Addis Ababa (2021-2025)
CLIMATE ACTION PLAN

Towards a Climate Resilient, Inclusive, Carbon Neutral City by 2050

Prepared by:

Addis Ababa Environmental Protection and Green Development Commission
in collaboration with C40 Cities Climate Leadership Group

ETHIOPIA

C40 CITIES

ADDIS ABABA
THE CITY THAT CARES

Message from the Mayor

Addis Ababa has rapidly grown into being the largest economic, educational and administrative centre of the Republic of Ethiopia. Addis is also commonly referred to as the 'African Capital' as a result of its historical, diplomatic and political significance in the African continent.

The city accounts for one fourth of the country's urban population and contributes more than quarter of the national Gross Domestic Product (GDP) with the service industry dominating a GDP , followed by industry and agriculture .

With the city's rapid growth and expansion as a result of urbanization, it is imperative to look into both developmental and environmental issues that impact the lives of urban residents and take bold actions in building a clean, safe, inclusive and resilient city while adapting to the impacts of climate change.

Climate change is one of the major threats in Addis with more frequent flooding events, extreme precipitation and temperatures resulting in heat waves and droughts among other climate hazards being experienced in the city. These climate hazards pose a significant threat to the development of the capital and also to the national climate change objectives and vision of becoming carbon neutral nation and achieving a middle-income status with a climate-resilient green economy by 2030.

As such, the Addis Ababa City Administration and the Addis Ababa Environmental Protection and Green Development Commission (AA EPGDC) have been working with C40 Cities Climate Leadership Group to develop its work on both mitigation and adaptation and produce the first Climate Action Plan (CAP) for the city. This plan of action on how to address the climate change challenge provides a package of sectoral climate change mitigation and adaptation strategies, actions, pathways and implementation roadmaps for building a sustainable, emissions neutral and resilient Addis - in line with the UN Sustainable Development Goals (SDGs) and objectives of the Paris Agreement.

This plan of action focuses on key high impact, practical actions that can significantly reduce GHG emissions in the city from the waste, energy, buildings, industry and transport sectors while building a city that can adapt to the impacts of a changing climate and deliver multiple co-benefits to the city's urban residents.

In addition, in the face of the COVID 19 pandemic, Addis Ababa is fully aware of the grim implications of the epidemic on the efforts of tackling climate change, building a green, sustainable economy and improving peoples' lives. Cognizant of these implications and the need for a green recovery to salvage the threatened sustainable development objectives, Addis has embarked on a path that puts forth critical actions that are aimed at addressing the global health epidemic while grappling with the climate change challenge to protect the lives and livelihoods of the most vulnerable urban residents – as cities are the epicenters of the epidemics globally.

The CAP development process encompassed the preparation of a series of reports including the Climate Change Risk Assessment (CCRA) Report that provides the city's plan of action on how to adapt to climate change and build the city's resilience and adaptive capacity.

I would like to thank C40 Cities Climate Leadership for the continued and relentless support in our work in addressing climate change, the consultants who have been fundamental in undertaking key actions together with city teams at Addis Ababa Environmental Protection and Green Development Commission (AA EPGDC) and other entities, partners and stakeholders for their contribution in the preparation of this document.

Adanech Abiebie
Mayor of Addis Ababa

Message from the Executive Director C40 Cities Climate Leadership Group

C40's Deadline 2020 Programme supports the world's leading cities to meet the objectives of the Paris Agreement. C40 works with its member cities to help them develop Paris Agreement compatible climate action plans that if implemented with the speed required will help the world limit global temperature rise to 1.5°C above pre-industrial levels.

Addis Ababa is one of the 11 cities in Africa which are part of the Deadline 2020 Programme, the city's plan outlines ambitious and transformational actions to cut greenhouse gas emissions from the transport sector and transition the city towards clean mobility and non-motorized transport, enhance building energy efficiency, foster the use of sustainable and green energy, and promote waste and waste-water management, while building resilience of the city to the impacts of the climate crisis.

The 14 mitigation and 20 adaptation priority actions identified during the climate action planning process in Addis are meant to steer the city towards a carbon-neutral, resilient pathway creating an equitable and inclusive city. Addis aims to transition to a green economy in the face of the COVID-19 pandemic – reducing emissions whilst creating good green jobs, a healthier environment and a more liveable city.

The COVID-19 pandemic has exposed critical urban inequities and gender inequalities that exist when it comes to addressing the public health crisis in Africa. African cities are the most vulnerable to the climate crisis and the pandemic exacerbates the situation bringing to light the compounding impacts of climate change and COVID-19. Cities are therefore on the frontlines of addressing both crises through creative solutions with the full recognition that actions in response to COVID can also transform cities to be greener and more climate-resilient to impacts of climate change.

The creation of new bike lanes in Addis to reduce the risk of COVID-19 transmission and decrease congestion, pollution, and greenhouse gas emissions is a good example of how Addis is taking initiative and planning for safer streets for pedestrians and cyclists and fostering public transport during and after the pandemic to improve mobility and foster inclusive urbanization.

I would like to recognize and appreciate the effort of the Mayor of Addis Ababa, Adanech Abiebie, for her remarkable and continued leadership in climate action planning and for being on the forefront in tackling the climate crisis. The Mayor's commitment to support Addis in developing an ambitious, equitable, and inclusive plan of action serves as a guide to other cities within Ethiopia and Africa on how to effectively address the challenge of climate change focusing action on where greenhouse gas emissions are energy and buildings, transport and waste sectors.

C40 aims at pursuing continuous engagement with the city of Addis Ababa to actualize this plan of action and achieve bespoke ambitious climate targets set out in this transformational plan.

Mark Watts
Executive Director
C40 Cities Climate Leadership Group

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1. Introduction

1.1

Climate Change in the Global Context

Climate change is the greatest environmental challenge of the 21st century. Changes in the Earth's climate systems have been driven by the significant increase in GHG emissions since the industrial revolution. It is reported that the global average temperature increase has reached approximately 1°C higher than pre-industrial levels, equating to a 0.2°C increase per decade, with some regions experiencing warming greater than the global average.[1]

The impacts of this increase are already being felt in many parts of the world, in the form of severe events such as rainfall, flooding, storms and sea level rise, extreme temperatures, heatwaves, droughts and fires – with multiple knock-on effects on human society as well as natural ecosystems. For example, climate change affects all sectors of the global economy, including agriculture, health, water, energy, transport, waste and industry. Climate change can also have costly impacts on infrastructure, basic services, housing, public health and human livelihoods.

According to the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the climate will continue changing for decades to come. Additional warming of the planet, even by 0.5°C, is expected to amplify both the likelihood and severity of adverse events. As such, it jeopardizes the achievement of the UN Sustainable Development Goals (SDGs) and economic prosperity of nations around the world.[4]

Tackling climate change, therefore, is a global responsibility that requires collaboration at the international, national and local levels to effect long-standing transformational change. Global commitments, namely the Paris Agreement (2015), have been put in place to try and limit temperature increases to 1.5°C, which serves as the benchmark for the climate action planning work in Addis Ababa.

To achieve this, it is crucial to mitigate global warming by reducing greenhouse gas (GHG) emissions. However, it is equally important to build the resilience and adaptative capacity of communities, institutions and systems to cope with the effects of climate change.

Climate Change in Ethiopia

In Ethiopia, climate change is expected to contribute towards a range of effects, including higher temperatures, more variable rainfall patterns, flooding, and droughts.

Evidence suggests that mean annual temperatures have already increased by 1.3°C between 1960 and 2006, with an average rate of 0.28°C per decade.[2] The frequency of hot days and nights has also increased, with hot days having increased by **20%** between 1960 and 2003. By contrast, the frequency of cold days has decreased significantly in all seasons except December, January and February.[3]

[1] IPCC. (2019). Global warming of 1.5°C
[2] Irish Aid (2018). Ethiopia Country Climate Risk Assessment Report
[3] Irish Aid (2018). Ethiopia Country Climate Risk Assessment Report
[4] A collection of 17 goals established by the United Nations General Assembly of 2015 for the year 2030

1.2.

Taking Action in Addis Ababa

As centers of commerce, communication, culture and innovation, cities are the biggest contributors to climate change and consequently, must play a leading role in climate change mitigation and adaptation. Addis Ababa, the capital city of Ethiopia, is taking bold actions in meeting the objectives of the Paris Agreement and the country's climate change objectives. Addis Ababa has developed its first Paris Agreement **Compatible Climate Action Plan(CAP)** that depicts the city's commitment to tackle climate change and build resilience to its now-inevitable impacts.

VISION OF THE ADDIS ABABA CLIMATE ACTION PLAN

To make the city carbon neutral and resilient to climate change, and set out a 'green path' that safeguards resources for future generations

The CAP identifies key emission sources by sector within the city under the BASIC level of reporting of the Global Protocol for Community-scale Greenhouse Gas Emission Inventories Standard, in order to a set of recommendations and pathways towards an equitable, inclusive, climate resilient and carbon neutral Addis by 2050.

The CAP:

- Identifies city-specific actions in relation to both climate change adaptation and mitigation, that aim to transform the ways in which people in Addis Ababa travel, work and go about their lives;
- Sets targets on how to achieve transformational change in the city by the years 2030, 2040 and 2050;
- Documents the potential emissions reductions that could be achieved by implementing these actions;
- Provides strategic guidance to the Addis Ababa City Administration (AACA), as well as other relevant institutions and departments, on priority interventions; and
- Explains the wider co-benefits for human society and the natural environment that are associated with climate change.

1.3.

Structure of the Climate Action Plan

This structure of the CAP is intended to provide an overarching narrative that not only explains what actions are proposed for Addis Ababa, but also states, in a transparent way, what the process was for developing each action, and what the arrangements will be for ensuring that they are implemented effectively.

SECTION 1 *presents the vision and intention of the CAP*

SECTION 2 *describes the context for climate action in Addis Ababa*

SECTION 3 *summarizes the key pieces of strategic technical evidence that were used as the baseline to inform the CAP development*

SECTION 4 *sets out the goals and targets that Addis Ababa has set for climate change mitigation and climate change adaptation, based on future projections of emissions and climate impacts and the need for ambitious action*

SECTION 5 *presents a holistic 'Climate Action Roadmap' for the key climate mitigation and adaptation sectors, setting out details of the prioritized actions and how they may be implemented*

SECTION 6 *describes the implementation strategy for the CAP, including the current system of climate change governance in Addis Ababa and how this will be utilized and strengthened in order to successfully implement the CAP, and the human resource and financing plan*

SECTION 7 *outlines the proposed approach to monitoring, evaluation and reporting of CAP actions and targets*

Finally, **SECTION 8** *addresses the challenges posed by the global COVID-19 pandemic, and how this links with climate action to ensure a 'green recovery'.*

2

2. Context for climate change action in Addis Ababa

2.1.

City Profile

❖Addis Ababa

Ethiopia

Addis Ababa is the capital city of Ethiopia and plays an important role in the economic development of the country while serving as a center of education, commerce, culture, urbanization, communication and innovation.

The city had a population of 3.3 million as of 2016, accounting for approximately 17% of the country's total population.[5,6] With an estimated growth rate of 3.8% per year, Addis Ababa is anticipated to be home to around 9.8 million people by 2037.[7] In addition to natural population growth, this is due in large part to high rates of rural-urban migration, as people come from all over the country to seek employment opportunities and services. The rapid increase is placing additional pressure on the city's infrastructure and resources.[8]

Addis Ababa

Population

3.3 million
(2016)

3.8%
Estimated growth rate per year

9.8 million
(2037)

[5] C40. (2020). Addis Ababa Rapid Climate Risk Assessment.
[6] UN-Habitat. (2017). The State of Addis Ababa.
[7] World Bank. (2015). Addis Ababa, Ethiopia: Enhancing Urban Resilience.
[8] Kotebe Metropolitan University and Addis Ababa Environmental Protection Authority (2018). Addis Ababa City State of the Environment and outlook

Addis Ababa

Economic & industrial contribution

Addis Ababa
Contributes
38% **GDP**

while employing only
15% per capita
of the total workforce

service industry
63%

industry
36%

agriculture
1%

33%
(2003)

unemployment rate

21%
(2016)

Addis Ababa is the main economic and industrial hub in the country. It contributes around 38% towards the national Gross Domestic Product (GDP) which per capita while only employing while 15% of the total workforce.[9] The service industry dominates the GDP share in the city at 63%, followed by industry at 36% and agriculture making up the remaining 1%.[10] The growth in GDP is associated with job creation whereby the city reduced unemployment from 33% to 21% between 2003 and 2016. The Ethiopian Government has a national vision for Ethiopia to become a middle-income country by 2025, and the city of Addis Ababa is likely to play a crucial role in achieving this status.[11]

In terms of the administrative structure, Addis Ababa is governed by the city council, and is further divided in to 11 sub-cities and 129 Woredas (districts). The city council itself is comprised of 18 bureaus, offices and authorities (for more information, see Section 6). As the capital city, Addis Ababa also hosts more than 92 embassies. [12]

Administrative Structure

Governed by:
City Council

11 sub-cities

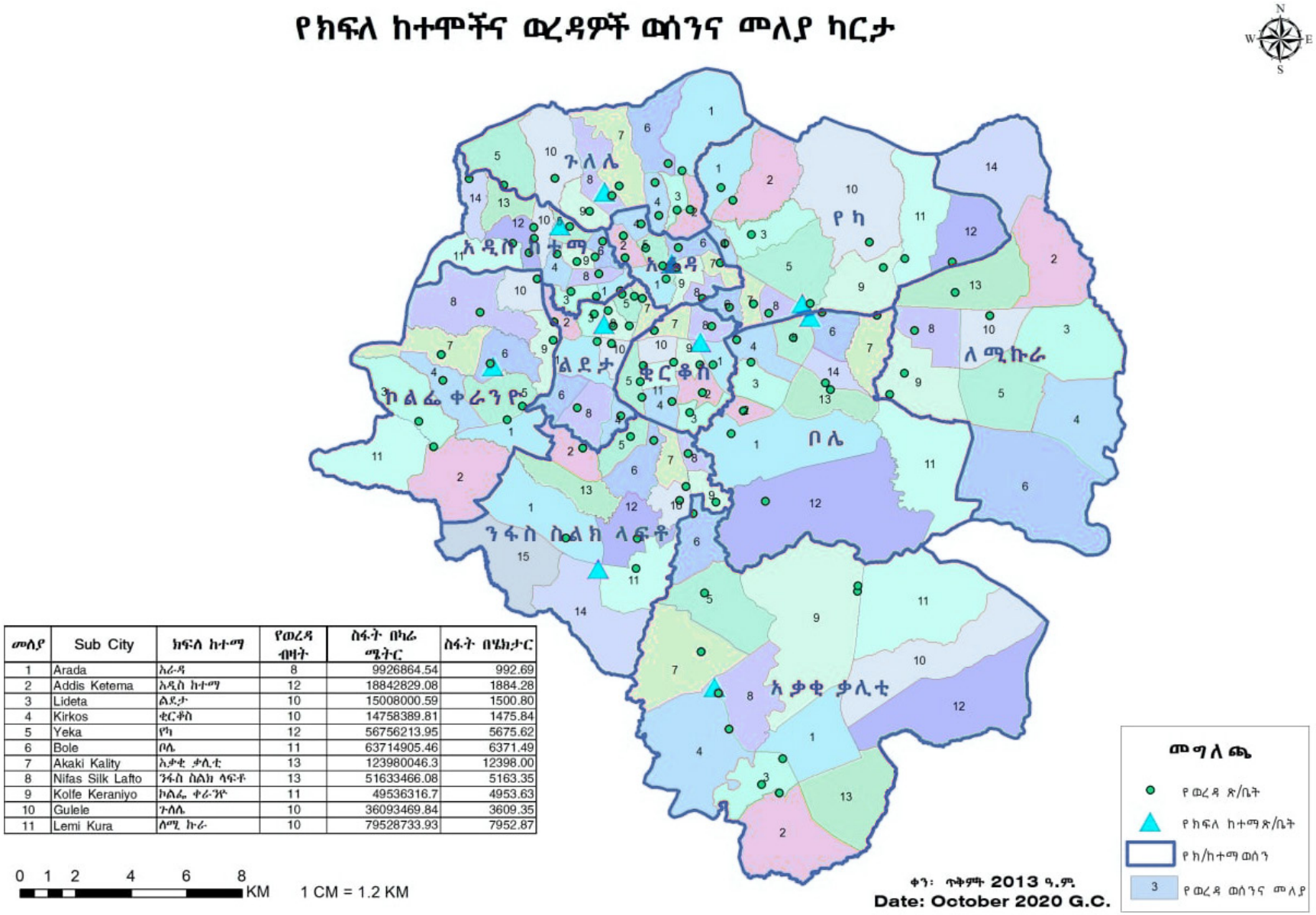
129 Woredas

18 bureaus, offices and authorities

>92 embassies

[9] World Bank. (2017). Country Partnership Framework for the Federal Democratic Republic of Ethiopia for the Period FY18–FY22.
[10] UN-Habitat. (2017). The State of Addis Ababa.
[11] Federal Democratic Republic of Ethiopia. (2016). Growth and Transformation Plan II (GTP II) (2015/16-2019/20). Volume I.
[12] http://www.ethiopia.gov.et/addis-ababa-city-administration

A map of the administrative boundaries



መለያ	Sub City	ክፍለ ከተማ	የወረዳ ብዛት	ስፋት በካሬ ሜትር	ስፋት በሄክታር
1	Arada	አራዳ	8	9926864.54	992.69
2	Addis Ketema	አዲስ ከተማ	12	18842829.08	1884.28
3	Lideta	ልደታ	10	15008000.59	1500.80
4	Kirkos	ቂርቆስ	10	14758389.81	1475.84
5	Yeka	የካ	12	56756213.95	5675.62
6	Bole	ቦሌ	11	63714905.46	6371.49
7	Akaki Kality	አቃቂ ቃሊቲ	13	123980046.3	12398.00
8	Nifas Silk Lafto	ንፋስ ስልክ ላፍቶ	13	51633466.08	5163.35
9	Kolfe Keraniyo	ክልፌ ቀራንዮ	11	49536316.7	4953.63
10	Gulele	ጉለሌ	10	36093469.84	3609.35
11	Lemi Kura	ለሚ ኩራ	10	79528733.93	7952.87

Figure 1: City Boundary, Sub-cities and Woredas Source: AA Planning Development Commission (2020)

2.2.

National Action on Climate Change

When considering a city-scale climate response for Addis Ababa, it is important to account for existing national plans, strategies and targets. An overview is provided below.

The Federal Democratic Republic of Ethiopia, as a signatory to the Paris Agreement, has committed to limiting its net national greenhouse gas (GHG) emissions by 53.5% by 2030 from the 2010 baseline in its updated Nationally Determined Contribution (NDC). The 53.5% encompasses a 12% (unconditional) and 41% (conditional) reduction of GHG emissions compared to a BAU scenario. The updated NDC also includes an adaptation component with about 45 prioritized national adaptation interventions.

The country's mitigation and adaptation efforts are also reflected in the 10-Year Development Plan (2020/21-2029/30) and the Climate-Resilient Green Economy (CRGE) Strategy which sets out the country policy for low-carbon, climate resilient growth and development. The CRGE Strategy not only documents the development pathway for the country to reduce per capita emissions, but also highlights adaptation actions to improve resilience and reduce the vulnerability of Ethiopia's population, economy and environment to climate change impacts. The Strategy is founded on 4 main 'pillars':

- Adopting energy efficient technologies in transport, industry and buildings
- Expanding renewable electricity generation
- Reducing emissions from the agricultural sector
- Protecting and expanding forests

The National Adaptation Plan (NAP) aims at building the adaptative capacity and resilience of the country to climate change impacts in line with the CRGE Strategy and the Second Growth and Transformation Plan (GTP II).

Other relevant plans and strategies that have informed the development of this CAP are:

1. Ethiopia's Climate-Resilient Green Economy Green Economy Strategy (2011)
2. Ethiopia's Climate Resilient Transport Sector Strategy (2017)
3. Ethiopia's Climate-Resilient Green Economy Climate Resilience Strategy: Water and Energy (2015)
4. Ethiopian Energy Authority Indicative Strategic Plan (2019/20 - 2029/30)
5. Ethiopia's Climate Resilient Green Economy Climate Resilient Strategy Agriculture
6. Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa (2014)
7. Central Statistical Agency Population Projections for Ethiopia (2007-2037)
8. Addis Ababa Waste Management Policy (draft Amharic Version)
9. Addis Ababa Structural Plan (2017 – 2027)
10. Ethiopian Transport Policy (draft)
11. Addis Ababa Transport Strategy (draft)
12. Ethiopian Panel on Climate Change (EPPC) First Assessment document
13. Coverage Percentage, Assessment of Availability, Access, Distribution, Quality and Long Term Roadmap of Potable Water Supply and Sewerage in Addis Ababa City
14. Other documents such as the 10 Years Perspective Plan for transport, waste and energy, etc.

Box 1: Plans and strategies used to inform the development of climate actions

At the city level, a number of activities have already been undertaken or are underway, which support or promote climate action. These were important context for CAP preparation, which builds on such existing initiatives – see Box 2.

Major climate actions undertaken in Addis Ababa to date include:

- Tree planting campaign and activities
- Promoting Autonomous Adaptation at the Community Level
- Greening of the city: Sheger beautification project
- Development of the light rail transit system (LRT)
- Development of the Bus Rapid Transit (BRT) – under construction
- Car free days
- Promotion of Walking and Cycling
- Smart Parking as an Instrument to Improve Traffic Flow and Emissions Reduction
- Implementation of 10% ethanol in fuel for gasoline vehicles
- Development of an Air Quality Management Plan (AQMP)
- Climate governance actions, such as:
  - Addis Ababa Environmental Protection and Green Development Commission (AAEPGDC) mandated to regulate the environment and climate change issues in the city
  - AAEPGDC assigning two teams to work on climate mainstreaming and climate smart technologies promotion

Box 2: Addis Ababa climate actions undertaken to date

For more information on how these relate to sector-specific actions, refer to Section 5.

The development of the Addis Ababa CAP builds on the ongoing climate change work and initiatives at the national and city level to build a carbon-neutral and resilient nation by 2050.


NATIONAL THEATRE
PARLAMA
T/HAIMANOT

2.3.

CAP Development Process

2.3.1.

Overview

The Addis Ababa CAP has been developed as part of the Climate Action Planning Africa programme, which was initiated in 2017 by C40 Cities Climate Leadership Group. As part of that programme, Addis Ababa signed up to C40's 'Deadline 2020', pledging to reduce GHG emissions to net zero by 2050. This CAP responds to the specific requirements of the C40 Climate Action Planning Africa programme as it addresses the following:

- Pathways towards delivering GHG emissions neutrality by 2050 (at the latest) with interim targets for the year 2030.
- Details of how the city will adapt, and build resilience, to climate hazards and risks that may impact the city now and in the future.
- The wider socio-economic and environmental co-benefits derived from implementing the actions in this CAP, and ensuring these benefits are distributed to the city's residents and wider population.
- The city's governance and institutional arrangements, powers and resources necessary for implementing this CAP.
- The stakeholder engagement framework necessary for developing and implementing the key actions outlined in this CAP.

The actions presented in this Plan were selected through a process that included reviewing existing plans and strategies which is called the Strategic CAP Appraisal; development of an emissions inventory and review of climate hazards; analysis of future emission trends and climate risks; and a series of discussions and workshops with key stakeholders. These were used to identify and prioritise suitable responses to the challenges of reducing emissions and managing climate risks. Further details are provided below.

2.3.2.

Mitigation Action Development

To develop GHG reduction targets and identify the actions needed to put Addis Ababa on a pathway to deliver its targets, the city needed to identify current and future emissions, and the mitigation potential of different measures, before prioritising actions for inclusion in the CAP.

The process started with the development of the updated GHG inventory and a long-list of existing city and national climate actions during a 'strategic appraisal' stage of the CAP development. This was used as the basis for developing early emission reduction pathways and a long list of climate actions. Three planned workshops were conducted in the city. These actions along with the initial scenarios were validated in the first in-city workshop ('from vision to scenario planning for Addis Ababa', October 2018), to also explore opportunities to enhance ambition and develop additional ambitious actions.

A second stakeholder workshop (July 2019) then assessed these climate actions using a simplified multi-criteria analysis (MCA) with scores and weightings for different action benefits, in order to develop a set of priority actions. A third stakeholder workshop (October 2020) then further identified the most 'implementation ready' actions via a survey process and developed a set of road maps for these actions.

The process for the mitigation evidence base, action identification and CAP development is summarized in **Figure 2**.

GHG (GREEN HOUSE GASES) EMISSION INVENTORY COMPILATION

- Data collection and inventory development
- Climate change capacity building and vision planning
- GHG inventory validation

STAKEHOLDER WORKSHOP #1

EMISSION REDUCTION SCENARIO DEVELOPMENT

- BAU scenario
- Existing policies & actions identification
- Modelling scenarios

STAKEHOLDER WORKSHOP #2

EMISSION TARGETS AND ABATEMENT POTENTIAL DEFINITION & PRIORITISING ACTIONS

- Identifying opportunities to enhance ambition
- Prioritising a shortlist of actions using multicriteria analysis
- Abatement potential of each action confirmed

STAKEHOLDER WORKSHOP #3

IDENTIFYING IMPLEMENTATION-READY ACTIONS

- Roadmapping prioritised actions
- Strategy development
- Benefits assessment

Figure 2: Mitigation action development approach

2.3.3.

Adaptation Action Development

The adaptation actions in this plan started with a Climate Change Risk Assessment (CCRA). The CCRA was conducted via desk-based review of relevant documents on climate change and development in Addis Ababa and Ethiopia. Climate risks were studied, identified and discussed, and key adaptation actions were identified, prioritised and defined.

Two workshops were held with a range of key stakeholders from the city. Stakeholders were identified through the CAP city team (including AAEPGDC team and C40 advisor) and engaged from project inception to ensure that the risk assessment conducted, and adaptation actions identified were salient, credible and legitimate.

