban to low-carbon options by 2050 2.2) Change the procurement policy to transition all eThekwini Municipality's fleet and procured vehicles to low-carbon options by 2050 2.3) Develop and implement a project to supply low-carbon transport infrastructure in Durban 2.4) Roll-out awareness-raising campaigns and outreach initiatives related to low-carbon and fuel-efficiency in Durban aimed at both women and men 2.5) Develop and implement training for small businesses, led by both women and men, in Durban to enable them to service zero- and low-emission vehicles 2.6) Develop communication materials to lobby National Government to enforce the target of switching 70% of vehicles to zero-emission vehicles by 2050
3) Implement travel-demand measures to reduce existing private car trips by 50%	A very effective intervention to reduce GHG emissions from transport is to reduce the need for travel. The purpose of this programme is to reduce existing private car trips by 50% in Durban. This will be achieved by establishing ultra-low emission zones in Durban and limiting entry by vehicles using fossil fuels into such zones, establishing a dedicated metro police unit to enforce compliance with demarcated emission zones, and by promoting and rewarding ride-sharing and public transport use. The projects included in this programme are: 3.1) Develop a policy to establish ultra-low emission zones within public transport corridors in Durban and limit the entrance of vehicles using fossil fuels into such zones 3.2) Establish a dedicated unit in the Durban Metropolitan Police Service/Precinct Management to enforce compliance with demarcated emission zones in Durban 3.3) Implement a programme to increase public transport ridership in transport corridors and nodes starting with the C3 corridor of the Integrated Public Transport Network (IPTN) in Durban 3.4) Implement a project to promote working from home to reduce travel demand
4) Provide and maintain high-quality active mobility and non-motorised transport (NMT) infrastructure and increase their use by 30%	The purpose of this programme is to increase the use of active mobility and non-motorised transport (NMT) in Durban by implementing eThekwini Municipality's Non-Motorised Transport Plan and supporting the human-powered transport of goods within key commercial nodes in Durban. The projects included in this programme are: 4.1) Continue to implement eThekwini Municipality's Non-Motorised Transport (NMT) Plan 4.2) Develop and implement a project to support the human-powered transport of goods within key commercial nodes in Durban

Programme Title	Programme and Projects
5) Facilitate a freight shift from road to rail	The purpose of this programme is to facilitate the shift of freight from road to rail by developing inland intermodal hubs and advocating for improved freight rail infrastructure. The projects included in this programme are: 5.1) Develop spatial plans for inland intermodal hubs on the major transport routes in Durban 5.2) Advocate for National Government and Transnet to facilitate the transition from road to rail for freight

7 Way forward

Cities, like Durban, are where climate change is made real. They are areas where most greenhouse gas emissions occur. The most severe impacts of climate change will be felt in cities and these will place additional strain on an already stressed environment and the city's social and economic systems. At the same time, new opportunities associated with climate change response will almost certainly be realised in cities where markets and people aggregate. As a result, cities have a key role to play in preparing for climate change.

Durban has been preparing for climate change for several years. The city has made significant strides in research and policy development as well as the implementation of innovative programmes, particularly in the water sector. However, there are also gaps in these preparations. Cross-sectoral stakeholder structures need to be established, access to climate financing needs to be improved, and communication and awareness-raising for all citizens needs to become a key focus. This revised strategy addresses some of these gaps by introducing an enabling theme as the foundation for cross-sectoral and multi-stakeholder participation in Durban's climate change responses. Once these foundations are in place, the sector-specific programmes and projects outlined in the adaptation and mitigation themes contained in this strategy will be able to flourish.

But a strategy is only as good as the change it ultimately affects. Going forward, Durban must focus on the implementation of this climate change strategy. The targets, programmes and projects have been set and revised. In the future, the details will continue to be revised and updated as programmes evolve. However, the broad principles and strategic requirements are clear. We need to build our environmental, social and economic systems to take into account a changing world. We must seize new opportunities to enable us to leapfrog traditional developmental stages.

Most importantly, the eThekwini Municipality cannot do it alone. The municipality has a key role to play in creating an enabling environment for climate change response to take place. This strategy is a key component of that enabling environment. However, for Durban to fully prepare for the dramatic shifts required by climate change, everyone in the city must work together. We need to collaborate and support one another to transform Durban's governance, social, developmental and economic systems to effectively respond to climate change. Only then can we take our place as Africa's most caring and liveable city in a climate-changed future.