The process for the adaptation evidence base, action identification and CAP development is summarised in **Figure 3.**

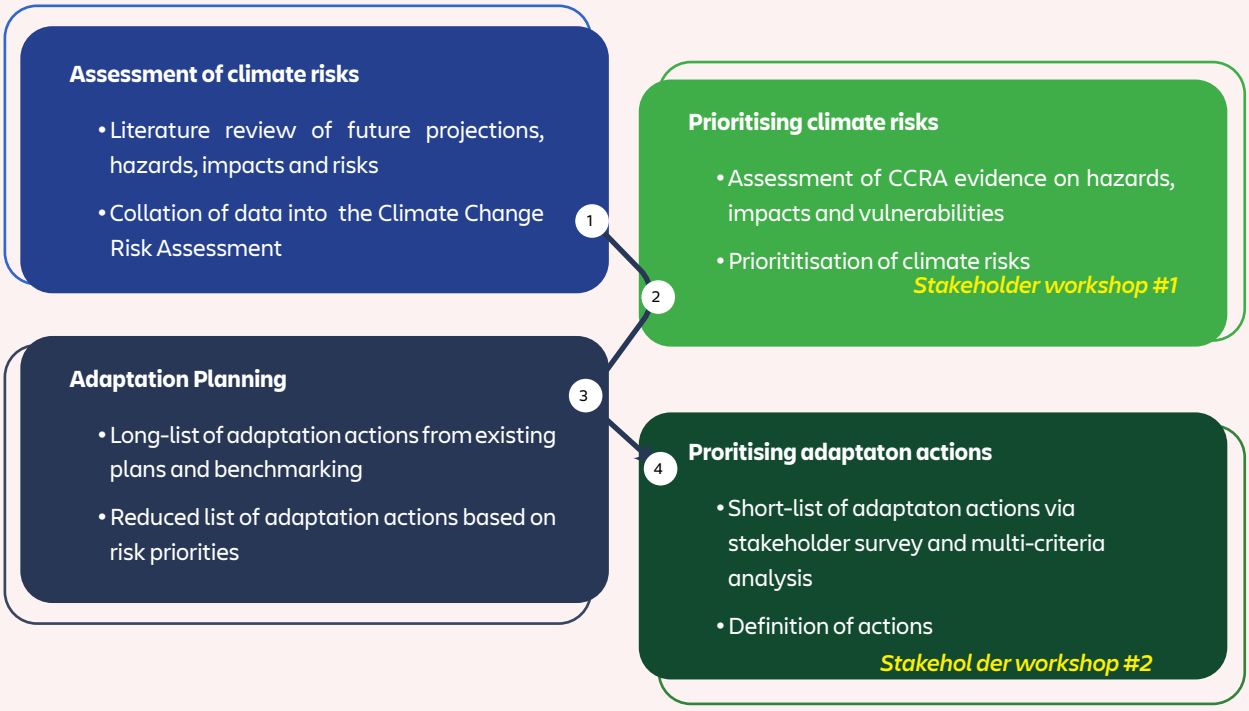


Figure 3: Adaptation action development approach

2.3.4.

Prioritisation of Actions

Prioritising actions is important to ensure that the Addis Ababa City Administration and other stakeholders target resources and fast-track those actions that will deliver the largest reductions in emissions or risks and deliver the greatest benefits. Criteria were used with stakeholders via surveys and participatory multi-criteria analysis processes in order to transparently prioritise climate actions for inclusion in the CAP, including assessing the most 'implementation-ready'. The key criteria is shown in **Figure 4 and 5** below.

Mitigation Action Prioritization Criteria

Stage one:

Criteria to prioritize actions

- GHG abatement potential
- Adaption/resilience potential
- Level of city power and capacity
- Alignment with existing national policies/ plans
- Social acceptability
- Political Acceptability
- Ease of implementation
- Capital Cost
- Operational cost
- Environmental co-benefits
- Social co-benefits

Stage two:

Criteria to identify implementation-ready actions

- Technical skills available
- City ownership / control to implement
- Within existing plans/policies
- Clear leadership and responsibilities
- Effective collaboration
- Legal or regulatory framework in
- Budget secure
- Sufficient resources
- System for management, monitoring and evaluation
- Data available

Figure 4. Mitigation Actions Prioritisation Criteria

NOTE:

Stage 1 of the mitigation action prioritization was undertaken during a facilitated in-person stakeholder workshop, using scoring sheets and an excel matrix

Stage 2 of the mitigation action prioritization was undertaken via a remote 'Mentimeter' survey and then validated in a short stakeholder workshop

Adaptation Action Prioritization Criteria

- ☑ Can reduce emissions
- ☑ Can benefit vulnerable groups
- ☑ Avoided loss (infrastructure)
- ☑ Potential for job creation
- ☑ Benefits the environment
- ☑ Potential for positive economic multipliers
- ☑ Potential pilot in the short term (<5 years)
- ☑ Opportunity to scale/ ease of implementation
- ☑ Enhances local amenities
- ☑ Enhances mobility
- ☑ Reduces heat induced impacts
- ☑ Reduces drought induced impacts
- ☑ Reduces river flood induced impacts
- ☑ Reduces surface flood induced impacts
- ☑ Enhances or protect living (residential) conditions
- ☑ Boosts tourism/visitors/ attract talent
- ☑ Aligns with principles of densification
- ☑ City power to steer/ progress
- ☑ Locally appropriate (culture, values and available skills and technology or solutions)
- ☑ Builds capacity and knowledge of climate change for citizens

Figure 5. Adaptation Actions Prioritisation Criteria

2.3.5.

Summary of Actions

The following provides a summary of the prioritized mitigation and adaptation actions. A small number of 'additional' actions were also identified, which although were not identified as a priority by stakeholders, were agreed to be necessary to achieve the emission reduction targets set out in the CAP.

ACTION	Priority	Additional
Action #M1 - Campaign to Promote the Waste Hierarchy	✅	
Action #M2 – Construct Composting Facilities	✅	
Action #M3 – Enhance Sewage/Wastewater Treatment System	✅	
Action #M4 – Enhance Landfill Management and Install Gas Capture Facilities		✅
Action #M5 – Improving Vehicle Efficiency via Emissions Standards	✅	
Action #M6 – Improve Public Transport Networks	✅	
Action #M7 – Promote Modal Shift to Non-Motorized Transit	✅	
Action #M8 – Enhancing fuel efficiency via switch to hybrid/electric vehicles or biofuels		✅
Action #M9 - Improve Permitting Process for New Buildings	✅	
Action #M10 - Improve Energy Efficiency in Existing Buildings	✅	
Action #M11 - Improve Energy Efficiency in Industrial Facilities	✅	
Action #M12 - Increase/Diversify Renewables in Electricity Generation		✅
Action #M13 - Transition to Efficient cooking stoves		✅
Action #M14 - Upgrade Street Lighting		✅

Table 1: Priority mitigation actions

ACTION
Action #A1: Require new development permitting to account for increasing resilience to flood, drought and extreme temperatures
Action #A2: Increase green vegetated buffers between urban settlement and hazardous areas prone to flooding, landslide and subsidence
Action #A3: Ensure climate change representation on the dedicated Megaprojects Office
Action #A4: Enhance urban greenery with heat and drought tolerant vegetation to combat the loss of green spaces
Action #A5: Rehabilitate deforested areas/water sheds to reduce soil erosion, enhance biodiversity and offer better ecosystem resilience
Action #A6: Provide water for irrigation of nature and greenspaces during heatwaves and droughts
Action #A8: Technical and capacity building activities for urban agriculture farmers
Action #A9: Improve water security through rainwater harvesting and irrigation management for urban agriculture
Action #A10: Improve access to, and quality of, wastewater and sanitation infrastructure
Action #A11: Awareness raising of public health and climate change issues
Action #A12: Provision of preventative healthcare services in relation to vector-borne diseases (VBD)
Action #A13: Update infrastructure design standards for improved resilience in order to undertake a programme of improvements to the infrastructure networks (e.g. transport, waste and sewage networks)
Action #A14: Undertake more detailed hazard mapping of risk areas to infrastructure
Action #A15: Improve the City's urban maintenance response and emergency response capacity
Action #A16: Smart Grid to create energy efficient electricity distribution networks within the City
Action #A17: River basin and watershed management to protect both hydropower potential and water resources
Action #A18: Protecting rivers from solid waste, debris and harmful diffuse / pollution discharges
Action #A19: Efficient wastewater treatment and stormwater management
Action #A20: Accelerate urgently required water supply investments into water insecure and underserved areas

Table 2: Priority adaptation actions

2.3.6.

The Role of Stakeholder Engagement

Stakeholder engagement has been deployed throughout the climate action planning process in Addis Ababa as a key element of modern administration and decision making. It is necessary to improve governmental transparency and the quality of decision-making, promote public trust and a sense of ownership in the process, and ensure the fairness and effectiveness of interventions. This approach is in line with the legal requirements for public participation in Ethiopia.

Figure 2 and Figure 3 (above) highlight instances during the CAP development process where stakeholder engagement played a prominent role – most notably during the action prioritization process (described further in Section 2.3.4 above) A full list of stakeholders that were involved in the CAP process is set out in the table below.

Table 3: Stakeholders involved in the CAP Process

Addis Ababa City Level Institutions

- Construction Bureau
- Environmental Protection and Green Development Commission
- Health Bureau
- Solid Waste Administration Agency
- Transport Authority
- Transport Bureau
- Water and Sewerage Authority
- Watershed and Green Environment Development Agency
- Drivers and Vehicle Licensing and Control Authority
- Finance and Economic Bureau
- Fire and Disaster Risk Management Commission
- Housing Development Agency
- Trade and Industry Development Bureau
- Labor and Social Affairs
- Planning and Development Commission
- Resilience Project
- River and Riverside Development Project Office
- Addis Ababa Science and Technology University
- Solid Waste Administration Agency
- Transport Programme Management Office
- Addis Ababa Women and Children Affairs Bureau
- Addis Ababa Urban Productivity Safety Net Programme
- Addis Ababa Farmers and Urban Agriculture Development Commission
- Addis Ababa Road Authority
- Sub-cities Environment and Climate Change Focal Experts

National Level Institutions

- Central State Agency
- Environment, Forest and Climate Change Commission
- Ethiopia Academy of Science
- Ethiopia Energy Authority
- Ethiopian Electricity Utility
- Ethiopia Environment Forest Research Institute
- Federal Transport Authority
- Ministry of Trade and Industry
- Ministry of Transport
- Ministry of Urban Development and Construction
- Ministry of Water Irrigation and Energy
- National Metrology Agency
- National Planning Commission
- Ethiopian Petroleum Supply Enterprise
- Ethiopian Biodiversity Institute

Academic Institutions

- Addis Ababa University
- Addis Ababa University (School of Chemical and Bio Engineering)
- Ethiopian Civil Service University
- Kotebe Metropolitan University
- The Ethiopia Institute of Architecture, Building and Construction

National/International NGOs

- Global Green Growth Institute (GGGI)
- Horn of Africa Regional Environment Centre
- Ramboll Group
- ENDA Ethiopia
- Population Health Centre

Figure 6: Stakeholders at the Addis Ababa scenario planning workshop (October 2018)

2.3.7.
An Integrated Climate Change Response

As outlined above, the approach to developing actions differed slightly depending on whether the action primarily addresses mitigation or adaptation. Whilst this distinction is useful in some respects, the CAP views mitigation and adaptation as being integrated and complementary, identifying synergies and interactions. This not only ensures that the CAP takes an overarching, holistic perspective, but it is also important to avoid any conflicts – such as ensuring the mitigation actions do not result in maladaptation, and adaptation actions do not increase emissions or cause 'lock in' to unsustainable solutions.

It is also important to recognise that actions primarily aimed at addressing climate change can offer wider co-benefits with regards to air quality, biodiversity, water quality, human health, the economy, and so on. These co-benefits are discussed in Section 5.5.

The C40 Air Quality team has also generated a more detailed report on the air quality impacts of the proposed actions, which is summarised in Section 4.1.6. Further information is provided in Annex III.

3. Strategic evidence for the CAP

To ensure that the CAP responds to the challenge of climate change most effectively, it must be developed from a robust and city-specific evidence base. For Addis Ababa, the two key evidence documents that support local climate change action are:

The 2016 Greenhouse Gas Emissions Inventory
This provides the baseline for understanding where emissions are coming from in the city, how they may change in the future, and which actions will be most impactful.

The 2020 Climate Change Risk Assessment
This provides a city-specific assessment of the key climate-related hazards relevant to Addis Ababa, which will help target actions to reduce vulnerabilities.

In addition to the evidence above, the strategic CAP appraisal helps to understand the existing city policies, strategies, governance and system structure to address climate change. These aid the identification of gaps and actions to address those gaps.

3.1.

GHG Emissions Inventory

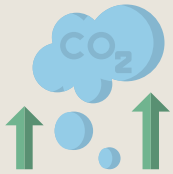
Addis Ababa has reported two city-wide GHG inventories to date. The first was prepared for the year 2012 and published in 2015, while the second was prepared for the year 2016 and published in 2020.

The 2012 GHG inventory for Addis Ababa showed that the city generated a total of 4.89 $MtCO_2e$ in that year. Per capita emissions for the city, which is home to a quarter of Ethiopia's urban population, were found to be 1.6 tCO_2e per capita. This equates to around 4,660 tCO_2e per $US GDP.

The 2016 GHG inventory was undertaken using an updated methodology that is more relevant to cities like Addis Ababa.[13] It includes a wider range of sectors and sources of emissions than the 2012 inventory. On this basis, in the 2016 GHG inventory, total emissions were estimated to be 14.5 MtCO2e. Per capita emissions were estimated at 4.3 tCO2e per year, or 2,169 tCO2e per $US GDP. This total includes several sources that are generally considered outside a city's scope of influence (known as 'BASIC+), but Addis Ababa has chosen included them within its GHG inventory for completeness. These include aviation, road transport in and out of the city, livestock, and emissions from produce use for example.

The breakdown of emissions from the 2016 inventory is shown in Figure 7 and Figure 8. In the 2016 inventory, the transport sector was identified as the highest emitting sector, accounting for 78% of total emissions, with 51% of total emissions coming from road transport. Aviation was the second highest emitting sector, accounting for 26% of the total emissions, followed by solid waste. Stationary energy (i.e. energy used in buildings and other facilities) was responsible for 8% of the total emissions. This level is relatively low, due to a very high level of renewable electricity generation in the country, and large consumption of biofuels, for which the CO2 emissions are considered 'biogenic' (biological origin) and therefore not reported in emission inventories. If these emissions are included, they would have a significant impact on the inventory total and the city's emissions profile, adding 9.4 MtCO2e and making residential energy the single largest sector. This is important for future policy purposes and also for understanding the air quality impact of current and future energy use.

The adjusted 2016 GHG inventory in the ANNEX I has formed the basis of Addis Ababa's emission scenarios, to determine future emissions, goals and targets, explained further in section 4.1.1.



Question:

Why did emissions increase so much from 2012 to 2016?

Answer:

The increase in emissions is attributable to a few different factors.

1. Some changes are due to upward or downward trends over time. This is true for sectors such as road transport, aviation, and waste, where emissions have increased.

2. The 2016 inventory includes some new sectors, such as open waste burning and incineration, that were not considered in the 2012 GHG inventory.

3. Finally, there were some differences in the methodology and data sources used.

These types of changes are necessary to ensure that the inventory provides the most complete, transparent, and up-to-date understanding of emissions in the city. Although it means that the numbers are not directly comparable, the key finding – that total GHG emissions have increased – is still considered reliable. For more information, see Annex II.

[13] The 2016 inventory followed the Global Protocol for community-scale GHG inventories (GPC), which is intended to be consistent with the IPCC Guidelines used for the 2012 inventory but adapted slightly to be more relevant to cities. Data and calculations were undertaken using the City Inventory Reporting and Information System (CIRIS) Tool developed by C40 Cities.

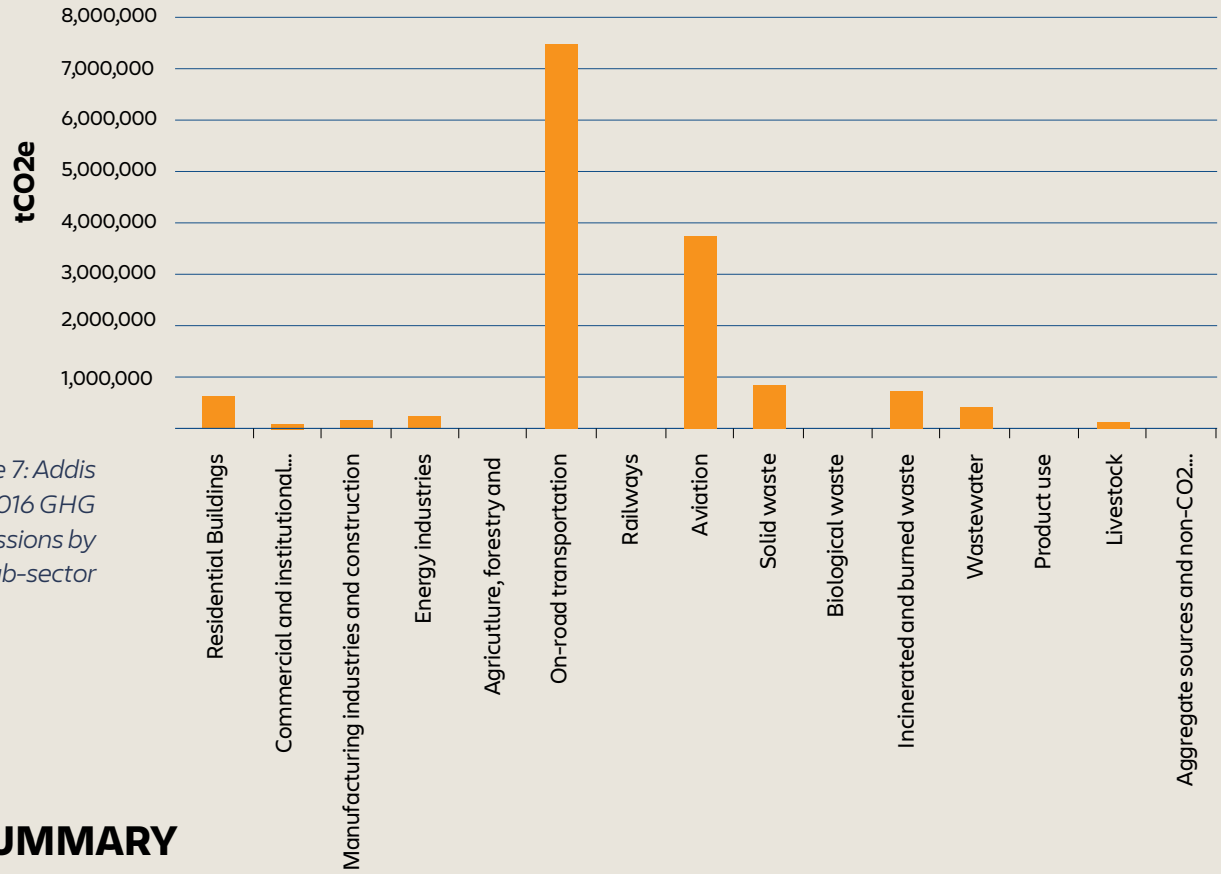


Figure 7: Addis 2016 GHG Emissions by sub-sector

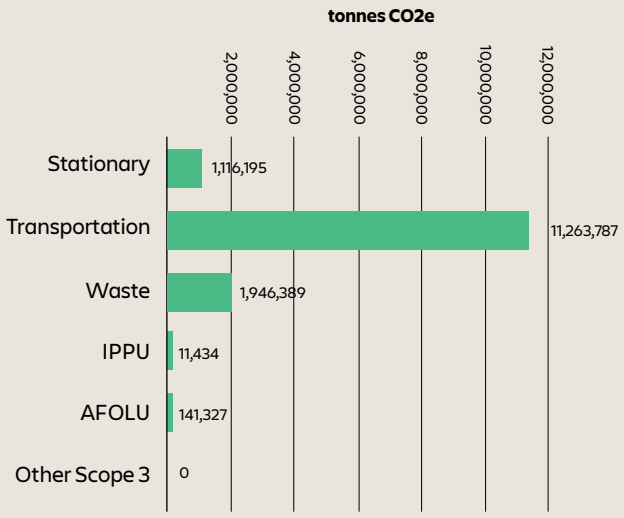
SUMMARY

Name of City: Addis Ababa, Ethiopia
Boundary: Basic
Inventory Year: 2016

Population: 3,353,000
Land Area (km²): 540
GDP(us$ million): 6,677

tCO2e	Basic+	Scope 1	Scope 2	Scope 3
	Stationary	1,115,659	537	
	Transportation	6,641,237	3	4,622,548
	Waste	1,946,389		
	IPPU	11,434		
	AFOLU	141,327		
	Other Scope 3			
	Total	14,479,133		

Figure 8: Addis 2016 GHG Emissions by Sector



Intensity Indicators	Per capita	Per unit land area (km²)	Per unit GDP (US$m)
Emissions	4.3	26,813	2,169

3.1.1.

Addis Ababa Air Quality

Air pollution and climate change are closely linked, and Addis Ababa aims to understand the opportunities for co-benefits, and to minimize trade-offs. By integrating air pollution management and climate action planning, Addis Ababa can enhance climate change mitigation ambition and identify co-benefits for air quality and residents' health.

In 2016, the baseline population-weighted annual average[14] $PM_{2.5}$ concentration for Addis Ababa was estimated to be 33 $\mu g/m^3$. This concentration was apportioned to sources using the city's GHG inventory, accounting for in-city emissions, and emissions associated with production of electricity used in the city.

It also included a non-modelled portion, which represents sectors not included in the GHG inventory, sources located outside the city that influence city air quality, and regional "natural" sources such as dust. This analysis showed that the major contributors to $PM_{2.5}$ air pollution are residential fuel combustion, on-road transport, waste incineration and open burning, and industrial/construction sources, shown in Figure 9.

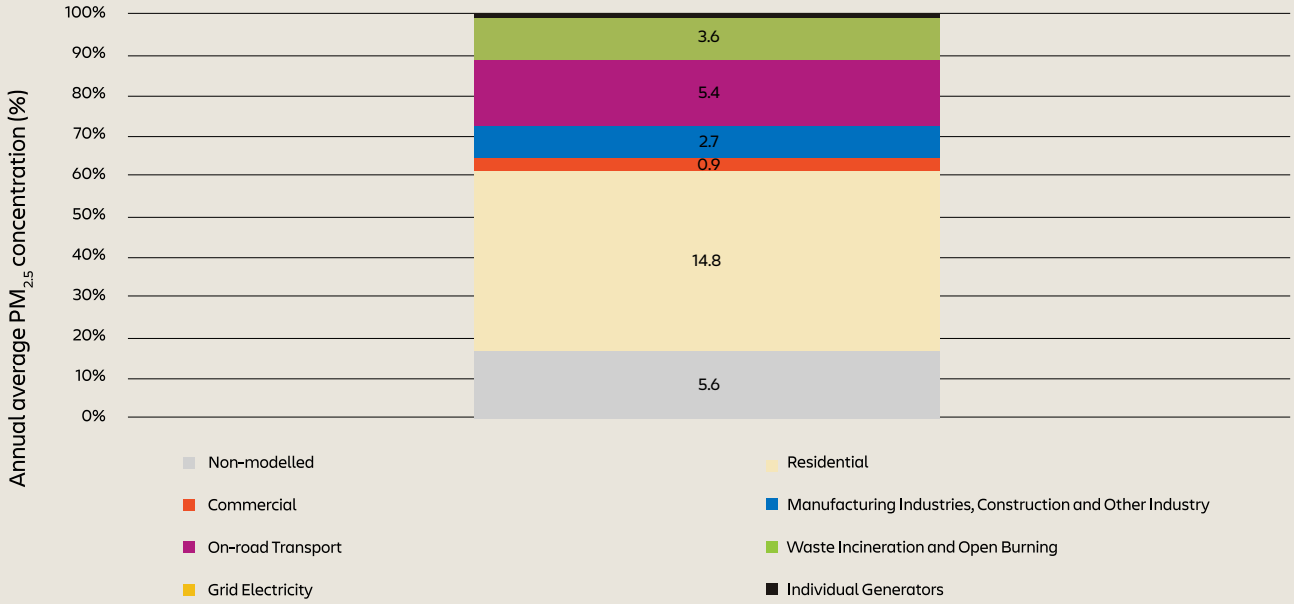


Figure 9. Baseline PM2.5 concentrations (from scope 1 and scope 2 emissions) [15].

[14] For simplicity, Pathways-AQ concentration estimates are often referred to as "annual averages"" throughout this document. The full technical term for what the concentration estimates represent is "population-weighted annual average concentration" since the model takes into account spatial patterns of population density within the city.

[15] Scope 1 emissions (emitted directly within the city) and scope 2 emissions (resulting from production of electricity consumed within the city) are included. Scope 3 (indirect) emissions are not included in this analysis.

3.2.

Climate Change Risk Assessment

With a population of over 90 million people, it is projected that climate change may reduce Ethiopia's GDP by up to 10% by 2045 [16]. Climate projections indicate a 1-2°C increase in temperature by 2050 in a 'Business as Usual' (BAU) scenario and this will have massive impacts on the agricultural productivity, livestock, infrastructure, economy, waste, water and human health among other impacts on critical sectors.

In order to understand the specific impacts on the city, Addis Ababa City Administration conducted a Climate Change Risk Assessment (CCRA) during 2020. This has enabled the city to better understand the current and projected future impacts of climate change to support adaptation planning.

3.2.1.

Past Climate Hazards in Addis Ababa

Drought

Reductions in rainfall, increases in the duration of periods between rainfalls and rainfall variability all contribute to drought events in the City[17] . Over the last 60 years, Addis Ababa has experienced 20 years of below average rainfall, which has led to significant water shortages. Drought also affects the health and wellbeing of Addis Ababa's residents, and dependence on hydroelectric power means periods of drought can result in supply failures[18]. The economic impacts associated with drought vary and depend on the severity of events, however, it is estimated that recent major droughts have reduced Ethiopia's GDP by between 1% and 4%[19] .

Intensity & frequency

- 16 drought events in Ethiopia 1900-2020, leading to the death of 402,367 people and affecting around 77 million others[20] .
- Severe drought in 2015 left 10.2 million Ethiopians without food security[21] .
- Addis Ababa suffered three disastrous events in 1974, 1975 and 2008, and three severe droughts in 1973, 1984 and 1999.

Risk level for Addis Ababa

High probability with high consequences

[16] Adamu (2020),Effect of Climate Change on Agricultural Output in Ethiopia
[17] C40 (2020). Addis Ababa Rapid Climate Risk Assessment.
[18] Worku. (2014). Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa.
[19] World Bank. (2020). Climate Risk Country Profile Ethiopia.
[20] World Bank. (2020). Climate Risk Country Profile Ethiopia.
[21] FAO. (2016). FAO in Ethiopia - El Niño Response Plan 2016.

30,000 people

are vulnerable to flooding across the city (DPPC, 2015)

Flooding

Flash or surface flooding and river flooding, as a result of heavy precipitation events are important hazards with the sub-cities of Kolfie Keranio, Nifasilk Lafto and Adis Ketema at greatest risk of flooding[22]. Vulnerability to flooding in Addis Ababa is particularly linked to rapid urbanisation, the location of poor-quality housing and informal settlements in flood-prone areas, poor drainage, lack of solid waste collection, and loss of greenspace[23]. It has resulted in loss of human life, and damage to property and infrastructure. In 2006, heavy rains caused rivers to overflow and resulted in widespread flooding across the City, leading to the loss of more than 100 lives and the destruction of homes and livelihoods[24]. Combined with poor sanitation, flooding also causes health impacts from waterborne diseases and contamination from pollution.

Intensity & frequency

- Flooding events in Addis Ababa were reported in 2018, 2017, 2009, 2006, 2004[25].
- Between 2010 and 2017, 94 flooding events in the City resulted in an estimated 16 million Birr of damage to property and displacement of 387 households[26].
- Between 2013 and 2018, there were a total of 89 flood-related hazards with a particularly large increase in flood hazards between 2017-2018[27].

⚠ Risk level for Addis Ababa

High probability with high consequences

Landslides

Landslides in Addis Ababa pose a significant risk, particularly residents in the sub-cities of Guele and Yeka[28] . Extreme rainfall events contribute to the risk of landslides and can result in the loss of human lives. The Fire and Emergency Prevention and Rescue Authority has identified 26 areas across the City that are vulnerable to flood-driven landslides. Rapid urbanisation across the City is pushing housing and development further into marginal lands and it is estimated that loss of greenspace contributes to around 40% of landslides (and flooding) in the City[29] . The increase in construction activity is further contributing to the risk.

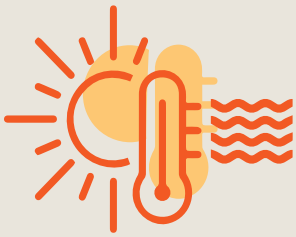
Intensity & frequency

- Flooding and extreme rainfall events can act as a trigger for landslides. The frequency of flood hazards increased between 2013 and 2018 with a high of 40 hazards occurring in 2018

⚠ Risk level for Addis Ababa

High probability with high consequences

[22] Kotebe Metropolitan University and EPA. (2017). Addis Ababa City State of the Environment and Outlook.
[23] Addis Ababa City Administration, Mayors Office and Global Resilient Cities Network. (2020). Addis Ababa Resilience Strategy.
[24] Douglas et al. (2008). Unjust waters: climate change, flooding and the urban poor in Africa.
[25] Addis Ababa City Administration, Mayors Office and Global Resilient Cities Network (2020). Addis Ababa Resilience Strategy.
[26] Kotebe Metropolitan University and EPA. (2017). Addis Ababa City State of the Environment and Outlook.
[27] C40. (2018). Strategic Climate Action Planning Appraisal Report.
[28] Worku (2014). Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa.
[29] Addis Ababa City Administration, Mayors Office and Global Resilient Cities Network (2020). Addis Ababa Resilience Strategy.



Heatwaves

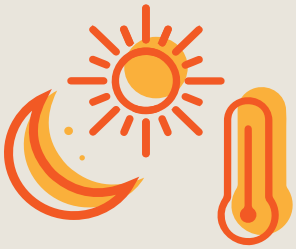
Heatwaves are a major climate hazard for Addis Ababa[30] . Given the compact and built-up nature of the City, with limited green space, heatwaves can be exacerbated by the urban heat island (UHI) effect[31] . This can result in the city experiencing temperatures that are 2°C to 5°C higher than surrounding areas. Health of residents can be directly impacted by through heatstroke and dehydration, which particularly affects the urban poor who may be subject to poor quality housing or poor working conditions. Heatwaves also impact directly on temperature-sensitive infrastructure and result in an increased demand for water and energy. In combination, these impacts can reduce productivity and, therefore, have implications for the economy[32] .

Intensity & frequency

- Analysis of heatwaves indicates that they have been increasing in frequency and duration in Addis Ababa[33] .
- Between 1971 and 2000, the average maximum duration of heatwaves in the City was 6 days.

⚠ Risk level for Addis Ababa

High probability with high consequences



Extreme hot days and hot nights

Similar to heatwaves, extreme hot days and nights can have significant impacts on the health of the City's residents alongside impacts on water and energy supply, and infrastructure. They are, therefore, considered to be a major climate hazard. The UHI effect can exacerbate temperatures across the City, thereby amplifying extreme hot days and hot nights.

Intensity & frequency

- The average number of hot days per year in Ethiopia has increased by 73, equating to an additional 20% of hot days, between 1960 and 2003[34] .
- The rate of increase is greatest for summer, where the average number of hot days for each month (June, July and August) has increased by 9.9 days over the same period, thereby affecting 32% of summer days.
- The average number of hot nights per year has also increased, affecting an additional 37.5% of nights, again most strongly in June, July and August.

⚠ Risk level for Addis Ababa

High probability with high consequences

[30] C40 (2020). Addis Ababa Rapid Climate Risk Assessment.
[31] The Urban Heat Island effect describes the effect whereby concrete, asphalt and other hard materials and surface prevalent in cities absorb heat during the day, and then release it at night. This leads to higher night time temperatures compared to green areas, and to higher temperatures overall compared to green areas.
[32] Worku. (2014). Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa.
[33] Pauleit, S et al. (eds). (2015) Urban Vulnerability and Climate Change in Africa: A Multidisciplinary Approach, Future City book series.
[34] McSweeney et al. (2009). UNDP Climate Change Country Profiles – Ethiopia.

Rainstorms and variability of rain

Rainstorms have increased in frequency in Addis Ababa over the 20th century[35] . Rainstorms in urban areas, which have a high proportion of non-permeable land, poor drainage and high population density, lead to a high risk of flash flooding[36] . Heavy rains also contribute to soil erosion, erratic soil moisture content, altered infiltration rates and waterlogging, all of which have negative impacts upon urban agricultural crop yields. It is estimated that rain-induced soil erosion has reduced the country's GDP by approximately 1%[37] . Heavy rainfall can also lead to the formation of gullies, which affects drainage systems and reduces the amount of permeable soil, thereby impacting groundwater supplies and groundwater contamination[38] . Sanitation systems can be overwhelmed, and other city infrastructure such as buildings or transport can also be damaged.

Addis Ababa has four rainy seasons but there is evidence that rainfall is becoming more variable which is further exacerbating rainstorms, flooding and droughts.

Intensity & frequency

- Long-term precipitation trends are difficult to determine given the strong inter-annual and inter-decadal variability.
- Throughout the 20th century, heavy one-day and heavy multi-day precipitation events have increased in frequency in Addis Ababa[39] .

⚠ Risk level for Addis Ababa

High probability with high consequences

[35] Worku. (2014). Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa.
[36] Federal Democratic Republic of Ethiopia, Ministry of Water Resources and National Meteorological Agency. (2007). Climate Change National Adaptation Programme of Action (NAPA) of Ethiopia
[37] CGIAR (2018). Climate Resilient Green Economy Strategy. Sector-wise GTP II Implementation Monitoring Checklist. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), East Africa
[38] Worku. (2014). Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa
[39] Worku. (2014). Climate Resilient Green Growth Strategy and Integrated Climate Change Response Investment Plan Development for Addis Ababa.

3.3.

From Evidence to Action

The key evidence on current emissions and past climate hazards in this section underpins the city's strategy for reducing emissions and adapting to climate change.

Section 4 below uses this evidence to demonstrate how emissions and hazards might change over time across different sectors in Addis Ababa, and identifies the city's priorities for action.

4. Addis Ababa's climate change goals and targets

Addis Ababa has committed to ambitious goals and targets for both climate change mitigation and adaptation, underpinned by the achievement of a range of wider benefits that such goals are expected to bring.

These goals and targets have been informed by a combination of baseline data on emissions and hazards as outlined in the above chapters, modelling of future pathways and potential actions, assessment of future impacts, and the scientific consensus on the need for ambitious reductions. This analysis to reach the goals and targets for the city is outlined here.

What are goals and targets?

Addis Ababa's **goals** are the city's broad objectives for mitigation, adaptation and wider benefits.

Targets provide the specific, measurable objectives for the city over a defined time period.

4.1.

Mitigation Goals and Targets

Addis Ababa's overarching mitigation goal is to achieve carbon neutrality by 2050, consistent with the requirements of the Paris Agreement.

To develop GHG reduction targets that would put Addis Ababa on a pathway to deliver this goal, the city identified current and future emissions, and the mitigation potential of different measures. This was used to develop a set of scenarios and associated actions, assess the abatement potential of measures and set targets.

4.1.1.

Business-as-usual Emission Scenario

Determining the likely future emissions provides the 'baseline' to understand the impact of future climate actions. This 'business-as-usual' scenario uses growth factors including population and GDP to estimate the likely future growth trend if no further action is taken.

Using the C40 emissions scenario tool called 'Pathways', based on current levels of emissions and growth in population and the economy and assuming no additional action, emissions are projected to increase by around 300% by 2050. This would equate to total annual GHG emissions of over 78 $MtCO_2e$ by 2050, as depicted in Figure 10 below.

Business as usual scenario (BAU)

Projection of future emissions based on population and economic growth factors (GDP) in the different emission sectors, assuming no additional climate action. This provides the 'baseline', from which to assess the impacts of actions.

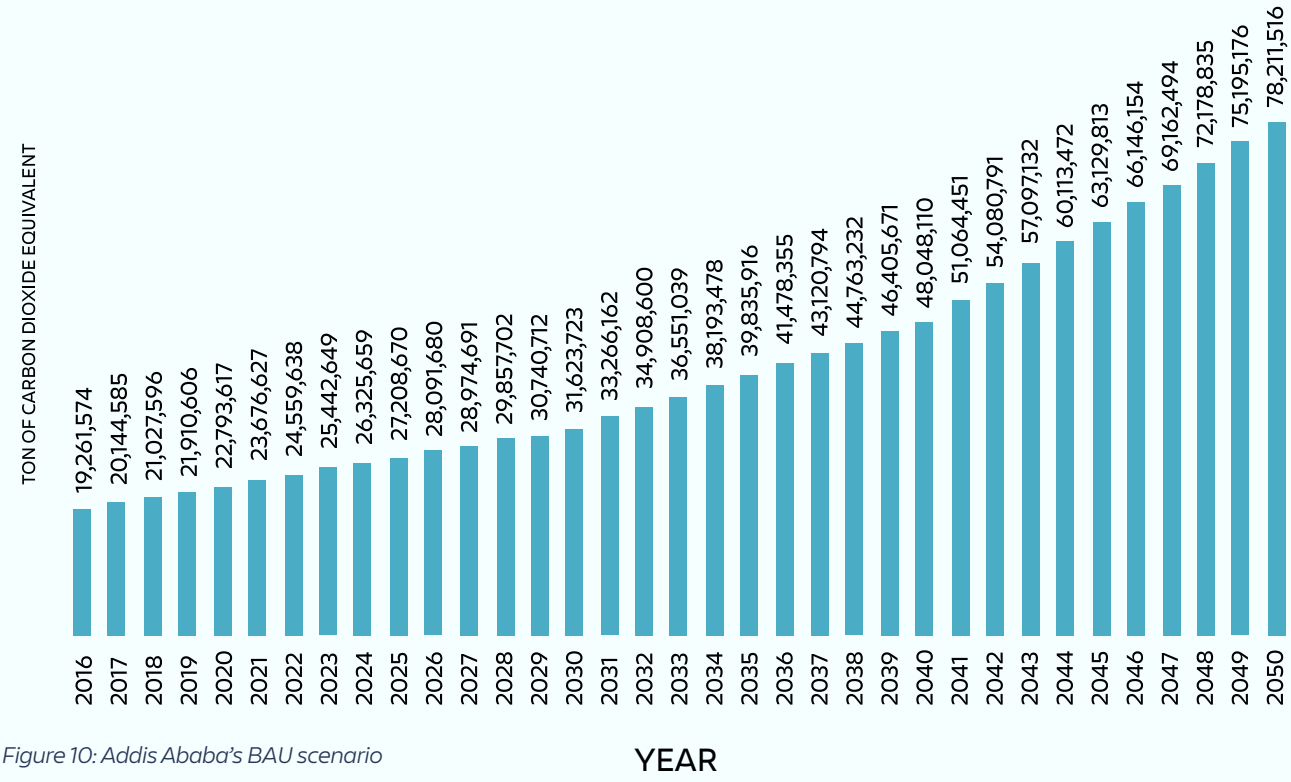


Figure 10: Addis Ababa's BAU scenario

Air pollutant emissions are also projected to grow. Using the Pathways-AQ rapid scoping tool, under the BAU scenario, annual average $PM_{2.5}$ concentrations are expected to increase by 71% between 2016 and 2030, 59% between 2030 and 2040 and 75% between 2040 and 2050 (Figure 11).

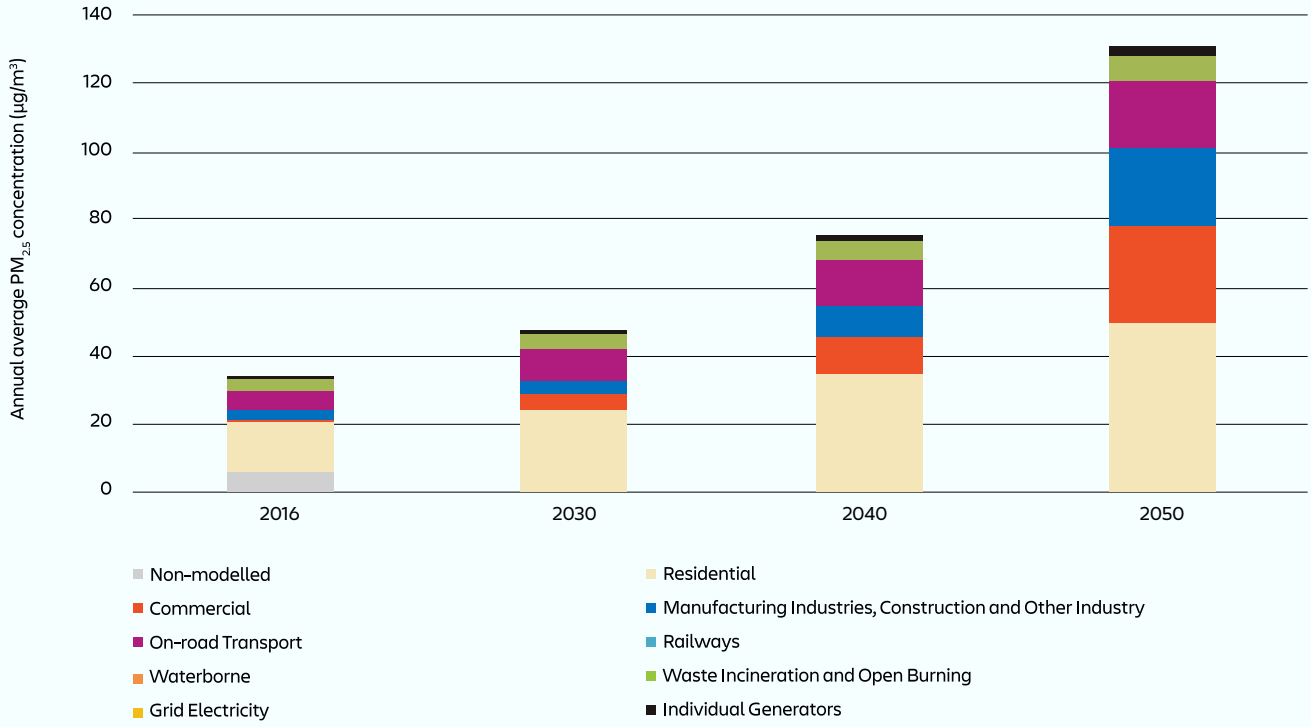


Figure 11. Baseline PM2.5 concentrations (from scope 1 and scope 2 emissions). [40]

[40] Scope 1 emissions (emitted directly within the city) and scope 2 emissions (resulting from production of electricity consumed within the city) are included. Scope 3 (indirect) emissions are not included in this analysis.

4.1.2.

GHG Emission Reduction Scenarios

Three emission reduction scenarios, in addition to a business-as-usual scenario, were developed for Addis Ababa. These form the basis of the city's climate mitigation targets to deliver the carbon neutrality goal. All scenarios were developed using a modified 2016 inventory [41] as the base year.

Existing & Planned action Scenario (E&PS)

A scenario based on existing policies and plans at the national and city level, such as Ethiopian Climate Resilience Green Economy Strategy (CRGE/NDC) and Climate Resilient Green Growth Strategy, and the Integrated Climate Change Response Investment Plan for Addis Ababa. Also includes other non-policy driven market trends like in the use of electric cook stoves or non-motorized transport.

Ambitious action Scenario (AS)

A scenario based on ambitious yet achievable actions, scaling up the strategies and actions that the city is already planning to undertake and also including new strategies and actions that are deemed feasible. Ideally, an ambitious scenario should enable the city to significantly shift emissions towards the goal of carbon neutrality by 2050 as required by the 'Deadline 2020' commitment, in order to maintain a 1.5 °C development pathway consistent with the goals of the Paris Agreement.

Extended action Scenario (ES)

A scenario based on the strategies and actions that are required to achieve the carbon neutrality 2050 goal, but not yet achievable. This scenario identifies the strategies needed conditional on the overcoming of present barriers to extended action, to close the gap between the ambitious action scenario and the Deadline 2020 emission reduction goal.

[41] The inventory was adjusted to exclude sectors that are outside the city's control, such as aviation, and better reflect the emissions impacts of future trends and actions, such as those relating to the use of biomass.

The GHG emission reductions projected under the four scenarios are summarised in the table below.

Year	BAU	E&PS	AS	ES
2016	19,261,071	-	-	-
2030	31,623,723	23%	41%	43%
2040	48,048,110	30%	60%	66%
2050	78,211,516	34%	76%	86%

Table 4: Addis Ababa's projected GHG emissions reductions in 2030, 2040 and 2050 under the different scenarios. These reductions are relative to the BAU scenario, from a 2016 baseline.

Existing and planned action scenario

The Existing and Planned action scenario will reduce future emissions compared to the BAU, but will still result in net emissions growth above the 2016 base year in all target years:

↑2030: 64% growth

↑2040: 149% growth

↑2050: 306% growth

This scenario will also positively impact air quality and health in Addis Ababa by 2050, but not enough to lower $PM_{2.5}$ concentrations to meet World Health Organization (WHO) ambient air quality guidelines.

Ambitious action scenario

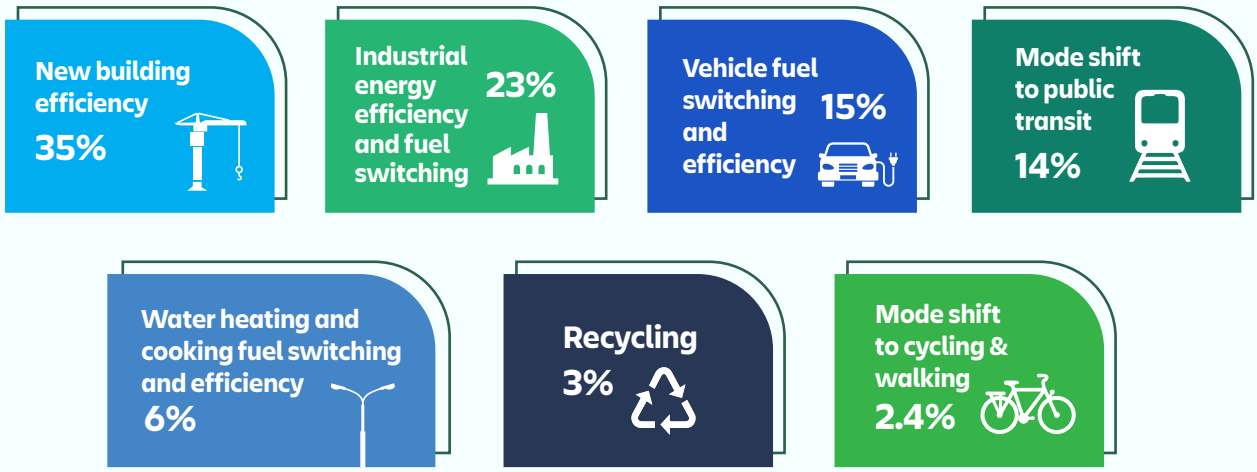
Addis Ababa recognises that it needs to go further to meet the city's goal. Implementation of transformational city-level climate actions under the Ambitious action scenario is therefore expected to reduce GHG emissions in Addis Ababa by:

41%
below the BAU scenario
by 2030

60%
below the BAU scenario
by 2040

76%
below the BAU scenario
by 2050

Emission reductions in this scenario, based on the Pathways modelling, come from:



This scenario results in significant reductions compared to the BAU, particularly in the short term, and net emissions remain around the level of the base year to 2050 (Figure 12).

The Ambitious Actions scenario is also projected to deliver air pollution reductions that are twice as big as those expected under the Existing and Planned Actions scenario. $PM_{2.5}$ concentrations from in-city emission sources are expected to decrease by 20 μg/m³ in 2030, 43 μg/m³ in 2040, and 94 μg/m³ in 2050 as a result of ambitious scenario implementation. The largest reductions in emissions of $PM_{2.5}$ and precursor pollutants are expected to come from the residential sector and on-road transport (Figure 13).

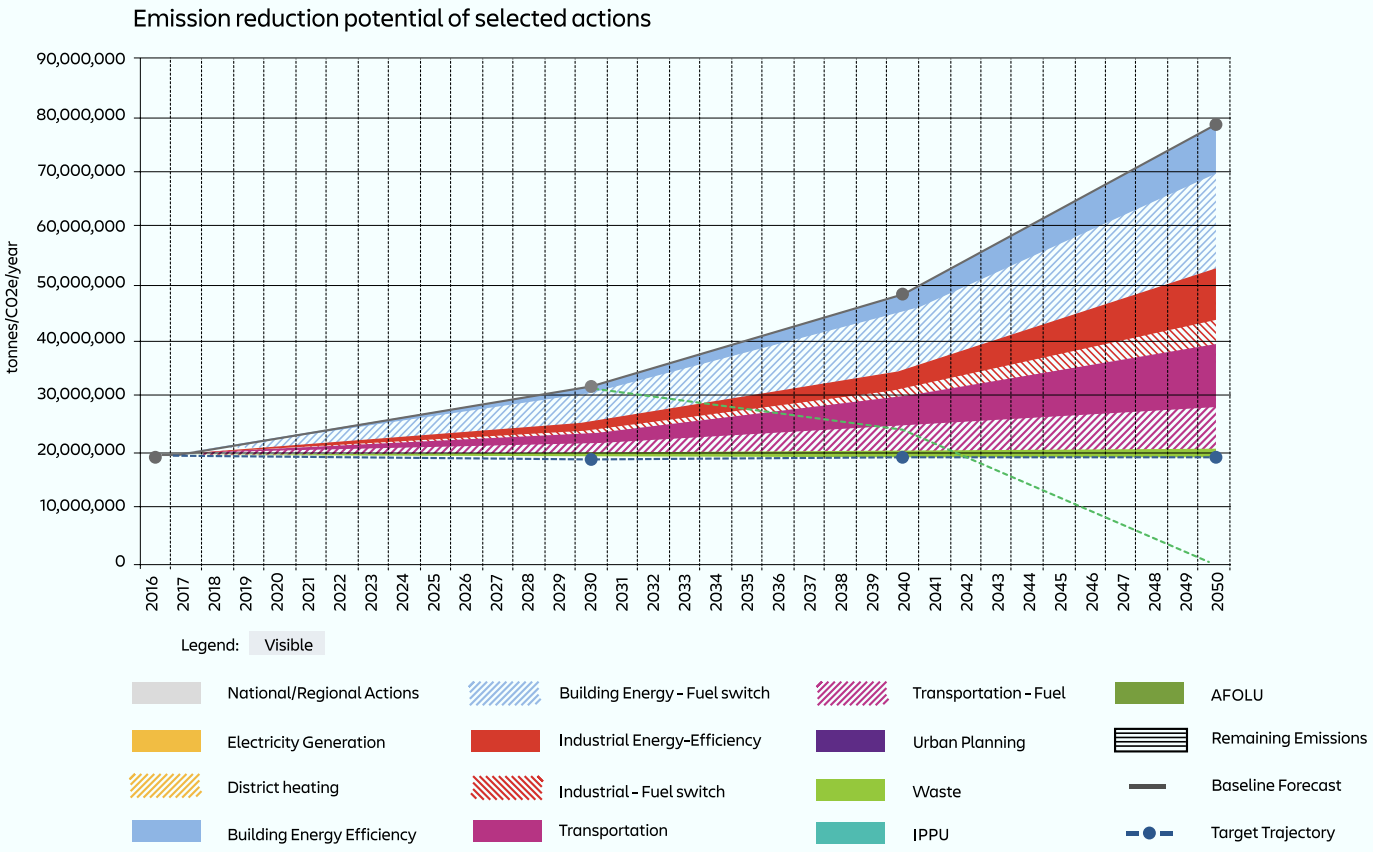


Figure 12: Ambitious actions scenario

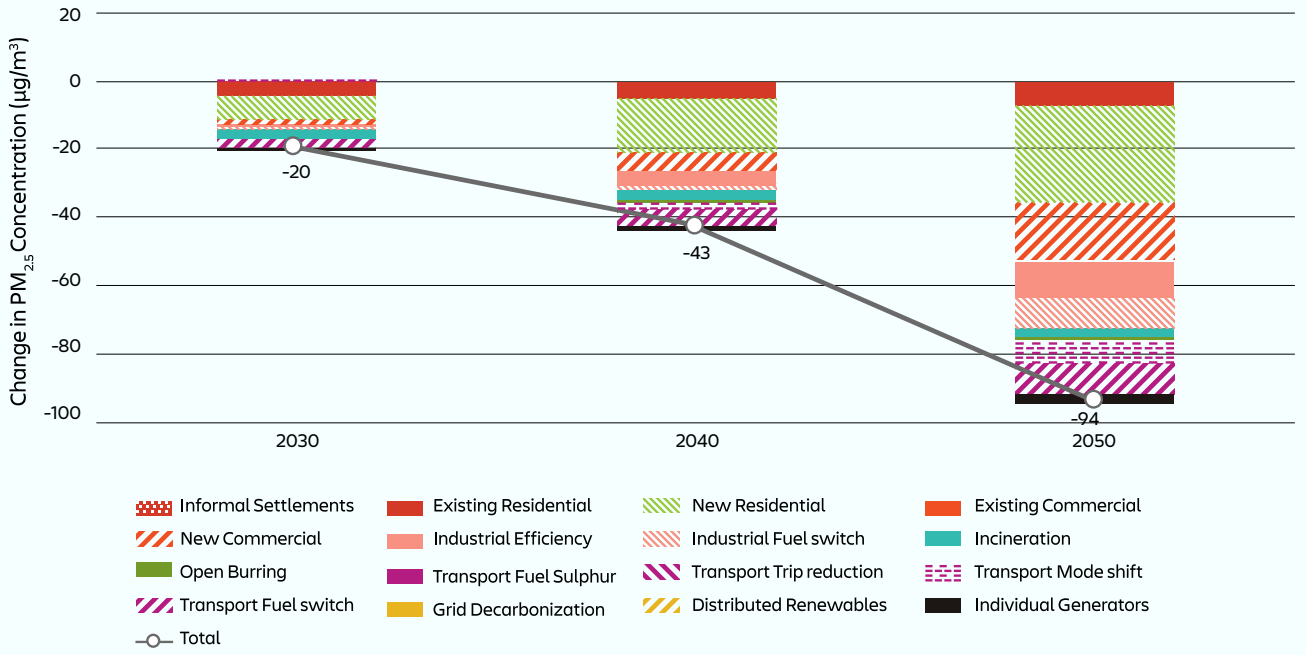


Figure 13. Change in PM2.5 concentration per action for the ambitious scenario

This scenario leaves an emissions gap of 24% (compared to the BAU) in 2050, which equates to 17.6 $MtCO_2e$ still being emitted.