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Annex 1: Table of Acronyms

Acronym	Definition
CAP	Climate Action Plan
CEBA	Community Ecosystem-based Adaptation
CO_2	Carbon dioxide
COP	Conference of Parties
COP17	The seventeenth Conference of the Parties – held in Durban in 2011 by the United Nations Framework Convention on Climate Change (UNFCCC)
CRISP	Climate Resilience Implementation Spatial Plan
D'MOSS	Durban Metropolitan Open Space System
DCCS	Durban Climate Change Strategy
DEA	Department of Environmental Affairs (now the Department of Environment, Forestry and Fisheries)
EMCCC	eThekwini Municipality Climate Change Committee
GHG	Greenhouse gas
HIV	Human Immunodeficiency Virus
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
IPTN	Integrated Public Transport Network
LOS	Level of service
LSM	Living Standards Measure
MDGs	Millennium Development Goals
MEPS	Minimum Energy Performance Standards
NAAQS	National Ambient Air Quality Standards
NCCAS	National Climate Change Adaptation Strategy
NCCRWP	National Climate Change Response White Paper
NDC	Nationally Determined Contributions
NERSA	National Energy Regulator of South Africa
NMT	Non-motorised transport
RCP	Representative Concentration Pathway
SACN	South Africa Cities Network
SALGA	South African Local Government Association
SCA	Systematic Conservation Assessment
SDF	Spatial Development Framework
SDGs	Sustainable Development Goals
SMME	Small, medium and micro-sized enterprises
SSEG	Small-scale renewable energy generator
SUDS	Sustainable urban drainage systems
tCO_2e	Tonnes of carbon dioxide equivalent
TOD	Transit-oriented development
TTT	Technical Task Team
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States Dollar
UV	Ultraviolet
WHO	World Health Organization
ZAR	South African Rands

Annex 2: Common Terms[195]

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

Adaptive capacity
The potential or ability of a system, region, or community to adapt to the effects or impacts of climate change.

Ecological infrastructure
Naturally functioning ecosystems that deliver valuable services to people, such as climate regulation, water provision, improved water quality, flood management and fertile soils. It is the nature-based equivalent of built infrastructure and is as important in supplying basic services, socio-economic opportunities, and in underwriting human well-being (eThekwini Municipality 2014).

Ecosystem-based adaptation
Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change. Ecosystem-based adaptation uses the range of opportunities for the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change [196].

Gini coefficient
A measure of inequality of the distribution of income among individuals within a country. The higher the number is, the higher the inequality in that country is. A value of 0 represents a perfectly equal society, whereas a value of 1 indicates a highly unequal society (eThekwini Municipality 2014).

Green economy
An economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low-carbon, resource-efficient and socially inclusive (eThekwini Municipality 2014).

Greenhouse gases (GHGs)
Greenhouse gases are the gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared

[195] The majority of these definitions are from the Intergovernmental Panel on Climate Change (IPCC) report, entitled, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. For definitions taken from alternative sources, the specific reference is provided at the end of the definition.
[196] Secretariat of the Convention on Biological Diversity, 'Connecting Biodiversity and Climate Change Mitigation and Adaptation'.

radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are some entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol. Besides CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) [197].

Integrated Development Plan (IDP)
In terms of South Africa's Local Government: Municipal Systems Act (No. 32 of 2000), an IDP is defined as a strategic planning instrument that guides and informs all municipal planning and development in the municipality. It is a five-year plan that consists of a long-term vision and details the development priorities and objectives that contribute to achieving this vision. These are implemented through the allocation of budget linked with the IDP (eThekwini Municipality 2014).

Mitigation (of climate change)
A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Nature-based solutions
Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits [198].

Resilience
The capacity of social, economic and environmental systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.

Storm surge
The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place.

Sustainable urban drainage systems (also called sustainable drainage systems)
Sustainable drainage systems or sustainable urban drainage systems are a sequence of management practices and control structures or technologies designed to drain surface water more sustainably than conventional techniques [199].

Tonnes of carbon dioxide equivalent (tCO_2e)

[197] IPCC, 'Annexure II: Glossary'.
[198] IUCN, 'Nature-Based Solutions'.
[199] Armitage et al., 'Alternative Technology for Stormwater Management'.

A measure to describe how much global warming a given type and amount of greenhouse gas may cause, using an equivalent amount of carbon dioxide (CO_2) as the reference (i.e. CO_2e). For example, methane is a greenhouse gas with a stronger effect on climate change than CO_2. To compare it with the effect of CO_2, it is converted into CO_2e. In this way, it is possible to say that 1 tonne of methane has the same effect on climate change as 25 tonnes of CO_2, or 1t methane = 25 tCO_2e (eThekwini Municipality 2014).