These remaining emissions after ambitious actions are mainly from on-road transportation, energy use across residential, commercial and industrial sector, and from wastewater.

Remaining transport emissions are largely associated with public transport fleets. Options to further decarbonize these include:

- Increased ambition in electrification for ALL types of buses (mini and microbuses as well as standard and BRT)
- Encouraging the uptake of electric cars / motorcycles

The largest emission reductions for **Residential and Commercial energy** are projected to be achieved through

- Hot water heating and cooking improvements
- Space heating improvements and insulation requirements in new and existing buildings
- Additional small-scale renewables

Box 3: Remaining emission reduction opportunities in the Ambitious actions scenario

Extended action scenario

The Ambitious action scenario does not achieve the goal of carbon neutrality in 2050, due to various technological, political, social and economic barriers. Addis Ababa has therefore also developed an Extended action scenario with a view to working with stakeholders in the city, nationally and internationally, to find ways to address these barriers in order to reduce emissions further. The Extended actions scenario is expected to reduce GHG emissions in Addis Ababa by:

43%
below the BAU scenario by 2030

66%
below the BAU scenario by 2040

86%
below the BAU scenario by 2050

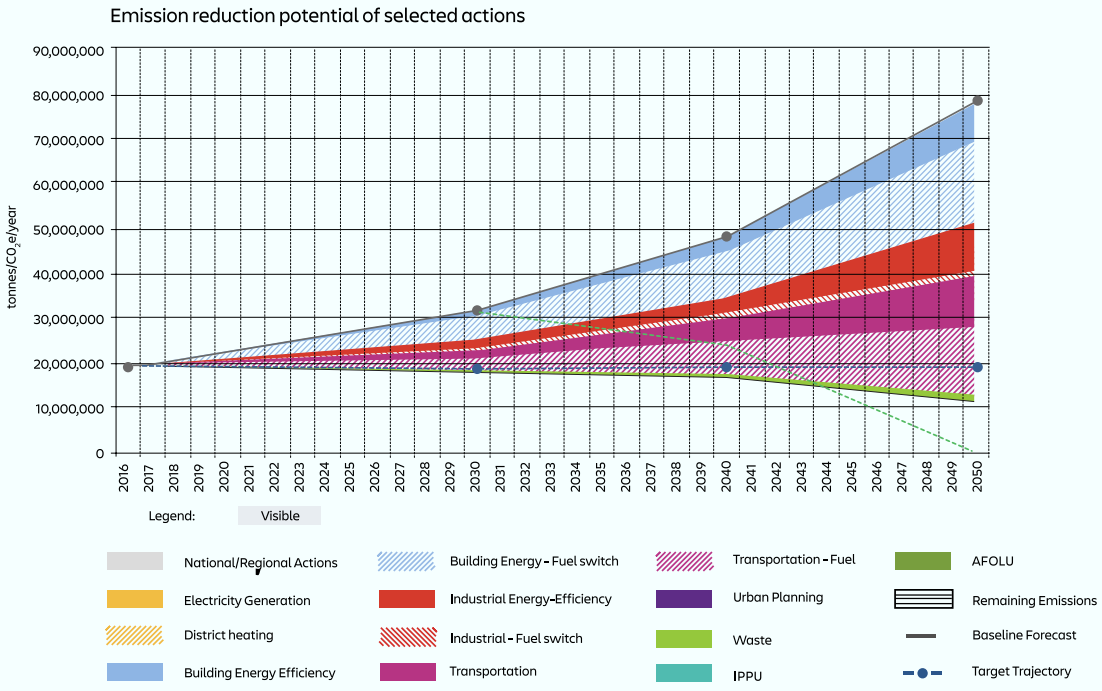


Figure 14: Extended actions scenario

4.1.3.

Addis Ababa's Pathway to Carbon Neutrality and City-wide Targets

The Addis Ababa GHG emission reduction goal is to achieve carbon neutrality by 2050. To achieve this goal, the city will start to peak emissions each year and aim to achieve the target emission reductions for 2030, 2040 and 2050, through implementing prioritized mitigation actions in the highest emitting sectors.

Addis Ababa has adopted the Ambitious actions scenario as the basis of the targets for this CAP, and the expected emissions reductions in this scenario therefore represent Addis Ababa's unconditional emission targets. These targets are 'baseline scenario' targets, which represent a reduction in relation to projected emissions under the BAU scenario. The base year for Addis Ababa's target is 2016, and it is based on the adjusted GHG inventory.

	2016	2030	2040	2050
BAU emissions in target year (Mt CO_2e)		31.62	48.05	78.21
Total Emissions in target year (Mt CO_2e)	19.26	18.60	19.15	18.80
★ **Ambitious action scenario targets (reduction from BAU)**		**-41%**	**-60%**	**-76%**

Table 5: Addis Ababa's climate mitigation targets

To achieve these GHG emissions reductions, Addis Ababa has developed ambitious climate actions to tackle emissions from energy, transport and waste, to ensure that the city embarks on a low carbon and resilient development pathway.

These actions are further outlined in Section 5, which will aim to deliver sectoral targets and major interventions needed in each sector. Addis Ababa's sectoral targets are summarized below:

Composting

- To divert 70% of organic waste to compost by 2050.
- Reduce open dumping of organic waste and amount going to landfill to 0% by 2050.

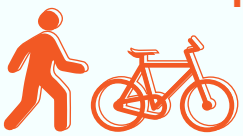
Recycling

- Increase the proportion of paper and plastic waste that is recycled from 0 % to 30% by 2050

Wastewater treatment

- Increase anaerobic treatment of wastewater from 0% in 2016 to 70% by 2050
- Decrease use of latrines from 72% in 2016 to 5% in 2050
- Decrease direct discharge from 16% in 2015 to 5% in 2050

Transport mode shift



- Reduce mode share of private cars from 10.8% (2016) to 1.2% by 2050
- Promote mode shift from car/ motorcycle/bus to walking: 80% walking by 2050

Public transit vehicles

- Improve the LRT and BRT to accommodate more passengers
- Buses (standard/BRT) to be 100% electric by 2050

Private/Freight vehicles

- Motorcycles and taxis to shift away from petrol, aiming for 10% electric by 2050
- Reduction in diesel use by freight vehicles, in favour of increased use of biodiesels and, when technology allows, switch to electricity.
- Improve the efficiency of vehicles through emission standards

New construction efficiency

- In both residential and commercial properties, 100% of new builds to use solar water heating by 2030
- 100% electric stoves in in newly built residential properties by 2030.

Upgrade efficiency of existing buildings

- 75% of existing properties will use solar water heating by 2050
- 50% will use LED lighting by 2030
- 90% of residential and 100% of commercial properties will transition to electric stoves by 2050.
- Energy Audits (EAs) through incentivizing mechanisms for energy efficient technologies in industries

Street lighting efficiency

- 100% LED streetlights by 2030

4.1.4.

Barriers to Achieving the Extended Actions Scenario

As the Ambitious action scenario does not achieve the goal of carbon neutrality in 2050, Addis Ababa developed the Extended action scenario to identify the level of intervention needed to deliver more ambitious targets and close the gap to achieving the carbon neutrality goal. This scenario represents a 'conditional' target for Addis Ababa.

	2016	2030	2040	2050
BAU emissions in target year (Mt CO2e)		31.62	48.05	78.21
Total Emissions in target year (Mt CO2e)	19.26	17.91	16.60	11.22
Extended action scenario Conditonal Targets (on business-as-usual)		**-43%**	**-66%**	**-86%**

Table 7: Addis Ababa's Extended action scenario

There are a number of barriers to achieving this target and the assumptions underpinning it in three key intervention areas, as follows:

Barrier	95% vehicles are electric	Existing residential cooking all upgraded to electric by 2050 (rather than improved wood)	Industrial energy improvements (electrification and efficiency) [42]
Legal	National policy will be required	Policy required to ban or disincentive use of fossil fuels for cooking	National policy required to stop industries moving out of city to avoid relevant policies
Financial	EVs are currently more expensive than their internal combustion engine (ICE) counterparts; overtime, this is likely to change	Switching equipment which has not yet reached end-of-life may not be economically attractive	Switching equipment which has not yet reached end-of-life may not be economically attractive
Political & social	Social concerns e.g., 'range anxiety', lack of infrastructure to charge vehicles and the cost of investing in an EV	Incremental changes may be preferred. For cooking, many people prefer cooking on gas instead of electric cook stoves	Incremental changes may be preferred. Much of the emission reductions for charcoal production are reliant on a large reduction in charcoal consumption.
Practical and technical	Grid flexibility required, increase demand on grid, and development of adequate EV infrastructure	Wide-spread electrification increases the demand for electricity which will need to be met by increased electricity generation	Wide-spread electrification increases the demand for electricity which will need to be met by increased electricity generation. It has also been assumed that there will be major improvements in the technology to allow for such energy efficiency improvements.

Table 8: Addis Ababa's major barriers to delivering extended actions in major intervention areas

[42] Includes 95% of industrial energy use converted to electricity by 2050; Manufacturing industries industrial efficiency increased to 60% improvement by 2050; Charcoal production efficiency increased from 42% to 60% by 2050

4.1.5.

Residual GHG Emissions

The Extended actions scenario is expected to deliver an 86% reduction in emissions from the BAU by 2050. This leaves 14% or 11.22Mt CO2e, which will remain if the Extended actions scenario is delivered and the barriers removed. The city will need to address these emissions in order to meet the carbon neutrality goal by 2050. Residual emissions occur mostly from the following sources:

- **Residential and commercial stationary combustion:** Most remaining emissions are relating to the combustion of wood for cooking and space heating.

- **Wastewater:** In 2050, the majority (70%) of wastewater is expected to be treated anaerobically without biogas capture so there are significant emissions here. 5% and 20% of wastewater is being treated by latrines and septic tanks, respectively, and 5% is untreated; these treatment types also mean some emissions are remaining.

The City has committed to updating the GHG inventory every 2 years and revising and updating the CAP every 5 years. This will enable the city to adjust the plan to respond to new challenges and opportunities, and act on opportunities to further reduce these residual emissions to achieve the carbon neutrality goal by 2050. Residual emissions will be monitored and specifically addressed by Addis Ababa after 2030. This will give the city the ability to identify and plan for technologies in those sectors and possibility of using emission offset mechanisms as well such as afforestation, reforestation, for instance.

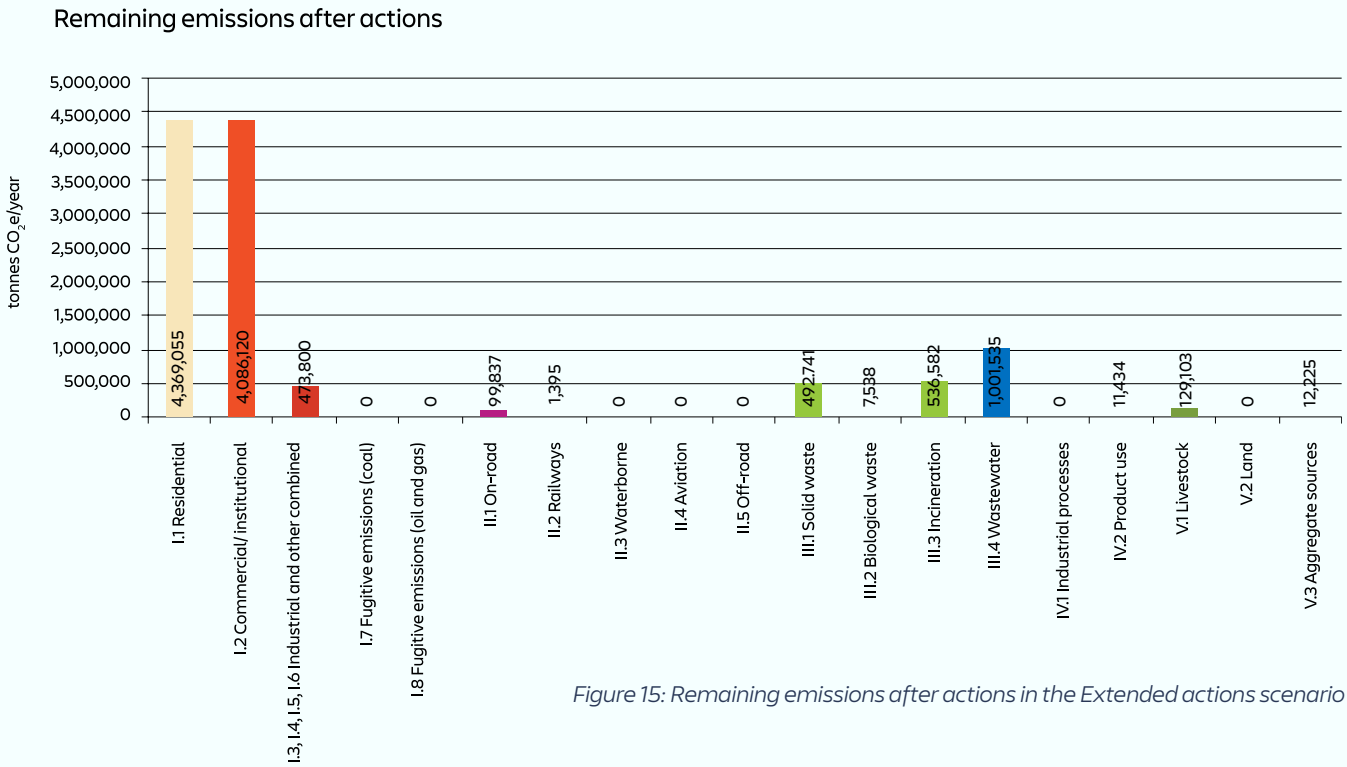


Figure 15: Remaining emissions after actions in the Extended actions scenario

4.1.6.

Air Quality Benefits of the Scenarios

By implementing Addis Ababa's Existing and Planned action scenario, the city can improve air quality by lowering annual average population-weighted $PM_{2.5}$ by 43 $\mu g/m_3$ by 2050. This cleaner air would prevent a significant number of early deaths each year.
Under this scenario, changes in the residential sector have the most potential to reduce air pollution: improving buildings and switching to cleaner sources of residential energy.

By implementing the Ambitious action scenario, the city could even more dramatically improve air quality, lowering annual average population-weighted $PM_{2.5}$ by 94 $\mu g/m_3$ in 2050. This reduction in air pollution would prevent 1,036 early deaths in the city, in 2050 alone. The top $PM_{2.5}$-reducing sectors in the Ambitious action scenario are (in order from greatest to lowest potential to reduce air pollution):

- Residential energy efficiency for cooking and space heating in new buildings (as a result of moving away from solid fuel use)
- Industrial energy efficiency and fuel switching
- Commercial energy efficiency
- Conversion of buses from diesel to electric

The majority of health benefits are expected to accrue from changes in new residential buildings (cooking and water heating improvements), from changes in new commercial buildings (space heating improvements), and from industrial energy efficiency measures.

In both scenarios (Existing & Planned action and Ambitious action), residential sector climate mitigation strategies– for instance, switching from unclean energy sources (such as in-home solid fuel combustion) to electricity–have high potential to mitigate GHG emissions and reduce air pollution (both household air pollution and ambient air pollution), while delivering significant benefits to health and well-being. Other climate mitigation strategies with potential to markedly improve air quality and reduce GHG emissions include:

- Shifting away from high-emitting on-road vehicles to walking and cycling
- Switching to cleaner on-road transport fuels
- Improving waste management infrastructure and systems
- Switching toward cleaner fuels in the commercial sector and in manufacturing industries

Details of which can be found in Annex III.

4.2.

Adaptation Goals and Targets

"Green, liveable, well managed and resilient Addis Ababa"

This vision was co-created with stakeholders and provides a lens for the outcomes-based adaptation planning approach taken by the city in defining its adaptation goals and actions

To ensure that Addis Ababa's future development pathway minimizes the future impact of climate change, the city's Climate Change Risk Assessment also identified priority future hazards and impacts in priority sectors.

From these, three key adaptation priorities were defined, and a set of actions were developed that would enable the city to achieve its adaptation goal.

4.2.1.

Future Climate Projections for Addis Ababa

Studies show that Ethiopia and Addis Ababa city are projected to experience higher temperatures in the future[43] . Across all the models studied, compared to a 1971-2000 baseline at the Addis Ababa Observatory, maximum and minimum temperatures in the City are projected to increase in magnitude and intensity up to the end of the century, with the highest increases occurring after 2020. A summary of these projections across two of the scenarios is shown in.

Temperature extremes in Addis Ababa are also projected to increase as well as hot days and hot nights. Rainfall is also likely to vary in future. Most reports agree that Ethiopia will see a gradual wetting trend, with increases in annual rainfall and frequency of extreme weather events by the end of the twenty-first century.

Temperature Projections	Year	CanESM2	
		RCP4.5	RCP8.5
Maximum Temperature	2020s	0.1°C	0.1°C
	2050s	0.4°C	0.6°C
	2080s	0.5°C	1.2°C
Minimum Temperature	2020s	0.0°C	0.0°C
	2050s	0.2°C	0.4°C
	2080s	0.3°C	0.7°C

Table 9: Projected Changes in Addis Ababa Maximum and Minimum Temperature[44]

[43] Feyissa et al. (2018) Downscaling of Future Temperature and Precipitation Extremes in Addis Ababa under Climate Change.

[44] Source: Fevissa et.al. (2018)

4.2.2.

Projected Future Climate Hazards

Based on the climate projections for Addis Ababa, the city expects that **future climate hazards** will increase in intensity and frequency under all scenarios **immediately**, in the short term (2020-2025) and the medium term (2026-2050).

To understand how Addis Ababa is likely to be impacted by future climate hazards, the city undertook a preliminary qualitative analysis of the current climate risks in Addis Ababa. The magnitude of the impacts on each sector was assessed through a qualitative process with stakeholders. The impacts on each sector were compared with each other to give a qualitative order of magnitude.

The assessment process and reporting followed the Global Covenant of Mayors for Climate & Energy recommendations (as set out in the C40 Climate Change Risk Assessment Guidance[45]) and was refined to suit the City context in Addis Ababa.

The most relevant and most pressing future climate hazards for Addis Ababa are shown in below.

Climate hazards in Addis Ababa are expected to increase in frequency and intensity under all scenarios immediately, in the short term (2020-2025) and the medium term (2026-2050)

Climate variable	Climate hazard group	Future climate hazard	Expected change in:		Timescale expect first changes by
			Frequency	Intensity	
Temp	Temperature stress	Heatwaves	↑	↑	Immediately
		Extreme hot days and nights	↑	↑	Immediately
		Gradual temp increase	↑	↑	Immediately
Rainfall	Water scarcity and subsidence	Drought	↑	↑	Immediately
		Subsidence	↑	Not known	Immediately
	Heavy rainfall	Rainstorms	↑	↑	Immediately
	Flood and landslide	Flash / surface flood	↑	↑	Immediately
		River flood	↑	↑	Immediately
		Landslide	↑	Not known	Immediately

[45] C40. (2018). Climate Change Risk Assessment Guidance.

4.2.3.

Future Climate Related Hazards and Priority Sectors

Seven sectors already adversely affected by climate change were identified as priorities from the Addis Ababa CCRA. Through a qualitative assessment with stakeholders, the impact that the projected climate hazards will have on each of these sectors, and the magnitude of the impacts, was identified. Following this, the most important climate hazards and their expected impacts were agreed for each of the seven sectors. The results are shown in Table 11.

Sector	Priority future climate-related hazards and primary impacts	Priority future resultant climate impacts expected for the sector
Urban planning (including buildings)	1. Flooding (river and surface/flash)	. Loss of land for built infrastructure and development
Critical ecosystems	2. Gradual (chronic) temperature increase with associated instances of drought	. Habitat degradation . Wildfire . Species loss
Food security	3. Temperature-related shocks: heat wave and drought	. Crop failure . Crop viability . Livestock survival/viability
	4. Flooding (river and surface/flash)	. Water quality / pollution influx-related impacts
Health	5. Flooding (river and surface/flash)	. Vector-borne disease . Pollution spread impacting vulnerable groups
Infrastructure (waste management)	6. Flooding (river and surface/flash)	. Pollution and debris spread
Infrastructure (transport)	7. Flooding (river and surface/flash)	. Disruption to motorised transportation . Disruption to non-motorised transit
Energy	8. Changes to rain seasons interspersed with instances of drought	. Hydropower production/viability
Water	9. Gradual (chronic) temperature increase	. Decline in water availability
	10. Temperature-related shocks: heatwave and drought	. Increased demand for water for agriculture, commercial uses & residences

Table 11. Collaboratively identified priority climate impacts for Addis Ababa sectors

4.2.4.

Adaptation Goal and Targets

The major climate hazards in the city identified through the CCRA can be categorized into three key areas which form the city's adaptation priorities:

- Flooding and landslide which is caused by high intensity of the rainfall together with the nature of the city's topography.
- Extreme heat/heatwave is related to temperature stress and temperature change.
- Drought is related to the above factors of temperature and annual average rainfall.

> Addis Ababa's overarching adaptation goal is to reduce the impact of climate hazards such as flooding, heatwaves and droughts on different sector, with targets to reduce the vulnerability to hazards by 30% in 2030, 60% by 2040 and 100% by 2050

Whilst most of Addis Ababa's adaptation actions and priorities are qualitative, there are a number of sectoral targets for adaptation in selected sectors, summarized below:

Urban Planning

100% of new developments to be to be climate compatible/ future-proof to physical climate impacts by 2050

Increase in net green coverage by 10% in the short term (by 2025) and by 20% in the medium term (2030)

Health

Maintain 30% allocation of city land for urban green spaces to reduce the urban heat island effect and flooding by 2030.

Critical Ecosystems

30% of the city's land area to be allocated to urban greenery and green space, and every resident living within 500 meters of a public green open space of at least 0.3 hectares by 2030

Infrastructure

Improve and mainstreaming of climate resilience parameters to 50 % existing and 100% new infrastructure for current and projected climate change hazards by 2030.

Water

Average litre per capita per day growth by 40% (89 l/c/d ,in 2016 to 133 /l/c/d by 2030) and balance the city's daily water generation capacity by 2030.

Food Security

Increase the GDP share by 50% of the urban agriculture production and productivity from the current 1% by 2030

Energy

Aligned with the mitigation actions targets (refer to Mitigation Actions)

Table 12: Addis Ababa's sectoral targets

4.3.

Goals and Targets for Wider Benefits

Addis Ababa is committed to improve the living standards of its residents by implementing actions that contribute to the Sustainable Development Goals (SDGs). The city has aligned its CAP priorities with the SDGs. When the CAP is implemented, the city will benefit from climate change actions beyond a reduction in GHG emissions, creating an economy that is resilient to current and planned climate change.

The major wider benefits from implementation CAP are categorized into environmental, social and economic benefits. The environmental benefits include reduced pollution and increased green spaces, whereas social benefits are linked to community health, culture and job creation.

SDG Goal 7 : Affordable and cleanenergy

SDG Goal 11 : Sustainable cities and communities

SDG Goal 13: Climate action

SDG Goal 17 : Partnerships for the Goals

The economic benefits are related to creation of new jobs, cost savings for households, attracting tourism and other indirect economic benefits. Table 13 summarises the relationship between the SDG goals and the wider benefits of the CAP actions.

Each of the actions included in this CAP (see section 5) considers the specific wider benefits to the environment, society and economy, and ensures these benefits can be realized in an inclusive way. These benefits are also summarised in section 5.5.

Environmental benefits

- Reduce air and water pollution
- Utilize Compost over chemical fertilizer
- Reduce Deforestation
- Maintain ecosystem, wildlife & biodiversity
- Reduces the risk of runoff
- Greening and restoration of natural resources

Social benefits

- Reduced health issues - vermin, disease, contamination
- Health through better sanitation
- Health through newer, safer, cleaner road infrastructure and vehicles
- Increased thermal comfort
- Improved reliability of energy supply for extracurricular benefits
- Greater equality of opportunity e.g. access to education, water, electricity,
- Access to cooling e.g. poor, vulnerable; Enhances local amenities
- Reinforces local culture, values, and available skills and technology or solutions Reduce food insecurity
- Job creation and benefit to vulnerable groups

Economic benefits

- New employment opportunities
- Creates new local industry and jobs
- Improved connectivity
- Biofuel production generating new industries and agricultural income
- Cost savings from lower energy consumption and available for export
- Potential to boost tourism/ visitors/ attract talent permanently
- Potential for positive economic multipliers

Table 13: Summary of wider benefits of the CAP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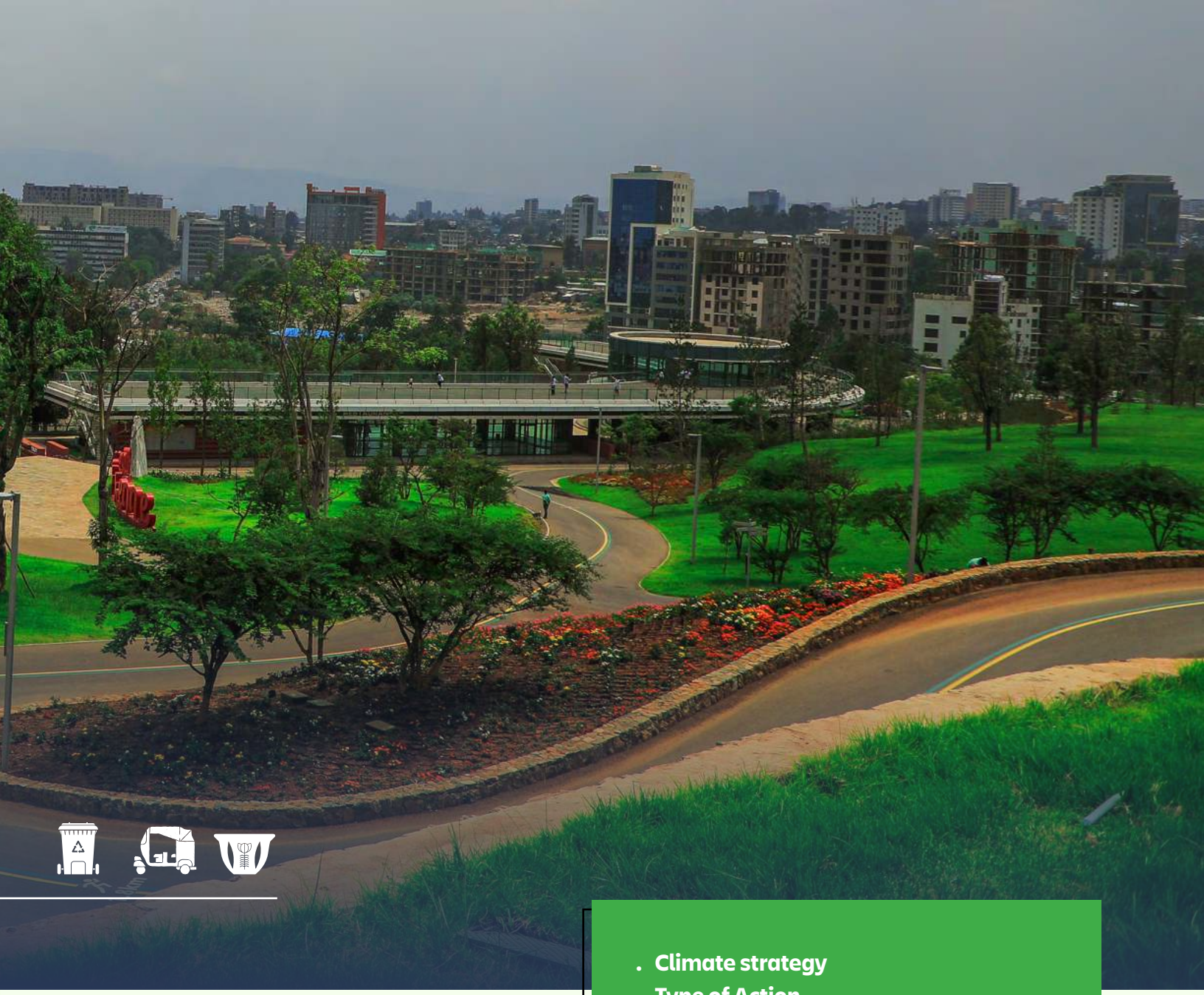
5. Climate action roadmap

The actions described in this CAP aim to transform the ways in which people in Addis Ababa travel, work and go about their lives, to deliver the goals of carbon neutrality and reduced vulnerability to climate impacts.

The following chapter considers a range of actions, grouped within overarching themes that are most relevant for reducing GHG emissions and/or improving climate change adaptation and resilience.

Many build on measures already being pursued by the city, whilst others will introduce actions that are not currently being implemented. Recommendations for sub-actions designed to support the implementation of each high-level action have also been provided with an indicative resourcing plan (funding and financing), indicators for monitoring, evaluation and reporting (MER), and co-benefits identified.



For each action, the CAP presents a summary of the key features and expected impacts, referred to as the 'Action Blueprint'. These provide critical information on the following:

- **Climate strategy**
- **Type of Action**
- **Climate impact**
- **Lead agency**
- **Collaborating agency(s) or stakeholder(s)**
- **Timeline**
- **Resourcing plan (funding & financing)**
- **Level of city control**
- **Alignment with Policies & Plans**
- **Key performance indicators**
- **Co-benefits**
- **Sub-actions**

5.1.

ACTION SUMMARY

PRIORITISED MITIGATION ACTIONS

Waste

#M1 – Campaign to Promote the Waste Hierarchy
#M2 – Construct Composting Facilities
#M3 – Enhance Sewage/Wastewater Treatment System
#M4 – Enhance Landfill Management and Install Gas Capture Facilities

Transport

#M5 – Improving Vehicle Efficiency via Emissions Standards
#M6 – Improve Public Transport Networks
#M7 – Promote Modal Shift to Non-Motorized Transit
#M8 – Enhancing fuel efficiency via switch to hybrid/electric vehicles or biofuels

Energy

#M9 - Improve Permitting Process for New Buildings
#M10 - Improve Energy Efficiency in Existing Buildings
#M11 - Improve Energy Efficiency and Industrial Facilities
#M12 - Increase/Diversify Renewables in Electricity Generation
#M13 - Transition to Efficient Cooking Fuel
#M14 - Upgrade Street Lighting

PRIORITISED ADAPTATION ACTIONS

Urban planning

#A1: Require new development permitting (new building/ development codes) to account for increasing resilience to flood, drought and extreme temperatures
#A2: Increase green vegetated buffers between urban settlement and hazardous areas prone to flooding, landslide and subsidence
#A3: Ensure climate change representation on the dedicated Megaprojects Office
#A4: Enhance urban greenery with heat and drought tolerant vegetation to combat the loss of green spaces

Critical ecosystems

#A5: Rehabilitate deforested areas/water sheds to reduce soil erosion, enhance biodiversity and offer better ecosystem resilience
#A6: Provide water for irrigation of nature and greenspaces during heatwaves and droughts

Food security

#A7: Establish sustainable Agricultural Urbanism (AU) systems
#A8: Technical and capacity building activities for urban agriculture farmers
#A9: Improve water security through rainwater harvesting and irrigation management for urban agriculture

Health

#A10: Improve access to, and quality of, wastewater and sanitation infrastructure
#A11: Awareness raising of public health and climate change issues
#A12: Provision of preventative healthcare services in relation to vector-borne diseases (VBD)

Infrastructure

#A13: Update infrastructure design standards for improved resilience in order to undertake a programme of improvements to the infrastructure networks (e.g. transport, waste and sewage networks).
#A14: Undertake more detailed hazard mapping of risk areas to infrastructure
#A15: Improve the City's urban maintenance response and emergency response capacity

Energy

#A16: Smart Grid to create energy efficient electricity distribution networks within the City
#A17: River basin and watershed management to protect both hydropower potential and water resources

Water

#A18: Protecting rivers from solid waste, debris and harmful diffuse / pollution discharges
#A19: Efficient wastewater treatment and storm-water management
#A20: Accelerate urgently required water supply investments into water insecure and under-served areas

Although the CAP presents actions separately for mitigation and adaptation, careful consideration of the synergies and trade-offs has been included in their development. Figure 16 summarises the major linkages between sectors and actions, and more detail on these is found in section 5.4.

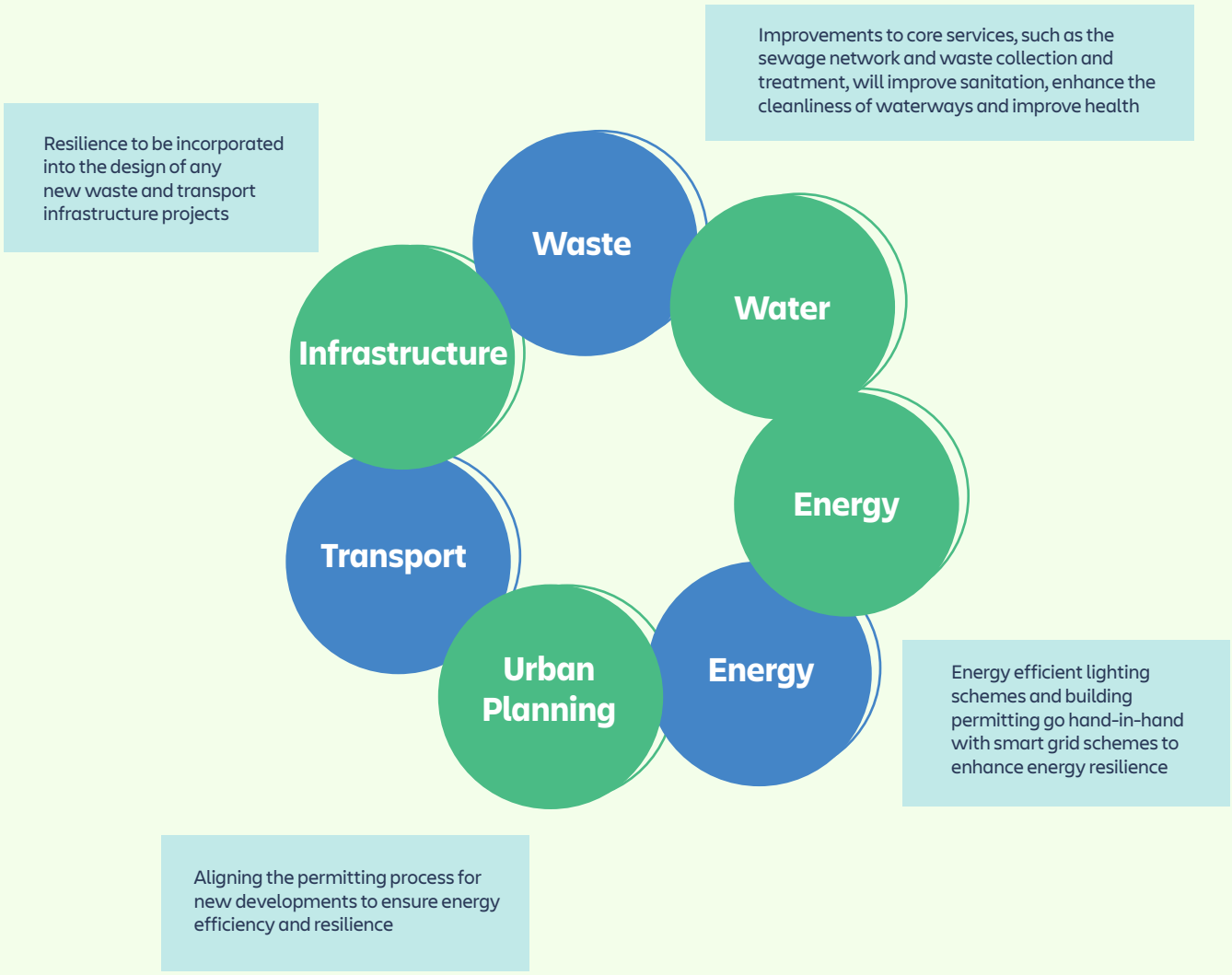


Figure 16: Major sector and action linkages

5.2.

Mitigation Actions Roadmap

This section sets out the actions aimed at mitigating the effects of climate change. Actions are broadly grouped by topic area. Each topic area is introduced with a summary of relevant contextual information for Addis Ababa.

5.2.1.

Re-thinking Waste and Wastewater Treatment

The 2016 GHG inventory for Addis Ababa showed that the waste sector (including solid waste and wastewater treatment) represented 13% of total GHG emissions.

Addis Ababa is home to more than 4 million people, who produce around 3,000 tons of solid waste per day[46] . Waste generation in the city is rising by 5% per year, due to a combination of population increase, higher incomes and changing consumption habits. Although the city has introduced ambitious waste reduction targets, at present, solid waste management is a major challenge in Addis Ababa. Nearly 55% of the population dispose of solid waste primarily through open burning[47] ; however, this has recently been reduced due through action of the Waste Management Agency to control practices through legal enforcement. Of the solid waste that is collected, around 85% is directed to landfill (with no gas capture), while only 5% is recycled. The remaining 10% is uncollected and dumped in unauthorized areas such as open fields, ditches, sewers, and streets. In addition to creating environmental and health hazards, particularly air pollution, this results in significant GHG emissions[48] .

The rising population in Addis Ababa is also increasing pressure on the city's wastewater infrastructure. Based on the 2016 GHG inventory, it is estimated to account for around 21% of emissions from the waste sector. A challenge for Addis Ababa will be to reduce emissions from this sector while also expanding coverage, as only 10% of the population is currently connected to the sewerage network. The city experiences problems with the lack of appropriate services for desludging, transportation and treatment of wastewater, along with unsafe containment and open defecation.

[46] Report from Addis Ababa Solid Waste Management Agency, 2020

[47] Environmental Policy Review 2011: Waste Management in Ethiopia Byby Matthew Cheever link

[48] Addis Ababa Solid Waste Management Agency ppt, 2020

Existing policies and plans

The national CRGE Strategy acknowledges that rapid growth of cities will require large scale investment in urban infrastructure, including management systems for solid and liquid waste. To this effect, Ethiopia has set out goals to use landfill gas management technologies to reduce emissions from solid waste, reduce methane production from liquid waste, increase composting and recycling of solid waste and to improve their wastewater treatment system.

In recent years, Addis Ababa has also undertaken significant transformations of their solid waste management system, in particular by rehabilitating Reppi-Koshe, a 50-year old major open landfill site. Relevant local plans are the Addis Ababa Climate Resilient Green Growth Plan and Integrated Climate Change Response Investment Plan (CRGCP) and the Addis Ababa Solid Waste Management Policy. To achieve its ambitious waste reduction targets, the city intends to promote the re-use and recycling of waste in households and commercial institutions, and increased composting of organic waste, which would require new facilities to be constructed.

The measures that are being implemented include raising awareness, setting penalties for unlawful dumping and open burning, and initiating a Construction Waste Recycling programme. Existing action on re-use and recycling requires strengthening as it currently stands at only 5%.

Regarding wastewater treatment, the CRGCP also outline plans to improve wastewater treatment, with the aim of increasing coverage to 75% of wastewater by 2030. by increasing the length of sewer line and fixing misconnections. The city also aims to increase the proportion of wastewater that is reused, treated and recycled from 0% to 10% by 2025. Other plans for action include introducing advanced treatment, promoting water reuse and recycling in industries, and source management.

List of actions

Stakeholders identified three top priority actions that are considered key to achieving the city's waste targets, along with one supporting action.

Priority actions:

- **Action #1 – Campaign to Promote the Waste Hierarchy**
- **Action #2 – Construct Composting Facilities**
- **Action #3 – Enhance Sewage/Wastewater Treatment System**

Additional actions:

- **Action #4 – Enhance Landfill Management and Install Gas Capture Facilities**

Further details are provided below.

Action #M1: Campaign to promote the waste hierarchy

Lead agency	AA Solid Waste Management Agency (SWMA)
Collaborating agency (s)/stakeholders	NGOs, City Land Management, Urban Greenery

This action will aim to reduce waste generation, increase re-use and recycling and improve waste management processes. Promoting re-use and recycling of waste in households and commercial institutions will reduce the amount of waste taken to landfills and the waste that remains uncollected. The action will be supplemented by improvements to the City's capacity to plan and manage waste streams.

Creating awareness on proper planning and waste management from the source is essential in handing waste. The City Authority has plans to enforce policies and strategies of waste management towards zero-waste (means no waste that the goes to landfill either the waste will be composted, reuse/recycled or energy for waste to energy facility) by creating awareness and setting penalties to unlawful dumping and open burning and developing a Construction Waste Recycling program for all demolition and construction debris. This is considered as a high priority action for improving air quality, but also has implications for GHG emissions.

Potential Impact

Increasing recycling of paper from 0% to 30% by 2050 will reduce emissions by up to 704,120 tCO2e per year (in 2050). Increasing recycling of plastic from 0% to 30% by 2050 will reduce emissions by up to 800,870 tCO2e per year (in 2050)

Steps to Implementation	<2 years	2-5 years	>5 years
Launch a public education and awareness campaign on waste reduction and segregation	✅		
Encourage recycling companies to expand their services, including upgrading/procuring/ recruiting necessary equipment and staff	✅		
Launch programmes to improve recycling capacity in the city	✅		
Promote waste segregation at the household level		✅	
Prepare, plan, tender and construct new waste transfer stations			✅

Action #M2: Construct composting facilities for the processing of organic wastes from domestic and commercial properties

Lead agency	AA SWMA
Collaborating agency (s)/stakeholders	NGOs, City Land Management, Urban Greenery

This action aims to support construction of large-scale facilities for composting and processing organic waste (from both domestic and commercial sources), thus diverting it from landfill. This will also require waste segregation and collection.

The city has plans to prepare compost from the organic component of the city waste, aiming to build four composting facilities by 2022. The current composting and recycling rate is around 5% of the total organic waste – the city needs to increase it composting activities as the city is aiming for a 100% reduction in waste by 2030. With this, the amount of waste directed to landfill will reduce from the 70% (current) to 10% by 2025.

Potential Impact

Composting actions will initially increase emissions, but by 2050 (70% of organic waste composted) will reduce emissions by 396,420 tCO_2e per year by 2050.

Steps to Implementation	<2 years	2-5 years	>5 years
Select and organize microenterprises to be involved in composting projects	✓		
Launch a public education and awareness campaign	✓		
Launch training programmes for site staff	✓		
Select appropriate sites for composting	✓		
Facilitate integration of (and communication between) implementation organisations (MOUs)	✓		
Supplying working materials to composting sites		✓	
Create a market network			✓
Establish monitoring and evaluation system			✓

Action #M3: Improve the sewage network in Addis Ababa

Lead agency	AAWSA, AACRA and AASWMA
Collaborating agency (s)/stakeholders	NGOs, City Land Management, AA Health Bureau

Replacing vacuum trucks with sewer lines, repairing sewer misconnections and the introduction of new regulations and policies to prevent waste dumping and waste burning.

This action will include the replacement of vacuum trucks with sewer lines and repairing sewer misconnections. The city also has plans to improve the centralized and decentralized wastewater collection system. Currently, the city has a centralized sewer system which is to be improved by 75% by 2030 by increasing the length of sewer line and fix misconnections. There is also a goal to increase per capita wastewater reused, treated and recycled from 0% (current) to 10% by 2025. This involves plans to implement anaerobic wastewater treatment and reduce use of latrines.

Potential Impact

Without biogas capture, anaerobic wastewater treatment actions will increase emissions by up to 230,834 (in 2050) tCO2e per year. This action will also protect the city against sanitation hazards.

Steps to Implementation	<2 years	2-5 years	>5 years
Fix sewer misconnections	✅		
Revise existing wastewater treatment regulations and enforce connection to sewage network	✅		
Undertake capacity building programmes to address a technical skill and resourcing gap	✅		
Design a payment modality for sewage connection	✅		
Implement the expansion of sewage lines throughout the catchment		✅	
Construct an additional new wastewater treatment facility			✅
Launch a public education and awareness campaign surrounding sewage network connection and use			✅
Undertake monitoring compliance to new regulations			✅

Action #M4: Enhance landfill management and install gas capture

Lead agency	AA SWMA
Collaborating agency (s)/stakeholders	NGOs, City Land Management, Urban Greenery

The key focus of this action is rehabilitating existing landfill sites and constructing new ones.

The Government of Japan has been supporting the rehabilitation of Reppi-Koshe using the Fukuoka Method of solid waste management, which reduces GHG emissions from landfills while also helping to prevent landslides and gas explosions. This action relates to that ongoing work, and also addresses the longer-term need to develop a new sanitary landfill in Addis Ababa that can replace it.

This will improve the urban environment by reducing smoke, bad odours and leachate groundwater penetration. The city also intends to operationalise gas capture and use at existing and proposed landfills which will provide further emission reductions.

Potential Impact

Prevent landslides and gas explosions at sites, combat the challenges and hazards of increasing waste and inappropriate disposal methods.

Steps to Implementation	<2 years	2-5 years	>5 years
Complete the Fukuoka landfill system	✅	✅	✅
Operationalize the landfill gas capture			✅
Undertake efforts to expand the well-managed landfill capacity (with gas capture) of the city			✅

5.2.2.

Transitioning to Clean Mobility in Addis Ababa

In the Addis Ababa GHG inventory for 2016, transport was the highest emitting sector, accounting for 78% of the total GHG emissions. [49]

Road transport is the largest source of GHG emissions in Addis Ababa. According to the Drivers and Vehicles Controlling Authority (DVCA) data, the number of vehicles in Addis Ababa has grown by 79% in the past 6 years, and it is estimated that Addis Ababa represents more than 60% of the vehicles registered in the entire country. Because such a large share of the city's emissions come from transport, transformational actions in this sector will be critical to achieving Addis Ababa's GHG reduction targets. They will also deliver a range of co-benefits to citizens, such as better air quality, road safety, and increased mobility.

Despite success with the unprecedented expansion of the road and highway networks in Addis Ababa in recent years, traffic congestion, accidents, and emissions have increased. To tackle these challenges, the city aims to promote a modal shift to mass transit, implement monitoring of traffic flows to reduce congestion, promote fuel switches and enact enhanced fuel efficiency standards.

Existing policies and plans

The Ethiopian government has developed several strategies that are relevant to sustainable transport. The Climate Resilient Transport Sector Strategy sets the framework for the government to deliver an integrated, modern transport system, with a strong emphasis on multi-modal transportation and customer service. The CRGE and CRGCP also propose further plans, for example to promote uptake of low emission technologies and increase the percentage of biofuels in the fuel mix for both petrol and diesel vehicles.

The Non-Motorized Transport (NMT) Strategy 2020-2029 outlines the measures the national government plans to implement over the next 10 years to improve mobility and facilitate inclusive urbanization. It includes a specific aim of increasing the mode share of NMT to 60% or above. Similar themes are addressed in the Ministry of Transport's 10-Year Perspective Plan, which addresses topics such as promoting walking and cycling, and improving public transport infrastructure and capacity. Currently, the city transport bureau is also preparing transport sector environment and air pollution strategy which will address GHG and air pollution. Moreover, the Ethiopian Road Transport Policy (draft report 2021) proposes specific solutions for developing an environmentally friendly transport system that include:

- Implementing standards to reduce emissions, noise, lighting and radiation pollution;
- Implementing a system that encourages the use of modern, efficient vehicles by setting vehicle age limits and replacing long-used vehicles; and
- Establishing fuel quality standards.

At a local level, the Addis Ababa Transport Systems Improvement Project (TRANSIP) Project aims to improve the traffic and safety management practices through measures such as:

- Improving road and pedestrian safety interventions at selected locations;
- Strengthening the capacity of organisations such as the Addis Ababa City Roads Authority, the Federal Transport Authority (FTA) and the Anbessa City Bus Enterprise; and
- Supporting the Addis Ababa Road and Transport Bureau (AATB) and the Transport Programs Management Office (TPMO) to improve their business planning and implementation.

Overall, these plans and strategies are expected to help reduce transport emissions, but there is scope for these to be strengthened and improved.

[49] This figure includes aviation. Road transportation alone accounted for around 68 % of emissions under the BASIC reporting framework, which excludes aviation and other sectors outside the city's scope of influence.

List of actions

Stakeholders identified three top priority actions that are considered key to achieving the city's transport targets, along with one supporting action.

Priority actions:

- **Action #5** – Improving Vehicle Efficiency via Emissions Standards
- **Action #6** – Improve Public Transport Networks
- **Action #7** – Promote Modal Shift to Non-Motorized Transit

Additional actions:

- **Action #8** – Enhancing fuel efficiency via switch to hybrid/ electric vehicles or biofuels

Further details are provided below.

Action #M5: Improving vehicle efficiency via emissions standards

Lead agency	Addis Ababa Transport Bureau
Collaborating agency (s)/stakeholders	AA EPGDC, AACA, Industry, AATMA

This action aims to reduce emissions from vehicles by promoting the use of newer, more efficient models, and requiring routine maintenance, inspections and training.

This action will involve setting emission standards for both new and imported vehicles, to be implemented via taxation and maintenance. The national government aims to incentivize the uptake of newer cars through taxation and improve the efficiency of operating vehicles by carrying out maintenance, inspections and training. The import of older cars will also be limited, and all vehicles will be subject to annual inspection and maintenance. Here it should be noted that vehicle age is not always a proxy for emission standards. Therefore, this action will need to be supported with emissions testing / inspection standards and consideration of import controls.

Potential Impact

This action has the potential to reduce about 10% of GHG emissions from the transport sector.

Steps to Implementation	<2 years	2-5 years	>5 years
Align new emissions standards with international benchmarks	✓		
Identify the routes and types of vehicles to be covered by new regulations	✓		
Develop programmes to enhance the capacity of regulatory bodies	✓		
Prepare new vehicle emissions regulations to be enforced in the city		✓	
Launch a public education and awareness campaign			✓
Begin the implementation and enforcement of new regulations			✓

Action #M6: Improve public transport networks

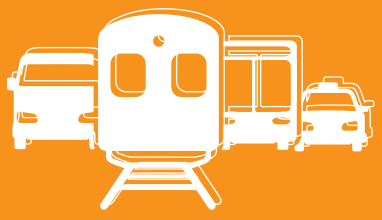
Lead agency	Addis Ababa Transport Bureau
Collaborating agency (s)/stakeholders	AA EPGDC, AACA, Industry, AATMA

This action aims to reduce the use of personal motor vehicles by promoting mass transit, car sharing, and improved infrastructure.

The promotion of mass transit will include road pricing via tolls, promotion of car sharing, improved regulation for buses, expansion of light rail transit (LRT) and bus rapid transit (BRT), and improved infrastructure. The public transport infrastructure will be improved so that BRT passengers increase from 150,000 passenger per day to 876,000 passengers per day in 10 years.

Potential Impact

A shift towards mass transit has the potential to reduce emissions by over 8 $MtCO_2e$ per year by 2050.



Steps to Implementation	<2 years	2-5 years	>5 years
Purchase new (conventional) buses to service existing demands	✅		
Improve and develop transport infrastructure (e.g. depots, parking space)	✅		
Launch a public education and awareness campaign to promote and encourage public transport use		✅	
Design & implement improved regulations for buses		✅	
Purchase new BRT buses		✅	
Construct new BRT corridors/roads		✅	
Develop and implement projects to expand LRT		✅	

Action #M7: Promote modal shift to non-motorised transport

Lead agency	Addis Ababa Transport Bureau
Collaborating agency (s)/stakeholders	AA EPGDC, AACA, Industry, AATMA

This action focuses on supporting a reduction in car use. This will involve improvements to footpaths, the construction of secure bicycle parking and cycling infrastructure, the introduction of bicycle purchase subsidies, car sharing, car free days and a supporting awareness campaign. It will align with, and support, the national Non-Motorized Transport (NMT) Strategy, which proposes measures such as:

- Increasing the modal share of walking, cycling and public transport;
- Reducing the use of personal motor vehicles;
- Enhancing road safety;
- Reviewing the existing Street Design Standards;
- Improving street lighting to enhance safety and security;
- Developing guidelines for mobility planning;
- Fostering intersection improvements; and
- Promoting car-free days and car sharing/pooling.

Potential Impact

A shift towards NMT has the potential to reduce emissions by 1.4 $MtCO_2e$ per year by 2050.

Steps to Implementation	<2 years	2-5 years	>5 years
Develop a programme that provides financial incentives for cycling and supports the upfront costs of bicycles	✓		
Prepare legal frameworks that will support implementation of the NMT strategy		✓	
Promote use of new technologies, bike share schemes and electric bikes		✓	
Build a new cycling training ground		✓	
Rehabilitate and build walkways to encourage walking and improve pedestrian safety		✓	
Conduct research and studies that assess progress towards transport mode shift goals		✓	
Launch a public education, awareness and capacity building campaign (e.g. promoting and creating cycle cultures in schools and different parts of the city via events, PR, through decision-makers, champions etc.)			✓
Build the appropriate infrastructure for walking, cycling, and parking, including undertaking feasibility studies, design and construction			✓
Develop a comprehensive city-wide green cycling / walking network			✓

Action #m8: Enhancing fuel efficiency via a switch to hybrid/ electric vehicles

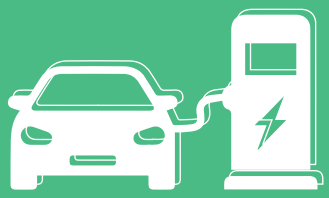
Lead agency	Addis Ababa Transport Bureau
Collaborating agency (s)/stakeholders	AA EPGDC, AACA, Industry, AATMA

This action will enhance vehicle efficiency by promoting a switch to electric vehicles. This will require the construction of charging stations, recognising that there are already two depots with charging stations. This action may include encouraging the substitution of imported fossil fuels with sustainable biofuels, where there are demonstrable lifecycle carbon benefits. It will be supported by the introduction of more stringent fuel efficiency standards (see Action #5).

This action will align with the national government's aspiration for all buses to become electric, and to introduce 15 corridors. For instance 40 mass transit buses in one corridor. Addis Ababa will aim to increase their share of electric vehicles from 0% to 2% over the next 10 years.

Potential Impact

Switching to low- and zero-emission vehicles has the potential to reduce emissions by roughly 8 $MtCO_2e$ per year by 2050.



Steps to Implementation	<2 years	2-5 years	>5 years
Engage with national government on alternative vehicle promotion and roll-out plans to ensure policy alignment	✓	✓	✓
Develop local policies and regulations for alternative fuel vehicles	✓	✓	✓
Identify priority existing transit routes and new routes for electrification of transit	✓		
Identify community electric vehicle charging point needs (numbers and locations)	✓		
Undertake planning and feasibility studies to understand requirements for electrification of transit		✓	
Identify suitable sites for biofuel sales to vehicles		✓	
Design and implement awareness raising and educational campaigns		✓	
Design and implement financial incentives for purchase, lease or loan of EVs for public use		✓	
Construct charging stations for electric vehicles		✓	✓
Establish new storage and refilling facilities for sustainable biofuels (e.g. depots)			✓

5.2.3.

Energy Transition and Building Optimization

Promoting power generation that is resilient to climate change impacts requires diversifying the energy mix, while enhancing energy efficiency measures and increasing access to off-grid energy.

The energy sector in Ethiopia accounts for around 3% of the total GHG emissions, which is far below the global average of more than 25%. This is because grid electricity production is largely based on renewable technologies: hydropower contributes to more than 90% of the total power generation capacity. There is also a significant contribution from wind, geothermal, solar, and biomass. Going forward, it will be important to ensure that all energy use can be delivered via renewables.

At present, available data suggests that energy use in buildings, and the resultant GHG emissions, are mainly associated with electricity. However, fossil fuels such as wood, charcoal and biomass waste, kerosene and LPG (for cookstoves) are also commonly used in commercial and residential premises, and most commercial and industrial facilities have a backup diesel generator for use during power outages. For manufacturing industries, the most commonly used fuel is furnace oil or heavy fuel oil.

Existing policies and plans

There are multiple existing policies and plans related to improving energy efficiency in buildings and delivering a decarbonized energy system. For example, the CRGE Strategy speaks to increasing renewables in electricity generation, aiming for 20% from wind and solar, 10% from geothermal, and continuing to produce 70% of the country's energy from hydropower. The CRGE Strategy requires that existing buildings upgrade their water heating to solar water systems; if the national strategy is implemented, up to 19% of residential homes in Addis Ababa could have these systems installed by 2030.

Energy efficiency in buildings is another one of the key CRGE initiatives in the urban sector and is also targeted in the EEA (Ethiopia Energy Authority) Indicative Strategic Plan and the CRGCP. The Ministry of Urban Development and Housing (MOUDH) has set out a target of reducing national emissions by 0.5 MtCO2e per year from the implementation of energy efficiency building sector actions between 2020 and 2030.

Also prioritized in the CRGE Strategy are plans to improve fuel efficiency by distributing 30 million improved cookstoves by 2030 nationally. If achieved, this would significantly reduce or eliminate the number of people consuming biomass at unsustainable rates, as well as providing a host of other health, productivity and emissions benefits.

Within the urban public realm, the CRGE Strategy and the EEA Indicative Strategic Plan outline goals to retrofit streetlighting with more efficient technologies. The Addis Ababa City Roads Authority (AACRA) has embarked on a project to brighten the streets of Addis Ababa through installation of new technology and replacing existing streetlights with energy efficient lamps and LEDs. This is part of an initiative to provide a safer environment at night for both commuters and pedestrians. In 2018, the Authority allocated 100 million Birr towards this initiative. The new technology streetlights have a longer durability time of up to 10 years, and cut the 240W consumption of older lights by half, consuming only 120 W.

List of actions

The city is targeting success by encouraging the uptake of small-scale renewables and energy efficiency improvements in existing buildings, as well as introducing improved permitting processes (supported by Green Building Standards) for new buildings. There are various interrelationships between these topics, but for the sake of clarity they have been divided into three priority actions and three supporting actions.

Priority actions:

- **Action #9** - Improve Permitting Process for New Buildings
- **Action #10** - Improve Energy Efficiency in Existing Buildings
- **Action #11** - Improve Energy Efficiency in Industrial Facilities

Additional actions:

- **Action #12** - Increase/Diversify Renewables in Electricity Generation
- **Action #13** - Transition to Efficient cooking stoves
- **Action #14** - Upgrade Street Lighting

Further details are provided below.

Action #M9: Improve permitting process for new buildings

Lead agency	AACA
Collaborating agency (s)/stakeholders	AA EPGDC, MoWIE, EFCCC

The city is working towards improving the energy efficiency of new buildings through changes to the permitting process, including increasing the use of the ISO Certified Energy Efficiency Materials Green Building Standards. This has the potential to result in a 12-20% emissions saving in new buildings by 2030.

This action would create changes in the permitting process in order to address energy efficiency measures such as improving the building envelope, upgrading lighting to LED and promoting the use of energy efficient appliances. In the quest to enhance energy efficiency in new buildings, the city would also require all buildings to have necessary conditions and space to install solar water heaters and solar home systems, including efficient space cooling upgrades such as HVAC.

Although this action would impact all new buildings, the city administration recognises the particular importance of taking a leadership role by implementing best practice standards in any of its own new facilities. This could include going above and beyond the improved requirements.

Potential Impact

Estimated emissions reduction of 20.7 $MtCO_2e$ per year by 2050.

Steps to Implementation	<2 years	2-5 years	>5 years
Undertake a survey of buildings, building owners and construction companies to understand opportunities and challenges to permitting programmes for new buildings and current energy efficiency status and measures (<2 years)	✅	✅	✅
Design and undertake stakeholder engagement and awareness raising amongst building developers, construction companies, building owners/managers and with the public (<2 years)	✅		
Development of a framework for energy efficiency permitting and standards, consultation and pilot, including roll-out of the timescale and requirements (<2 years)	✅		
Begin implementation of new building standards for new developments (2-5 years)		✅	
Begin monitoring and evaluation of compliance with new building standards (>5 years)			✅

Action #M10: Improve energy efficiency (and uptake of small-scale renewables) in existing buildings

Lead agency	AACA
Collaborating agency (s)/stakeholders	AAEPGDC, MoWIE, EFCCC

This action involves assessing the energy efficiency of the existing building stock, and then identifying and delivering targeted interventions (e.g. aimed at specific building types, neighbourhoods, etc.) that can deliver benefits across the city. This aligns with the national CRGE Strategy requirements for existing buildings to improve appliance efficiency and upgrade their water heating to solar water systems. It has strong links with other actions related to increasing renewable energy uptake and reducing energy demand in new buildings (see Actions #9, #11 and #12).

The city administration will also seek to demonstrate best practice standards when upgrading or retrofitting publicly owned buildings, wherever feasible.

Potential Impact

Upgrading water heating could reduce emissions by 2.3 $MtCO_2e$ per year by 2050 and lighting upgrades could deliver reductions of 0.24 $MtCO_2e$ per year by 2050.

Steps to Implementation	<2 years	2-5 years	>5 years
Identify and select potential renewable energy technologies and other energy efficiency interventions that might meet different community and housing types across the city	✓	✓	✓
Undertake a detailed planning and feasibility study of energy efficiency and renewable energy technologies to further define needs, requirements and methods for roll-out	✓		
Launch a programme of stakeholder engagement and capacity building on energy efficiency measures, including media/ PR campaigns, and local training programmes for households and installers via community networks	✓		
Identify and secure funding to support the roll-out of renewable energy technologies, including establishing a fund / financing schemes for householders and developers to low carbon finance measures	✓		
Roll out implementation of measures across priority areas of the city, working with local installers and communities		✓	
Launch a monitoring and evaluation programme to track implementation progress and savings (>5 years)			✓

Action #M11: Improve energy efficiency in industrial facilities

Lead agency	AACA
Collaborating agency (s)/stakeholders	AAEPGDC, MoWIE, EFCCC

This action will focus on fuel switching and renewables, and is to be supported by training, capacity building, targets and incentives. Enhancing energy efficient technologies in industries will require the undertaking of Energy Audits (EAs) and putting in place an incentivization mechanism for efficient technologies in industries.

This will also include refining and putting in place a policy and implementation framework that increases the uptake of energy efficient equipment and appliances by major market players in residential, commercial and industrial sectors.

Potential Impact

Estimated emissions reduction of 9.3 $MtCO_2e$ per year by 2050.

Steps to Implementation	<2 years	2-5 years	>5 years
Conduct a study / assessment of current energy efficiency status in different industries in the city, and opportunities/challenges for improvement	✓		
Identify and scope out requirements for potential alternative resources via research and studies – includes both energy resources (renewables/fuel switching), efficiency measures, and financial and other resources required to assist a transition	✓		
Conduct capacity building for all stakeholders – targeting key industry sectors in the city for engagement and training on possible improvements	✓		
Strengthen institutional set up for compliance monitoring and control with industry bodies and permitting organisations	✓		
Issue regulations, standards and guidelines on energy use in key emitting industrial sectors		✓	
Create incentives and an uptake-mechanisms for the industrial sector, including financial, technological and capacity incentives and support			✓
Conduct compliance monitoring and control to ensure adherence to measures and track impact on energy & emissions			✓

Action #M12: Increase/diversify renewables in electricity generation

Lead agency	AACA
Collaborating agency (s)/stakeholders	AAEPGDC, MoWIE, EFCCC

This action is intended to promote uptake of diverse renewable energy technologies. This action would provide expanded grid connections to communities that currently do not have them, while also ensuring that the electricity grid is supplied by renewable technologies to meet the changing demands.

As part of this, it will also be important to address the use of diesel back-up generators; this action aims to almost eliminate these by 2030.

Potential Impact

Helps to ensure continued energy security, sustainability and affordability while reducing emissions.

Steps to Implementation	<2 years	2-5 years	>5 years
Support expanded grid connections in the city through identifying locations without existing connections, and working with the Ethiopian Electricity Company to upgrade these settlements	✅	✅	✅
Phase out diesel generators utilized for back-up power through design and implementation of regulations for use (to almost 0% by 2030)	✅	✅	✅

Action #M13: Transition to efficient, low emission cooking stoves

Lead agency	AACA
Collaborating agency (s)/stakeholders	AAEPGDC, MoWIE, EFCCC

The key focus of this action is reducing emissions from domestic cookstoves. As mentioned previously, the CRGE Strategy outlines a plan to improve fuel efficiency by distributing 30 million cookstoves by 2030 nationally, which has the potential to reduce national GHG emissions by around 50 MtCO2e. This action aims to deliver those benefits locally to the residents of Addis Ababa, where most of the fuel used for cooking currently comes from biomass and other unconventional sources. This action will focus on existing buildings and prioritise low-income neighbourhoods.

Potential Impact

Potential emissions reduction of 1.5 MtCO2e per year by 2030.

Steps to Implementation	<2 years	2-5 years	>5 years
Distribution of improved stoves (100% by 2030)	✅	✅	✅

Action #M14: Upgrade streetlighting

Lead agency	AACA
Collaborating agency (s)/stakeholders	AAEPGDC, MoWIE, EFCCC

This action aims to replace lighting technology with efficient models. This will require the phased roll-out of replacement bulbs and improvements in supporting technology, where necessary. It will also involve ensuring that the existing lighting systems in the public realm are adequately maintained.

This supports the AACRA's ongoing initiative aimed at upgrading streetlighting across the city.

Potential Impact

Potential to reduce energy demand by 148 MWh/year by 2050.

Steps to Implementation	<2 years	2-5 years	>5 years
Install (or replace with) LED streetlighting (target year 2022)	✅		
Maintain existing streetlighting (target year 2022)	✅		

5.3.

Adaptation Actions Roadmap

This section sets out the actions aimed at adapting to the current and projected effects of climate change. Actions are broadly grouped by topic area. Each topic area is introduced with a summary of relevant contextual information for Addis Ababa.

5.3.1.

Urban Planning Sector

Addis Ababa faces significant problems related to urban planning, primarily due to the rapid population growth. The urban planning sector of Addis Ababa has undergone several changes, whereby planning institutions have experienced frequent reshuffling of roles and responsibilities. The city masterplans developed by Addis Ababa's City Government Planning and Development Commission demonstrate the long-term nature of this challenge.

Existing policies and plans

The national Urban Planning Proclamation no 547/2008 establishes a legal framework to promote well-planned and -developed urban centres. The Environmental Policy of Ethiopia (1997) has a sectoral policy framework addressing forest, woodland and tree resources, with subsections concerning human settlement, urban and environmental health. The Ministry of Urban Development and Housing prepared the Climate Change Resilient Urban Green Development Strategy, as a roadmap to fulfil the urban population's need in relation to urban green infrastructure service provisions.

The 2017-2027 Masterplan of Addis Ababa is based on four planning principles that aim to ensure that major environmental / greenspace components into are integrated into the City, namely: multifunctionality, green-grey interactions, connectivity, and social inclusiveness. The Masterplan requires socio-economic conditions to be considered in planning proposals, which contributes greatly to building the adaptive capacity to climate change. However, it is worth noting that most developments carried out in the City are reportedly not complying with the masterplan principles or requirements.

Another noteworthy policy, introduced by the city's Environment and Green Development Commission, requires that large projects should allocate 30% of land for greenspace. This is relevant to various adaptation-related topics including urban planning, critical ecosystems, and the health sector (due to the impacts on local temperatures/microclimate, mental and physical wellbeing, and so on).

List of actions

- Action #A1: Require new development permitting to account for increasing resilience to flood, drought and extreme temperatures
- Action #A2: Increase green vegetated buffers between urban settlement and hazardous areas prone to flooding, landslide and subsidence
- Action #A3: Ensure climate change representation on the dedicated Megaprojects Office
- Action #A4: Enhance urban greenery with heat and drought tolerant vegetation to combat the loss of green spaces

Further details are provided below.

Action #A1: Require new development permitting to account for increasing resilience to flood, drought and extreme temperatures

Lead agency	Urban Planning and Development Commission, AA EPGDC
Collaborating agency (s)/stakeholders	Private sector, NGOs, Government

Regulate all new developments across all public and private sectors, including in-situ upgrades, to be climate compatible/future-proof to physical climate impacts of extreme heat, flood and drought. This would be addressed via implementation of new building / development codes. It links with the mitigation actions set out in Section 5.2.3, particularly Action #M9.

Potential Impact

This action will help to protect the city against flooding (river and surface/ flash flooding), temperature stress and landslides.

Steps to Implementation	<2 years	2-5 years	>5 years
Define what the improved development permits are conditional on.	✅		
Requirement for new builds to be adapted to future conditions and have more appropriate material selection for resilience, e.g. consider inclusion of green roofs and incentivise rainwater tanks.		✅	✅
Test as a pilot on a select number of development applications, adjust the review/inspection/ approval process as needed, and plan for scale up.		✅	

Action #A2: Increase green vegetated buffers between urban settlement and hazardous areas prone to flooding, landslide and subsidence

Lead agency	Urban Planning and Development Commission, AA EPGDC
Collaborating agency (s)/stakeholders	Private sector, NGOs, Government and Higher Education Institutes

This action seeks to retain and reinstate vegetated green buffers between urban settlement and landscape features prone to natural hazards like flood.

Note: This action links with Actions #A4 (urban greening), #A5 (re-afforestation of watersheds) and #A6 (water for greenspaces).

Potential Impact

This action would help to protect the city against flooding (river and surface/ flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Develop guidelines on vegetation buffer widths for different landscape features (e.g. river buffers, steep slope buffers).	✅	✅	
Regulate the need for vegetated buffers and setback lines from sensitive/high risk areas like floodplains and steep areas.		✅	
Delineate landslide and flood risk areas and set appropriate vegetation buffer requirements.		✅	
Consider incentives (e.g. rebates) for private landowners to retain and maintain vegetated green buffers as green open spaces.		✅	
Vegetate and maintain all buffers.		✅	✅

Action #A3: Ensure climate change representation on the dedicated megaprojects office

Lead agency	AA SWMA, AA EPGDC
Collaborating agency (s)/stakeholders	Government, Private sector, Higher institutions, NGOs

This action is encouraged with a view ensure that the climate resilience and adaptation narrative features in all mega project planning and that it is embedded into Addis Ababa's major urban planning projects through representation on its dedicated Megaprojects Office.

Potential Impact

This action would help to protect the city against identified climate hazards and primary impacts.

Steps to Implementation	<2 years	2-5 years	>5 years
Identify sector specialists in (i) adaptation and (ii) mitigation to be represented / housed within Megaprojects office.	✅		
Specify the mandate of these professionals, bestowing them with suitable powers of authority.	✅		
Identify key projects for climate action inclusion.	✅		
Add climate change to all development meeting agendas for consideration and inclusion in project and non-project discussions.	✅		
Detailed vulnerability and impact assessment for the infrastructure sector and critical ecosystems sector.	✅		

Action #A4: Enhance urban greenery with heat and drought tolerant vegetation to combat the loss of green spaces

Lead agency	AA Planning and Development Commission, AA EPGDC
Collaborating agency (s)/stakeholders	Private sector, NGOs and Government

The loss of green spaces is estimated to contribute to 40% of flooding and landslides in Addis Ababa. The City needs to combat the loss of green spaces through greater protection measures for green spaces and plant more resilient and climate-tolerant urban greenery. Implementation of green space planning, elaborated in the master plan, will contribute significantly to an increase in the net coverage of the City's green space in the next ten years.

Note: This action links with Adaptation Actions #A2 (green vegetated buffers), #A5 (re-afforestation of watersheds) and #A6 (water for green spaces).

Potential Impact

This action will primarily protect the City against flooding (river and surface/ flash flooding), temperature stress and landslides.

Steps to Implementation	<2 years	2-5 years	>5 years
Set development controls relating to the loss of green space with a zero net-loss policy.	✅		
Consider a 'one home one garden' campaign to increase green cover throughout the City by citizens, educating them on the benefits derived from gardens.	✅		
Develop a scientifically researched catalogue of resilient, low maintenance urban tree and plant species and publicise.		✅	✅

5.3.2.

Critical Ecosystems Sector

Recently, Addis Ababa's urban planning principles have strongly considered ecosystem-based planning in the foundational and structural planning/reimagining of the City. The City has adopted a linear greenspace development strategy whereby greenspaces will boost connectivity and the provision of ecosystem services across the cityscape. Implementation of the strategy's principle of linear connectivity will:

- Increase urban tourism through rehabilitating the riversides
- Enhance the well-being of city dwellers by keeping river flooding in check and creating public spaces, parks, bicycle paths and walkways along the riverbanks, and
- Enable an aspirant green economy by expanding green spaces that increase provision of ecosystem services, including for the benefit of tourism, talent attraction/retention and overall economic development.

Existing policies and plans

The 2015 Ethiopian National Urban Green Infrastructure Standard proposed that there should be 15m2 public green open spaces per capita within the City boundaries and that every resident should live within 500 meters of a public green open space of at least 0.3 hectares, though this standard has yet to be implemented in the City. This will equate to 30% allocation of city land to urban greenery/green space, with 40% allocated to built-up area, and 30% to street networks in the City.

Ethiopia's CRGE Strategy incorporates economic and ecosystem services (including carbon stocks) as one of the pillars in which more than 60 initiatives are identified and prioritised to achieve development goals whilst limiting GHG emissions. Some of these currently underway include:

- Increased GHG sequestration through forestry, i.e., protecting, and re-establishing forests.
- Green space planning, which is based on an ecosystem services approach, which contributes to the reduction of flood risk.
- Incorporation of green space into the master plan of the City increases the total coverage of green area providing multiple ecosystem services.

Other existing plans include the National Urban Green Infrastructure Standard of Ethiopia (2015) and the Addis Ababa Masterplan (2021-2027).

List of actions

- Action #A5: Rehabilitate deforested areas/water sheds to reduce soil erosion, enhance biodiversity and offer better ecosystem resilience
- Action #A6: Provide water for irrigation of nature and greenspaces during heatwaves and droughts

Further details are provided below.

Action #A5: Rehabilitate deforested areas/water sheds to reduce soil erosion, enhance biodiversity and offer better ecosystem resilience

Lead agency	AA EPGDC
Collaborating agency (s)/stakeholders	EFCCC, Oromia regional state (EFCCCO Agency), MoWIE, AAU (Addis Ababa University), AAFDRMC (Addis Ababa Fire and Disaster Risk Management Commission) and AARPO (Addis Ababa Resilience Project Office)

Re-afforestation of watersheds in Addis Ababa will provide a wealth of wider ecosystem and societal benefits in combination with better management of existing forested areas.

Note: This action links to Adaptation Actions #A4 (urban greenery), #A2 (green vegetated buffers) and #A6 (water for greenspaces).

Potential Impact

This action will primarily protect the City against gradual (chronic) temperature increase with associated instances of drought.

Steps to Implementation	<2 years	2-5 years	>5 years
Identification and delineation of areas for rehabilitation on a prioritised basis, and mapping thereof.	✓	✓	
Consider an adopt-a-spot for rehabilitation efforts by community members, schools and/or corporations.	✓		
Re-afforestation of deforested watersheds, land and gullies to reduce soil erosion, absorb precipitation, sequester carbon and boost air quality.		✓	✓
Increase involvement of indigenous and multipurpose tree species in parks and greenery areas to foster ecological function, increase climate amelioration and reduce species loss.		✓	✓
Introduce more stringent, regulated protection and management of existing forested areas.	✓	✓	
Communication and citizen involvement plan for the re-afforestation of watersheds.		✓	

Action #A6: Provide water for irrigation of nature and greenspaces during heatwaves and droughts

Lead agency	AA EPGDC and AA WSA
Collaborating agency (s)/stakeholders	NGOs, Private sector and Volunteers

This action is designed to avoid habitat degradation, wildfire, species loss and wider loss of refuge/shade/cooler space for species and urban dwellers. During extreme drought and heatwave events, this action seeks to ensure natural areas have access to enough water. This can be achieved through city-wide management interventions, supported by increased rainwater collection and runoff retention.

Note this action links to Adaptation Actions #A4 (enhance urban greenery), #A2 (green vegetated buffers) and #A5 (re-afforestation of watersheds), and #A9.

Potential Impact

This action will primarily protect the City against gradual (chronic) temperature increase and reduced rainfall regime, with associated instances of drought.

Steps to Implementation	<2 years	2-5 years	>5 years
Develop city-wide management protocol for water conservation and irrigation of natural areas during drought and heatwave events.	✓		
Enhance awareness of city maintenance teams with respect to extreme heat-related events, i.e. how to anticipate, prepare for, and guard natural areas against these events.	✓		
Train and amend working schedule for maintenance officials to cope with hot working conditions.		✓	
Boost access to water for irrigation through rainwater capture in strategic areas, retention ponds, etc.		✓	✓

5.3.3.

Food Security Sector

Urban agriculture plays a key role in contributing to urban food security and has been identified as one of the key sectors for enhancing resilience in Addis Ababa. Overall, 13.9% of the City's land area (7,175 ha) has been identified by local government and committed as agricultural land. The Addis Ababa City Development Plan (2002-2012) indicated that the livelihoods of 51,000 families in Addis Ababa were associated with farming. About 60-70% of fresh milk, 40-50% of egg, 30% of vegetables and about 3% of food grains consumed within the city are supplied from urban and peri-urban farms in/around Addis Ababa. However, food security is at risk from factors such as water pollution and urban encroachment, while urban sprawl and housing projects have displaced many farmers.

Existing policies and plans

The absence of policy in urban agriculture has resulted in poor land use planning in terms of land allocation for urban agriculture in the City. This is supported by evidence that most urban agriculture practices take place on waste lands and riverbanks.

While the master plan of 2017-2027 has integrated urban agriculture into current planning, urban and peri-urban agriculture does not feature in the planning tools for regulating the actual implementation of the plan (i.e., Strategic Development Framework, Strategic Development Action Plans; and Local Development Plans). Recently, and as a result of historical encroachment, the designated agricultural areas under the latest master plan (2017-2027) have been handed to a newly established institution called the Addis Ababa City Government Farmers and Urban Agriculture Development Commission.

List of actions

- Action #A7: Establish sustainable Agricultural Urbanism (AU) systems
- Action #A8: Technical and capacity building activities for urban agriculture farmers
- Action #A9: Improve water security through rainwater harvesting and irrigation management for urban agriculture

Further details are provided below.

Action #A7: Establish sustainable Agricultural Urbanism (AU) systems

Lead agency	Farmers and Urban Agricultural Development Commission
Collaborating agency (s)/stakeholders	City Land Administration and Urban Food Security Agency

Agricultural Urbanism (AU) aims to integrate food and agricultural activities into planning and development considerations to improve resilience through food security, and access to knowledge. It encourages approaches that would provide space for the City to grow sustainable foods and boost livelihoods without being subjected to encroachment or poor/risky environmental conditions.

Note: This action links to Adaptation Action #A8 (AU capacity building).

Potential Impact

This action will primarily protect the City against both temperature-related shocks (heatwave and drought) and flooding (river and surface/flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Regulate and promote Urban Agriculture through updates to the Strategic Development Framework, Strategic Development Action Plans, and Local Development Plans.	✓		
Identify, subsidise, educate and promote use of proven technologies and use of more resilient plant varieties		✓	
Increase the number of city farms and gardens in parks, on vacant lots, school grounds, and other appropriate and available areas.			✓
Promote AU as a business so that it can effectively contribute to income generation, achievement of sustainable livelihoods and poverty reduction.		✓	
Local and National governments (and other stakeholders) to consider new budgetary provisions to institutionalise UA.		✓	
Identify the predicted demand for urban farmed food and recommend location and distribution of UA and urban agricultural institutions.		✓	
Strengthen the infrastructure necessary for widespread, sustainable urban food production.		✓	✓
Recycle organic waste from urban agriculture to create compost (for reuse and also possible sale).	✓	✓	✓
Develop a plan that will promote healthy, local, and, where possible, organic food production, and include multiple stakeholders currently involved in food production and job training.	✓		

Action #A8: Technical and capacity building activities for urban agriculture farmers

Lead agency	Farmers and Urban Agricultural Development Commission
Collaborating agency (s)/stakeholders	Urban Food Security Agency

Strengthening urban farmers' skills and knowledge, including on climate change risks, to enhance productivity, food security, and the overall resilience of vulnerable urban dwellers.

Note: This actions links to Adaptation Action #A7 (sustainable Agricultural Urbanism) and #A9 (AU rainwater harvesting and irrigation).

Potential Impact

This action will primarily protect the City against both temperature-related shocks (heatwave and drought) and flooding (river and surface/flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Develop appropriate and tailored training/ capacity building materials.	✓		
Identify training service providers and deliver trainings.	✓		
Provide ongoing technical support and capacity strengthening in sustainable urban production to farmers through agricultural extension agents.	✓		
Build the capacity of local growers and city residents how to grow food and drought-tolerant crops/species		✓	✓
Identify funding accessible to farmers/co-operatives/small businesses.	✓		
Explore synergies between key stakeholders through appropriate information exchange and ongoing learning and knowledge-sharing platforms.	✓	✓	✓
Effectively coordinate interventions in education and training in the safe use of pesticides especially for fresh vegetable production.		✓	✓
Increase awareness of climate change impacts on food production and security.	✓		

Action #A9: Improve water security through rainwater harvesting and irrigation management for urban agriculture

Lead agency	AA Construction Bureau and the Farmers and Urban Agricultural Development Commission
Collaborating agency (s)/stakeholders	Urban Food Security Agency and Ministry of Innovation and Technology

Implementation of measures to sustainably secure water resources for agricultural activities during periods of low rainfall or drought (whilst minimising use of poor-quality water for irrigation).

Note: This action links with Adaptation Actions #A6 (green space irrigation), #A7 (sustainable Agricultural Urbanism) and #A8 (AU capacity building).

Potential Impact

This action will primarily protect the City against temperature-related shocks (heatwave and drought).

Steps to Implementation	<2 years	2-5 years	>5 years
Investigate and incentivise water harvesting and storage structures for supplemental irrigation.	✅		
Identify subsidy and funding mechanisms (and convey to the public).	✅		
Undertake a campaign on rainwater harvesting.	✅		
Research, plan for and support the development of small-scale irrigation schemes.		✅	
Introduce interventions such as safe irrigation techniques, improved shallow wells and boreholes that will minimise health risks in the use of marginal quality water.		✅	
Adaptation of vertical irrigation technologies via Ministry of Innovation and technology to most/all of residents for securing fruits and vegetables supply at household level		✅	

5.3.4.

Health Sector

The health sector has wide-ranging thematic and practical links to other environmental, social, and economic issues that have already been discussed in this CAP. Within Addis Ababa, public health is a major concern. This is due to a combination of factors, including but not limited to poor sanitation and wastewater management, air and water pollution, and others. Informal settlement areas are particularly affected.

There are currently 48 hospitals in Addis Ababa. The majority of general hospitals and health institutions belong to the private sector, which has reportedly improved access to health services at neighbourhood level, although affordability is an issue. On average, each health centres in the city serves approximately 35,000 inhabitants, which is better than the standard of 1: 40,000 adopted by Health Bureau of Addis Ababa City Government. However, like all forms of critical social infrastructure, the health system is likely to be impacted by climate change.

The increase in spread of communicable diseases in cities with poor sanitation and drainage reduces the adaptive capacity to climate change. Other significant health related issues can arise with increased flooding. Adaptation strategies associated with public health issues in Addis Ababa are integrated with strategies for other sectors and services. Such strategies need to promote "co-benefits" to ameliorate the existing and usually unequally distributed urban health hazards, and to reduce vulnerability to climate impacts.

Existing policies and plans

The master plan of the City proposed improvements to the health sector, which focus on increasing and upgrading the number of health centres and the number of health professionals. As the health of urban dwellers is also affected by water quality, waste disposal and food security, policy and planning require cross-sectoral co-operation.

Public health is linked with multiple other topics, particularly waste and wastewater management. For a description of existing policies and plans for those sectors, refer to Section 5.2.1. There are also cross-cutting issues that relate to urban planning and land use which are described in Section 5.3.1.

List of actions

- Action #A10: Improve access to, and quality of, wastewater and sanitation infrastructure
- Action #A11: Awareness raising of public health and climate change issues
- Action #A12: Provision of preventative healthcare services in relation to vector-borne diseases (VBD)

Further details are provided below.

Action #A10: Improve access to, and quality of, wastewater and sanitation infrastructure

Lead agency	AAWSA, AACRA and AASWMA
Collaborating agency (s)/stakeholders	NGOs, City Land Management, AA Health Bureau

Poor health in the City is often linked to weaknesses in other services that are important for public health, such as water supply and sanitation. Improvements to these core city services, and infrastructure will be key to increasing resilience. Note: This action strongly links with Mitigation Actions #M3 and #M4. Refer to Section 5.2.1 for further details.

Potential Impact

This action will primarily protect the City against flooding (river and surface/flash).

Steps to Implementation	<2 years	2-5 years	>5 years
[See Actions #M3 and #M4]	✓	✓	✓

Action #A11: Awareness raising of public health and climate change issues

Lead agency	AA Health Bureau
Collaborating agency (s)/stakeholders	NGOs, Stakeholders and Community

Ensuring the City's population is informed of the potential health risks and the links with climate change will increase awareness and influence behavioural change. Note: This action links to Adaptation Action #A10 (improved waste and sanitation infrastructure) and Action #A12 (vector-borne diseases preventative healthcare).

Potential Impact

This action will primarily protect the City's residents from the indirect impacts of flooding (river and surface/flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Identify most effective means of communication around technical health matters (e.g. consider a mobile app, printed media, etc.).	✓		
Identify funding for implementation.	✓	✓	
Increase public education on disease prevention for vector-borne diseases and other diseases that could increase as a result of climate change.		✓	
Raise awareness on prevention strategies across various platforms.	✓	✓	
Share lessons learned across sectors.	✓	✓	✓

Action #A12: Provision of preventative healthcare services in relation to vector-borne diseases (VBD)

Lead agency	AA Health Bureau
Collaborating agency (s)/stakeholders	NGOs, Stakeholders and World Health Organisation

Rolling out of vaccination programmes to prevent vulnerability to disease (e.g. yellow fever, malaria) and expanding systems to monitor disease, while researching opportunities for new measures, combined with awareness raising activities.

Note: This action links to Adaptation Actions #A10 (improving access to water and sanitation services) and #A11 (public health and climate change awareness raising).

Potential Impact

This action will primarily protect the City's residents from the indirect impacts of flooding (river and surface/ flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Specific vectors to be identified for Addis Ababa and prevention measures identified (e.g. vaccination).	✅		
Boost existing vaccination programmes.	✅	✅	✅
Strengthen effective climate-sensitive disease surveillance and prevention programmes.	✅	✅	✅
Ensure effective surveillance systems for known diseases and potential diseases moving into the area, and act upon disease prevention and prepare healthcare system to respond.	✅	✅	✅
Promote Action #A10 to boost disease prevention.	✅	✅	
Introduce new prevention measures or increase existing prevention measures and spread awareness throughout the City (consider printed media, etc.), linked with Adaptation Action #A11.	✅	✅	

5.3.5.

Infrastructure Sector

Recently, the process of master plan development (a preliminary step in infrastructure development in Addis Ababa) underwent multi-stage planning through engagement with different sectors and institutions. Considering the overarching vision of making Addis Ababa "Africa's diplomatic capital", the plan's blueprint is based around five guiding principles:

- Compact and green development with good balance between open and green spaces and the built form
- Work on mixing society among income groups, housing typologies and land uses
- Balanced growth through appropriate distribution of housing, economic activities and infrastructure
- Efficient use of land in the City centre, along mass transit and renewal of informal neighborhood
- Environmental sustainability through protection of the natural ecosystem.

Existing policies and plans

Many of the existing policies and plans relevant to sustainable infrastructure are targeted at transport; these are described in Section 5.2.2. Notable among these is the Climate Resilient Transport Sector Strategy which explicitly addresses resilience topics; for the most part, the other strategies to not deal with climate adaptation or resilience directly.

The adaptive capacity of infrastructure is intrinsically linked with other topics such as urban planning and the protection of green spaces/ecosystems, which are addressed in Sections 5.3.1 and 5.3.2 respectively.

List of actions

- Action #A13: Update infrastructure design standards for improved resilience in order to undertake a programme of improvements to the infrastructure networks (e.g. transport, waste and sewage networks)
- Action #A14: Undertake more detailed hazard mapping of risk areas to infrastructure
- Action #A15: Improve the City's urban maintenance response and emergency response capacity

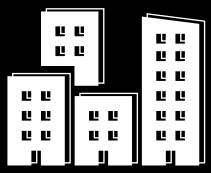
Further details are provided below.

Action #A13: Update infrastructure design standards for improved resilience

Lead agency	AAWSA and AACRA
Collaborating agency (s)/stakeholders	AA Construction Bureau, AATB, AAWSM, ETHIO Telecom, AA EPGDC, Local Communities

This action seeks to update infrastructure design standards and technologies used to advance urban adaptation and resilience across key sectors such as transport, waste and sanitation.

Note: This action links to various other actions such as Mitigation Actions #M2, #M3, #M4, #M6 and #M7, Adaptation Action #A14 infrastructure hazard mapping and #A15 emergency response capacity.



Potential Impact

This action will primarily protect the City against flooding (river and surface/ flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Undertake a study of all city-managed infrastructure to ascertain appropriately future-proof design standards and proven, modern technologies and/or materials which can be used to help the City cope with increased flood severity.	✅		
Repair of all sewer misconnections (consider installation of technologies such as sensors to detect faults).	✅		
Replace vacuum trucks with sewer lines.	✅	✅	
Update transportation design standards to cope with both flooding and heat stress (e.g. roads and road drainage design).		✅	
Policies to prevent waste dumping and open burning.	✅	✅	

Action #A14: Undertake more detailed hazard mapping of risk areas to infrastructure

Lead agency	AA Fire and Disaster Risk Management Commission
Collaborating agency (s)/stakeholders	AAWSA, AA Health Bureau

It is envisaged that this will entail detailed GIS-based hazard mapping for the City. This will serve to delineate and identify no-go areas for infrastructure in terms of current and future developments/networks, as well as identify areas for buffering of developments from risk areas (to inform Adaptation Action #A2 green vegetated buffers) and serve to identify pockets of infrastructure that require managed retreat.

Note: This action links to Adaptation Action #A13 infrastructure design standards and #A15 emergency response capacity.

Potential Impact

This action will primarily protect the City against flooding (river and surface/ flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Research, ground truth and map natural hazard zones in the city.	✅		
Make the map open source for wide access by city officials and complementary organisations.	✅		
Ensure that the city master plan accounts for (avoids) the newly mapped hazard zones.	✅	✅	

Action #A15: Improve the city's urban maintenance response and emergency response capacity

Lead agency	AA EPGDC
Collaborating agency (s)/stakeholders	AA Construction Bureau, AAWSA, AACRA, AATB

Establish and update a climate resilience emergency response plan for the City across all infrastructure sectors.

Note: This action links to Adaptation Actions #A13 infrastructure design standards and #A14 infrastructure hazard mapping.

Potential Impact

This action will primarily protect the City against flooding (river and surface/ flash) but will also help alleviate impacts from higher temperatures.

Steps to Implementation	<2 years	2-5 years	>5 years
Protection/strengthening of critical evacuation routes (contingency emergency evacuation route planning)	✅	✅	✅
Identification risk management drills and response procedures	✅	✅	✅
Develop/revise public emergency announcement protocols	✅		

5.3.6.

Energy Sector

See Section 5.2.3 sets out a range of mitigation actions aimed at the energy sector. Those actions complement the energy-related adaptation actions described below.

As most renewable energy sources are affected by a changing climate, Addis Ababa will be vulnerable to climate change. In particular, changes in the rainfall regime will impact the capacity to generate hydropower. The City is targeting a strategy to diversify energy sources, which will boost the adaptive capacity and energy independence of the community in relation to climate change. Other actions to improve adaptive capacity for Addis Ababa include updates to utility lines, better access to electricity for all, and upgrading of infrastructure in unplanned settlements.

Existing policies and plans

Relevant policies and plans related to energy are set out in Section 5.2.3. Although these are primarily aimed at climate change mitigation, going forward their implementation will also need to account for climate change adaptation and resilience.

List of actions

- Action #A16: Smart Grid to create energy efficient electricity distribution networks within the City
- Action #A17: River basin and watershed management to protect both hydropower potential and water resources

Further details are provided below.

Action #A16: Smart grid to create energy efficient electricity distribution networks within the city

Lead agency	MoWIE
Collaborating agency (s)/stakeholders	EEA, EEU, AA EPGDC, World Bank and GCF (Green Climate Fund)

Retrofit power grid with energy efficient, smart technology (e.g. smart meters), beginning with a short-term 'pilot' of energy efficient lighting. Efficiency measures and a smart grid will work to reduce overall consumption and demand on the grid; increasing access to clean energy for more people and businesses. The action will reduce the reliance on backup diesel generators by increasing the number of buildings connected to an electricity supply, which will provide a wealth of benefits, including through improved access to information and to communication channels that allow for improved adaptive capacity during extreme events. A smart grid will also enable more control of re-routing or switching supply and balancing the grid as a response measure during flood or droughts.

As part of this action, it will be important to establish a link to Adaptation Action #A17 protect hydropower potential and water resources, along with Mitigation Actions #M9: Improve Permitting Process for New Builds; Mitigation action #M10: Improve Energy Efficiency (and Uptake of Small-Scale Renewables) in Existing Buildings; Mitigation action #M14: Upgrade Streetlighting.

Potential Impact

This action will help increase access to a clean, reliable source of electricity.

Steps to Implementation	<2 years	2-5 years	>5 years
Retrofit of the electricity grid with smart technology for more efficient distribution		✅	✅
Consider a pilot project which tests the design and implementation of innovative financing mechanisms to support uptake of energy-efficient lighting by low-income households, and partnership with champion institutions to roll out lighting retrofit projects.	✅		

Action #A17: River basin and watershed management to protect both hydropower potential and water resources

Lead agency	AA EPGDC, AAWSA
Collaborating agency (s)/stakeholders	World Bank, GIZ, GCF and WASH

A feasibility study to ascertain resilience thresholds of hydropower supply affecting Addis Ababa; develop/update catchment management plans for improved resilience and develop contingency plans should dam levels ever fall below energy producing levels.

Note: This links to other actions in the water sector. Refer to Section 5.2.1 and 5.3.7.

Potential Impact

This action will primarily protect the City against changes to rain seasons interspersed with instances of drought.

Steps to Implementation	<2 years	2-5 years	>5 years
Establish catchment / watershed management to enhance the visibility of issues and ownership/piloting of response actions.	✅		
Consider basin-level study to understand risks to future hydropower production against all future climate scenarios to end of century.	✅		
While major schemes are developed (such as Gerbi dam), consider additional energy options/contingencies for critical city sectors and vulnerable groups.	✅		

5.3.7.

Water Sector

Despite significant efforts achieved over recent decades, access to safely managed and reliable water services continues to be a major challenge for the city. Rapid population growth coupled with higher living standards has resulted in increased water demand and per capita consumption. Water demand from industrial, commercial and construction sectors is also on the rise fuelled by a rapidly expanding economy and an unprecedented construction boom.

Meanwhile, the availability and supply of water is decreasing from groundwater depletion, natural resource degradation and climate change. Current water supply in Addis Ababa is 523,000 m3 per day, while the demand is 930,000 m3 per day. The percentage of water lost in the distribution system due to aging and poorly maintained infrastructure is 37%.

As a result of these shortages, there are pockets of the City that receive water in shifts, with some residents receiving water only twice a week, which negatively impacts public health and economic productivity. Residents in low-income areas are disproportionately impacted as they have limited alternative sources of water.

Existing policies and plans

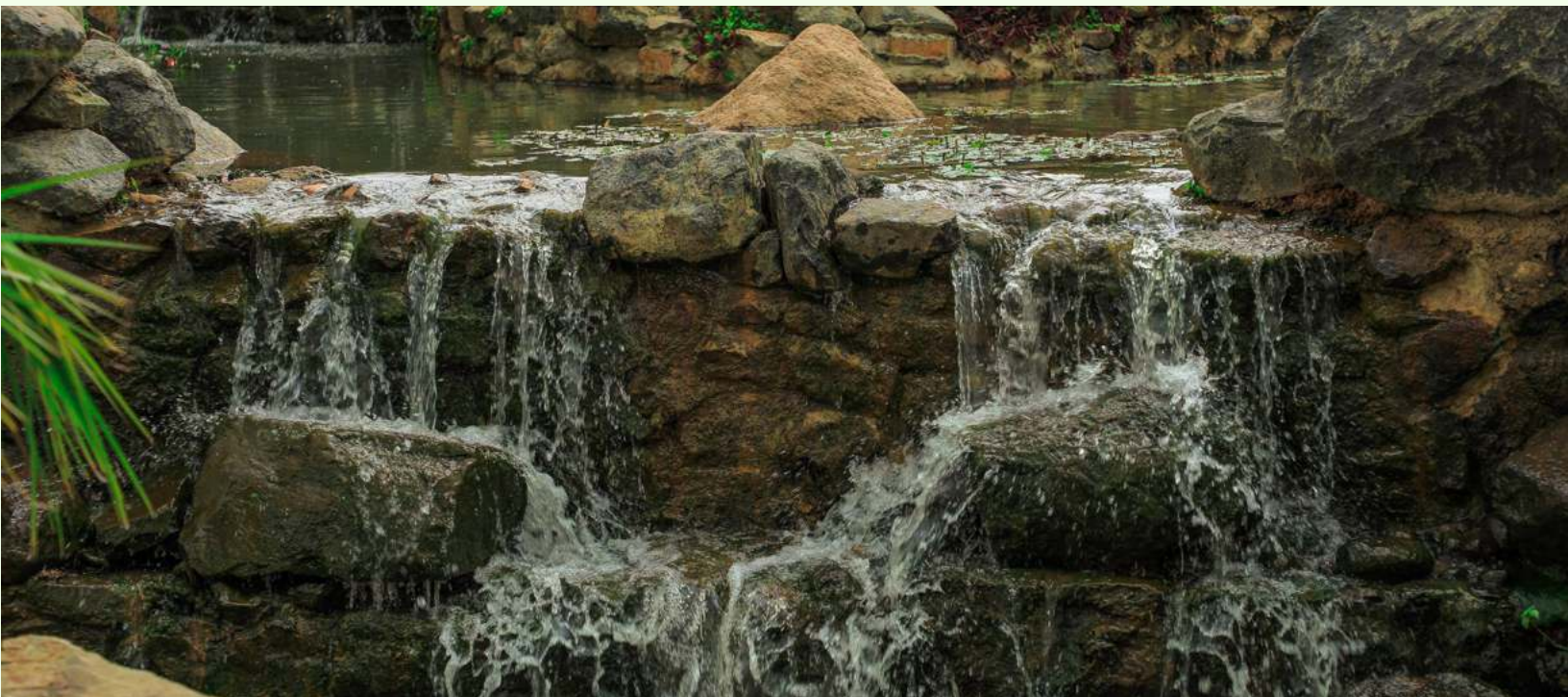
The national government is working to secure Addis Ababa's future water supply through the implementation of major improvement projects in the short-term including the Sibilu and Gerbi dam projects.

At a local level, Addis Ababa's Water and Sewerage Authority (AAWSA) recently launched mega projects with the aim of doubling its daily water generation capacity and introducing citywide water rationing. In addition, the 2017-2027 Masterplan of Addis Ababa has set goals to protect surface and groundwater resources while reducing water pollution.

List of actions

- Action #A18: Protecting rivers from solid waste, debris and harmful diffuse / pollution discharges
- Action #A19: Efficient wastewater treatment and stormwater management
- Action #A20: Accelerate urgently required water supply investments into water insecure and underserved areas

Further details are provided below.



Action #A18: Protecting rivers from solid waste, debris and harmful diffuse / pollution discharges

Lead agency	Government and AAWSA
Collaborating agency (s)/stakeholders	EEU, AA EPGDC, Bureau of Finance (BoF) and NGOs

This action promotes awareness-raising and new policies for the control of water pollution. Modernisation of the water service/supply sector in Addis Ababa, on which so many people depend, is also proposed.

When implementing this action, it will be important to:

- Establish a link to Adaptation Actions #A19 wastewater treatment and stormwater management and #A20 water supply investments; and
- Establish a link to Mitigation action #M2: Construct Composting Facilities.

Potential Impact

This action will primarily protect the City against flooding (river and surface/flash).

Steps to Implementation	<2 years	2-5 years	>5 years
Grow the City's skilled manpower.		✅	
Improve reach of built sewer line (as captured in other actions)		✅	
Improve engagement between city government of AA and Oromia region.		✅	
Develop an awareness-raising campaign around river-health.		✅	
Enforce the polluter pays principle for industries.		✅	
Modernise waste management (as captured in other actions).		✅	
Manage sewage waste (as captured in other actions).		✅	
Leverage data collected from an accredited environmental pollution monitoring lab and data management system to inform environmental policy design and implementation, particularly for river pollution management.		✅	

Action #A19: Efficient wastewater treatment and stormwater management

Lead agency	Government and AAWSA
Collaborating agency (s)/stakeholders	EEU, AA EPGDC, BOF, EFCCC, NGOs

This action proposes significant improvements to sewage and stormwater management in the City for improved water quality and overall service provision.

Potential Impact

This action will primarily protect the City against both gradual (chronic) temperature increases as well as temperature-related shocks (heatwave and drought).

Action #A20: Accelerate urgently required water supply investments into water insecure and underserved areas

Lead agency	Government and AAWSA
Collaborating agency (s)/stakeholders	EEU, EFCCC, BOF, AA EPGDC and NGOs

As was achieved successfully during Covid-19 risk management interventions, this action proposes the deployment of water tanker trucks in areas with water scarcity problems to ensure that households are able to practice proper hygiene and protect themselves from ill-health, dehydration and so forth.

While this is a short-term emergency response measure, longer-term water access issues must be addressed on a prioritised basis for the City's most vulnerable residents.

Note: This action links to link to Adaptation Actions #A18 protecting rivers from waste and #A19 wastewater treatment and stormwater management.

Potential Impact

This action will primarily protect the City against both gradual (chronic) temperature increases as well as temperature-related shocks (heatwave and drought).

Steps to Implementation	<2 years	2-5 years	>5 years
Keep updated records of vulnerable communities (for support on a prioritised basis	✅		
Deploy water tankers to these vulnerable areas during times of water shortage as an emergency response procedure	✅		
Consider additional water supply options such as boreholes or bulk supply transfers to boost longer term water security for the most vulnerable residents.		✅	

5.4.

Links between Mitigation and Adaptation Actions

The CAP recognizes that there are many actions which make both climate mitigation and adaptation contributions. Actions in energy, infrastructure, water, waste and urban planning sectors in particular have broad alignment to across adaptation and mitigation, by way of reducing emissions and reducing risks through, for example, improving waste management and sanitation, resilient and low carbon energy supply, and the construction of resilient and lower carbon transport infrastructure. Other actions, such as those relating to urban greenery and critical ecosystem restoration, can assist in carbon capture and storage mitigation strategies. Such priority adaptation actions should be considered and coordinated alongside priority mitigation actions.

Other adaptation actions with a broad link to mitigation may have a negative impact on emissions; these largely include actions involving building or development of infrastructure. For such actions, care should be taken to minimise emissions relating to activities, which might include incorporating renewable energy or energy efficiency measures into building/infrastructure designs and ensuring use of low-carbon alternative materials. Some mitigation actions could also cause maladaptation or increase risks, such as reliance on hydropower, or exacerbation of urban heat island effects.

Taking a holistic approach and identifying synergies and linkages between mitigation and adaptation options helps to ensure that mitigation actions are climate-resilient and that adaptation actions are consistent with a pathway towards low GHG emissions.

Addis Ababa's CAP has sought to do this, identifying synergies and alignment between adaptation and mitigation actions, outlined in Table 14.

Priority Adaptation action	Links to mitigation action	Explanation
#A1: New development permitting should account for resilience	#M9: Improve Permitting Process for New Builds	The permitting process for new development (the Green Building Standards) should include energy efficiency and resilience.
#A10: Improving access to and quality of wastewater and sanitation infrastructure	#M3: Improve Sewage Network	Improvements to core services, such as the sewage network, will improve sanitation and therefore health.
	#M1: Campaign to Promote Waste Hierarchy	Promoting the waste hierarchy and constructing new composting facilities will improve the core city service of waste collection and treatment.
#A13: Infrastructure design standards to include resilience	#M3: Improve Sewage Network	Improving the sewage network will involve new or updated infrastructure, which should be designed to include resilience
	#M2: Construct Composting Facilities	Resilience should be incorporated into the design of any new composting facilities.
	#M4: Enhance Landfill Management and Install Gas Capture	Resilience should be incorporated into the design of any new landfill gas capture systems.
	#M6: Improve Public Transport Networks	Resilience should be incorporated into the design of any new public transport networks.
	#M7: Promote Modal Shift to Non-Motorized Transit (NMT)	Resilience should be incorporated into the design of any schemes to promoted modal shift to NMT.
#A16: Smart grid and energy efficiency	#M9 Improve Permitting Process for New Builds	The permitting process for new development (the Green Building Standards) should include energy efficiency and resilience.
	#M10: Improve Energy Efficiency (and Uptake of Small-Scale Renewables) in Existing Buildings	The adaptation action specifically mentioned energy efficient lighting, which is included within mitigation action #10.
	#M14: Upgrade Streetlighting	The adaptation action specifically mentioned energy efficient lighting, which is included within mitigation action #14.
#A17: Protect hydropower and water resources	#M12: Increase/Diversify Renewables in Electricity Generation	Protecting hydropower infrastructure is key to ensure that the mitigation action to increase renewable electricity generation can be met.
#A18: Protecting water ways from waste pollution	#M1: Campaign to Promote Waste Hierarchy	Both of these waste-related mitigation actions will support improved waste management in Addis Ababa, and therefore help the aim of the adaptation action which is to protect rivers from waste pollution.
	#M2: Construct Composting Facilities	
#A19: Efficient wastewater and stormwater treatment	#M3: Improve Sewage Network	Improving the sewage network will directly improve the efficiency of wastewater treatment in Addis Ababa.

Table 14. Identified links between priority adaptation and mitigation actions

5.5.

Wider Benefits of Climate Actions

The actions in this CAP all detail the specific benefits that will be generated across environmental, social and economic categories. Ensuring the CAP actions deliver benefits, and deliver them equitably and inclusively is critically important to Addis Ababa.

This will be core to the implementation of the actions. A summary of the major benefits that are expected to result from the actions are summarized in the table below.

Environmental Benefits	
Reduce pollution such as air, soil &water	#M1, #M4, #M5, #M7 to M13, #A16, #A18, #A19
Utilize compost over chemical fertilizer	#M2
Reduce deforestation	#M13
Maintain ecosystems, wildlife & biodiversity	# A1, #A3, #A5
Reduce the risk of runoff and flooding	# A1, #A5, #A10, #A13
Greening and restoration of natural resources	# A2, #A4, #A6, #A7, #A8, #A17
Social Benefits	
Health benefits through newer, safer, cleaner road infrastructure and vehicles	#M5, #M6, #M7, #M14
Increased thermal comfort	#M9, #M10
Improved reliability of energy supply for extracurricular benefits	#M10, #M11
Greater equality of opportunity e.g. access to education, reduced health issues (vermin, disease, contamination and sanitation), water, electricity, increase women's free time	#M1, #M3, #M12, #A5, #A10, #A11, #A12, #A13, #A14, #A16, #A17, #A19, #A20
Enhance local amenities e.g. access to cooling to the poor, vulnerable	#A1, #A4, #A5, #A8, #A18
Reinforce local culture, values, and available skills and technology solutions	#A6
Reduce food insecurity	#A9
Job creation and benefit to vulnerable groups	#A15
Economic Benefits	
New employment opportunities, new local industry and jobs	#M1, #M2, #A1, #A2, #A4, #A7, #A8
Improved connectivity	#M6
Generating new industries and agricultural income	#M8
Cost savings from lower energy consumption and available for export	#M9, #M11, #M12
Potential to boost tourism/visitors/attract talent permanently	#A2, #A5, #A9
Potential for positive economic multipliers through decreased sensitivity of infrastructure, damage, sustainable access to water and energy, productive workers	#A3, #A5, #A6, #A10, #A11, #A12, #A16, #A20

Table 15: Summary of the benefits of climate actions

6

6. Implementation strategy

6.1.

Existing Institutional Arrangement and Governance Structure

Addis Ababa City is administratively divided into 11 sub-cities and 129 woredas within the sub-cities. Woredas are the smallest units of administration. The City Administration is led by the Mayor. It has different levels of institutions at the city, sub-cities and woredas level. The Mayor should form 18 cabinets who are heads of the bureaus at the city level which are accountable to the Mayor. Most bureaus have executive organs at the city level, offices at sub-cities and sometimes at Woreda's level. Figure 17 below[50].

[50] Addis Negari Gazeta of The City Government of Addis Ababa, 2012

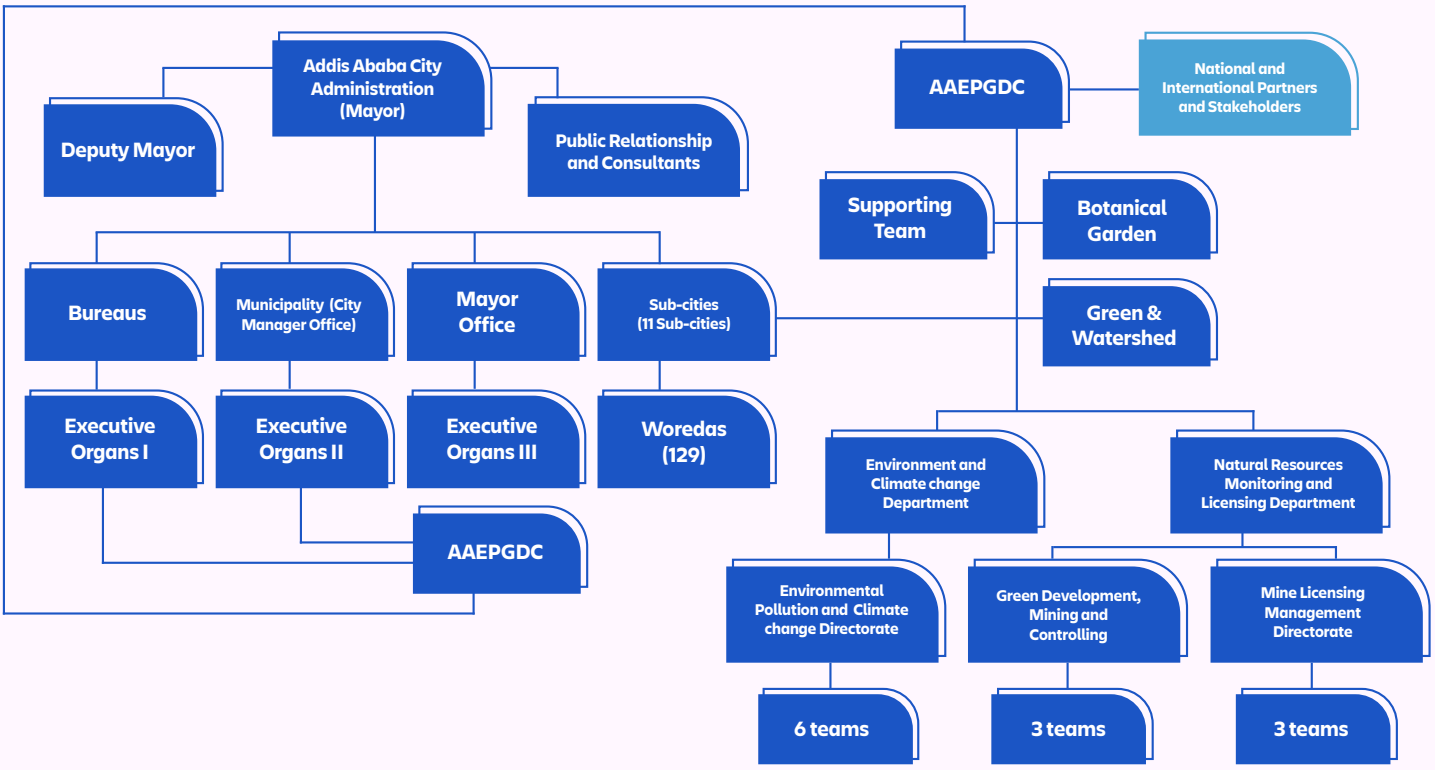


Figure 17: AA EPGDC in the City Structure

The main types and levels of institutions are described below:

Bureaus: There are about 18 bureaus in the city structure. These are land development and administration, housing, construction, women and children affair, transport, trade and industry, health, micro enterprise, culture and tourism, labour and social affair, youth and sport, communication, economic and finance, public services, education, planning, and TVET agencies.

Municipality Office: The municipality is led by the City Manager's office. The Office has executive organs under it, the main ones being the Water and Sewerage Authority, Beautification and Cemetery, Solid Waste Management Agency, and Slaughter Enterprise.

Executive Organs: Offices which are found at the city level which are accountable either to a Bureau, Municipality or Mayor's Office. Most Bureaus have Executive Organs which are the agencies and authorities that are accountable to it . For instance, the Transport Bureau includes the traffic management agency, public transport enterprise, city bus transport services, drivers and vehicles licensing and controlling authority etc.

Mayor's Office: Executive Organs include the Environmental Protection and Green Development Commission, Park Administration, Fire and Emergency Rescue Hazard Commission, Police Commission and Licensing Organization.

Sub-cities: there are 11 sub-cities in the city and each sub-city has woredas (the smallest unit administration level).

National and international partners and stakeholders: The AA EPGDC receives support from national government institutions, mainly the Environmental, Forest and Climate Change Commission. It is supporting the city through capacity building, training, workshops, and exploring the possibility of supporting with funds through the CRGE finance facility.

6.1.1.

Current Climate Change Governance System

The Addis Ababa Environmental Protection and Green Development Commission (AA EPGDC), directly accountable to the Mayor, is mandated to govern the environment and climate change issues of the city. The location of the AA EPGDC in the city's structure is shown in Figure 17. It is responsible for establishing the monitoring of GHG emissions data and climate action, working with other relevant institutions in the city.

Figure 17 also shows the structures within the AA EPGDC, including:

- The two institutes within its control: the Addis Ababa Botanical Garden, and the Green and Watershed Development Agency.
- The two departments: the Environment and Climate Change Department and the Natural Resources Monitoring and Licensing Department.
    - o These two departments incorporate three directorates, mandated to manage the city's issues environment and climate change.
    - o One of these is the **Environmental Pollution and Climate Change Directorate.**

The Environmental Pollution and Climate Change Directorate has six teams, of which two teams are dedicated to working on climate action mainstreaming and promoting climate smart technologies. These two teams work in line with other city institutions in planning, measurement, monitoring and reporting of climate action. The AA EPGDC has focal persons at the sub-city level to cascade climate actions at the sub-city level. Vertical integration with sectoral focal points at national level, such as Environment, Forest and Climate Change Commission, aligns well, since these sectors have a common mission of coordinating, planning and implementing climate actions.

The AA EPGDC is accountable to the City Administration and reports regularly to the Mayor's Office on a monthly, quarterly and annual basis. The EPGDC also has horizontal integration with other city departments which are working in the different sectors including transport, waste and education among others.

6.1.2.

Proposed CAP Steering Committee

The Climate Change Mainstreaming Team, under the Environmental Pollution and Climate Change Directorate, has developed a planning and reporting system within selected city departments. However, there is currently no city-level Steering Committee that oversees the planning and implementation of climate change measures which makes it difficult for departmental heads to plan, implement and report on any climate related work. There are many sectors that are required to report their progress on different parameters, but most of them intermittently do this. As such, it will be important to set up a Steering Committee of Heads of Departments (HoDs) to better coordinate climate change in the city.

A Steering Committee will support CAP implementation following its launch. The proposed steering committee will have the following sectoral departments within it:

To supplement the existing governance of the city, the AAEPGDC has plans to create a **CAP Climate Change Steering Committee (CCSC)** which will be composed of relevant sectoral institutions to execute the climate change mitigation and adaption and technologies in the sectors.

The Climate Change Sectoral Steering Committee members will include:

City-wide climate change steering committee HoDs:

Addis Ababa Farmers and Urban Agriculture Commission
Addis Ababa Roads Authority
Addis Ababa Water and Sewerage Authority
Addis Ababa Trade and Industry Development Bureau
Addis Ababa Waste Management Administration
Addis Ababa Food Security and Development Security
Addis Ababa Planning Development Commission
Addis Ababa Housing Development Administration Bureau
Addis Ababa Women and Children Bureau
Addis Ababa Education Bureau
Addis Ababa Construction Bureau
Addis Ababa Transport Bureau

CAP climate change steering committee (CCSC)

1. Roads and Transport Bureau
2. Construction Bureau
3. Water and Sewerage Authority
4. Watershed and Green Environment Development Agency
5. Industry Development Bureau
6. Health Bureau
7. Solid Waste Administration Agency
8. Planning and Development Commission
9. Finance Bureau

6.1.3.

Other Proposed Activities to Strengthen Climate Governance in the City

1. Establish a Technical Steering Committee at city level. The Committee will have a mandate of monitoring the planning and implementation of CAP actions in the city. The Steering Committee will be led by City-wide climate change steering committee HoDs. It will have Technical Advisory Committee from the Non-Governmental Organizations (NGOs), private and civic organizations.	**Immediate (within 1 year)**
2. Increase the city participation and engagements with international institutions which can technically and financially support the implementation of priority climate actions for Addis tapping into knowledge that comes through from technical assistance offered by these institutions.	**Short- medium term (1-5 years)**
3.AAEPGDC should play a key role in coordinating the capacity building activities required by the Steering Committee and Sectoral Departments on knowledge and planning for climate change. This especially includes tracking GHG emissions and climate risk vulnerability assessments using various tools to support the process, such as the GPC Standard and CIRIS.	**Short term (starting within 1 year)**
4. Strengthen communication systems between the AA EPGDC with other institutions, partners and stakeholders. It may be through creating a platform to exchange data and information about city climate action. This could also be through launching a website or forming continuous monitoring and evaluation (M&E) meetings to track and give feedback during CAP implementation.	**Short term (starting within 1 year)**
5. Strengthen the vertical integration with national level institutions mainly with the Environment, Forest and Climate Change Commission and with other levels of lower governance to reach grass root civics and community organizations and individuals such as sub-cities and Woredas.	**Short- medium term (1-3 years)**
6. Strengthen the capacity of AAEPGDC in coordinating and mobilizing resources for climate action for the city. This can be achieved by strengthening the practical experience of staffs through on-job training, workshops among others to acquire additional skills and practice required. The AAEPGDC will have the responsibility to develop the Key Performance Indicators (KPIs) for city institutions to achieve in climate action implementation such as GHG emissions reductions and reduction of climate vulnerability.	**Short- medium term (1-3 years)**
7. Incorporating key climate actions in Environmental Impact Assessments (EIAs) during project and business approvals.	**Medium term (2-5 years)**
8. Integrate climate action with other cross-sectoral development initiatives which have similar implementation actions such as air quality actions.	**Short term (starting within 1 year)**
9. Build the capacity of institutions in the preparation of proposals that will mobilize city, national, private, public and international finance.	**Short- medium term (1-3 years)**
10. Liaise with and support key sectors and institutions to ensure that they report to AAEPGDC in a timely manner (quarterly, bi-annually and annually) to understand the performance and the possible capacity building activities required to implement climate action in the city and enable the AAEPGDC to meet their reporting requirements to the Mayor's Office.	**Short term (starting within 1 year)**
11. Update the GHG emission inventory within 2 year intervals, and update the climate risk assessment within five-year time intervals.	**Medium term (2-5 years)**

6.2.

Financing Strategy and Resource Mobilization

Access to finance is often a key barrier to implementation of climate actions; however, there are significant sources of finance available to explore. Financing of the CAP will involve drawing upon a combination of sources that can be internal (including finance raised through taxes, user fees, transfers and bonds within the municipality and through other spheres of government) and external (including international and local sources such as bilateral and multilateral donors, concessional finance and funds, as well as co-financing through private-public partnerships, market-based approaches and private sector investments). There may also be opportunities to leverage funding from other related policies and strategies where the actions directly align, such as the Air Quality Management Plan (AQMP).

Where possible, the Addis Ababa City Administration (AACA) will seek to access funding from its own sources (internal financing). It will also seek to ensure that the city's budget prioritization process aligns with the goals and targets of the CAP, a process known as budget mainstreaming. This is critically important as it will ensure that CAP actions are funded, and that investments which may lead to carbon lock-in and maladaptation are avoided.

The AACA has bureaus and organs that allocate capital and operational budget to the city's institutions. The main organ which plans and disburses the annual budget for the city is the Finance and Economic Bureau. It allocates budget for climate action from the treasury of government, along with funds from loans and donors. The bureau disburses the budget to respective institutions per the city plan approved by the city council. Thus, it is responsible for the resourcing of any given plan which includes the resourcing of climate action.

In cases where external sources of funds are sought, it is critical that actions are designed and structured in such a way that they can meet the requirements of donors and financiers. Understanding the external funding options and their requirements is a prerequisite for securing finance.
Lastly, the city also needs to strengthen its relationship with the national government to access financial resources, and ties with international partners like C40, in order to further support both climate actions and institutional actions. For instance, the city has received technical and financial support in preparing this CAP document, and in filling data gaps through the 'Empowering Cities with Data' project.

Figure 18: Word cloud of Addis Ababa's potential climate finance landscape, developed by stakeholders during the climate adaptation workshop

6.3.

Human Resources

Delivery of the CAP will require a collaborative effort with all relevant institutions. It is important therefore that the design of actions includes not only details of the costs and funding sources, but also a leading institution for implementation (and the human resources needed to ensure the delivery of the Plan).

The human resources that directly contribute to climate action implementation at the city level consists of about 40 experts found at different hierarchies of the city administration. They can be categorized into the following:

- **AAEPGDC Structure:** The Climate Change mainstreaming team, which has role coordinating climate actions in the city, within the AAEPGDC. It has about 10 experts.
- **Sub-cities Structure:** Climate change experts have been hired in the 11 sub-cities (1 for each sub-city).
- **Sectoral Structure:** A non-formal structure created by the climate change mainstreaming team, by assigning one focal person for the CRGE strategy within sectoral institutions in the city (about 20 experts).

In addition to human resources described above who directly participate in climate action planning and implementation, the table below summarizes the potential human resource that could be available[51] in each of the lead agencies listed, to support CAP implementation. These staff represent individuals engaged in the delivery of activities that will directly or indirectly support the CAP goals. This may be through the delivery of activities in their respective departments that are supportive of or align to the CAP actions and goals, or through active engagement in taking forwards sectoral actions in sectoral plans.

Lead Agency	Total number of staff	Potential staff that could be available to support the CAP implementation
Addis Ababa City Administration	144,418	36
Addis Ababa Solid Waste Management Agency	288	15
Addis Ababa Transport Bureau (AATB)	128	10
Addis Ababa Construction Bureau (AACB)	276	15
Ethiopian Energy Authority	105	15
Ministry of Water, Irrigation and Energy (MoWIE)	400	20
Addis Ababa City Roads Authority (AACRA)	1853	15

Table 15: Staff available across the city that may participate in the delivery of climate actions in Addis Ababa

[51] The potential human resource reflects the staff that could be available in each agency, reflecting for example, attendance and engagement in CAP workshops and events and alignment of action delivery.

6.4.

City Power and Authority Analysis

The city powers and capacity to implement climate action in key sectors have been reviewed in relation to whether the city owns / is responsible for key infrastructure and operational systems where such action could be focused, and whether it has the power and capacity to control, implement, influence or promote changes in this infrastructure / these operational systems.

The city power is shared between the federal and city government. Almost all bureaus, authorities and agencies at the city level have line offices in the federal government. There are actors at the city and federal government levels which have a role in the different climate governance categories (Table 16). Moreover, it should be noted that the AAEPGDC has a role to play in each of the city level actors.

Categories	City Level Actors	Federal Level Actors
Decarbonizing the electricity grid	No City Level Actor	MoWIE, EEU, EEP, EEA
Optimizing energy use in buildings	AA Construction Bureau	Ministry of Urban Development and Construction, Environment, Forest and Climate Change Commission
Enabling next-generation mobility	AA Roads and Transport Bureau and Its executive organs, AA Planning Commission	Ministry of Transport, Federal Transport Authority, Planning Commission Commissioner, Ethiopian Railways Cooperation
Improving Solid Waste Management	AA Solid Waste Administration Agency	No line office at federal
Enhancing resilience of water and sanitation systems	AA Water and Sewerage Authority and AA Health Bureau	Ministry of water, irrigation and electricity, Ministry of Health
Manging disasters and flooding	Addis Ababa Fire and Disaster Risk Management Commission	National Disaster Risk Management Commission
Enhancing the resilience of natural capital	AA EPGDC (natural resource and utilization directorate, AA City Government Beautification, Parking and Cemetery Development and Administration Agency, Addis Ababa Trade Bureau	Environment, Forest and Climate Change Commission, Ministry of Agriculture, Ministry of Trade

Table 16: Assessment of power for delivering the CAP, at city government and federal government level

6.5.

Potential Barriers or Challenges

There are numerous potential challenges that Addis Ababa may encounter when implementing this CAP. A brief overview is provided below, with challenges broadly grouped by theme.

Knowledge, awareness, and commitment: Potential challenges could include, for example, ensuring adequate commitment from officials, political leaders, partners and stakeholders; lack of relevant expertise in different sectors to deliver or oversee projects; and low levels of public awareness of the importance of climate change and environmental issues.

Administrative control and coordination: For most of the actions proposed, there is at least a moderate level of control at the city level. However, where major projects have national stakeholders/implementers, it will be necessary to ensure strong coordination among the various sectors or stakeholders. In these circumstances, barriers can potentially arise due to weak interactions or poor communication. It can also be difficult to establish the correct bureaucratic and administrative procedures for complicated projects.

Access to funding and other resources: There may be challenges associated with securing financial funds for CAP implementation, or human resources for delivering projects. Some actions may rely on technologies or techniques that incur prohibitive capital or operational costs, such as renewable power generation, modern cookstoves, and new waste collection systems. The city also needs to strengthen its relationship with the national government in order to access financial resources.

Jurisdictional arrangements: Some projects will require collaboration between the city and other administrations, businesses, private landowners, tenants and/or other stakeholders. This can create challenges, particularly if there are competing priorities and ambitions relating to land use or development opportunities, which may impact the design of the actions themselves. An example of this would be in the informal settlement areas, where it may be difficult to change the land use, buildings, or infrastructure. Another example would be related to Addis Ababa border issues and the complex interrelationship between the city and the government of the Oromia region.

Other external challenges: Finally, it is acknowledged that there could be challenges associated with events such as natural disasters, or regional/local civil unrest.

To ensure implementation of the CAP, the city will work to address barriers as and when they arise. This will be a matter of priority.

The appropriate response will vary depending on the precise circumstances, but could include activities such as improved capacity-building among city staff (e.g. to address issues relating to knowledge or awareness), developing communication or administrative structures to facilitate closer engagement with the national government or other local administrations, and other forms of stakeholder engagement.

7. CAP monitoring, evaluation & reporting framework

Fundamental to delivering this CAP is the development of an integrated and comprehensive framework for monitoring, evaluation and reporting (MER), to measure the impact and effectiveness of both mitigation and adaptation actions set out in the CAP. With a climate action planning MER system, Addis Ababa will:

- **Improve accountability and transparency**
- **Provide relevant information to a wide range of partners and city dwellers**
- **Continue to make the case for (or against) other possible climate actions**
- **Assess progress and effectiveness and adapt**

7.1.

CAP Monitoring and Reporting

This section summarizes the existing MER system in the city of Addis Ababa and some recommendations on how this can be strengthened.

Note that terminology varies slightly depending on the context. MER-related activities are sometimes referred to as monitoring, reporting and verification (MRV), monitoring and evaluation (M&E) or monitoring and reporting (M&R). For clarity and consistency, in this CAP, MER is used as an umbrella term.

AAEPDGC with the city administration and the city planning commission

Addis Ababa Environmental Protection and Green Development Commission (AAEPGDC) is responsible for coordinating environment and climate change actions in the city along with the associated MER activities. The task is specifically allocated to the GHG inventory team within the Climate Change Coordination Directorate (CCCD), which is tasked with handling both climate change mitigation and adaptation/resilience.

AAEPGDC will lead the CAP MER in collaboration with the proposed CAP Steering Committee which will be formed at the city level. The Steering Committee will include members from selected city sectoral institutions, and will play a big role in following up on the MER on the CAP implementation. The MER system will involve following up with the implementation of key priority climate actions highlighted in key sectors in the CAP against a set of Key Performance Indicators (KPIs). The City Planning Commission (CPC) will be responsible for following up with the assigned lead institutions on the implementation of climate actions. AAEPGDC, the City Planning Commission and the AACA will work together to oversee the execution of key climate actions.

At the moment, AAEPGDC reports its work and activities formally to the Addis Ababa City Administration and the City Planning Commission. AAEPGDC's MER entails weekly, monthly and annual reporting. The same reporting structure will be deployed in reporting and tracking progress of the CAP. The main actors in this MER system will be the Climate Change Mainstreaming team, the Planning and Budget Supporting team and the MER team. The MER team is usually instituted and convened within the AAEPGDC at the end of every Bi-annual Accomplishment Plan.

The final Addis CAP will be fully integrated into the city's 10-Year's Perspective Plan through the approval of the AACA. The city has already included the GHG emissions reduction plan adopted in the CAP in the city's 10-Year's Perspective Plan, which in turn draws from the national 10-Year's Perspective Plan. The Addis CAP process has been fundamental in informing the city's 10-Year's Perspective Plan by detailing key climate actions and setting out an implementation plan with clear timelines.

AAEPGDC and the city sectoral departments

The AAEPGDC also has an MER system with horizontal city sectoral departments, institutions, bureaus and agencies. This MER system will provide opportunities to review the city sectors' accomplishments towards the implementation of the CAP. It is important to note that there exists no formal MER system between AAEPGDC and other city sectoral institutions horizontally. The city sectoral institutions will be designated with different mandates with regards to the CAP implementation by the City Planning Commission. As such, it is important that that this informal MER system is formalized and strengthened in the light of implementing the CAP.

AAEPGDC and the national environment, forest and climate change commission (EFCCC):

The national EFCCC coordinates national climate actions in line with the Paris Agreement while the AAEPGDC does the same at the city level. The EFCCC currently provides technical support to the city of Addis through trainings and capacity building activities on issues of climate change. There exists no MER system between EFCCC and AAEPGDC, and therefore the national and city climate action coordination is lacking. The AACA should create a linkage to contribute to the national efforts in implementing the NDC and take a leading role as the capital city to encourage other cities to take initiative in the implementation of the CRGE Strategy and the NDC. The MER framework for the CAP is intended to link closely with the national climate action planning process, enabling vertical integration between the city and national government. This will ensure alignment with the strategic national climate objectives, such as those set out in Ethiopia's CRGE Strategy and other city level plans such as the Addis CAP.

The AAEPGDC should strengthen its ties to the Climate Resilient Green Economy Facility (CRGE Facility) which is the national level institution coordinating the efforts towards its 2030 CRGE targets. The Facility was established to address financial and technical issues. The facility is managed by Environment, Forests, and Climate Change Commission (EFCCC) and the Ministry of Finance (MoF). EFCCC is playing role in programmatic and technical whereas MoF is playing the financial and budgetary aspects of CRGE implementation. CRGE directorates/units or case teams have been established in almost all relevant line Ministries.

AAEPGDC and CDP reporting

Addis participates in the Carbon Disclosure Project (CDP) process every year. The city discloses environmental data to manage emissions, build resilience and protect people and ecosystems from climate impacts. AAEPGDC collates data from different departments to generate the emissions inventory, which is how the city currently measures, discloses and tracks its GHG emissions. Progress on the CAP implementation will therefore be monitored and reported in line with the CDP reporting.

CAP key performance indicators (KPIs)

The monitoring aspect includes the development of Key Performance Indicators (KPIs) to enable an objective overview of the state of implementation of the climate actions (see Annex I). A Monitoring and Progress Report, framed around these main KPIs, will be periodically published, and serve as an interim opportunity to evaluate progress at key dates, so that steps can be taken to adapt and revise implementation strategies, as necessary. The city may choose to focus on reporting and evaluating progress towards select priority actions and then expand as the CAP develops. The Monitoring & Progress Report or CAP updates will, for those actions that have been fully implemented, evaluate the action according to its monitoring indicators and against the action's targets.

7.2.

Learning and Evaluating of Impact

The MER system in the city sets a robust framework for the evaluation of CAP actions implementation. The periodic review meetings and reports will ensure that prioritized actions can be tracked and adjusted accordingly based on changing technologies and approaches on how to reduce emissions and climate impacts.

The City's GHG inventory represents a crucial requirement in evaluating the impact of mitigation actions. Each mitigation action is to be linked to a sector detailed under the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) Standard, as to where emission reductions may be realised. In select cases, it may be necessary to, in addition to absolute emission reductions, track trends in emission intensity by sector or industry. This is to be termed as the 'inventory indicator'. Each mitigation action is also allocated a series of 'monitoring indicators', specific to the action detailed. If the action is associated with a target, the monitoring indicators should link to, or facilitate the calculation of whether the target is achieved.

MER for adaptation uses the assessment of climate hazards as its fundamental basis. Each of these hazards interact with several components, including exposure, physical or socio-economic vulnerability and existing adaptive capacity, combining to an overall risk. Whilst the monitoring and evaluation of mitigation actions can be focused towards reduction in GHG emissions, adaptation actions cannot be readily measured by any single metric and requires a more expansive approach. The logic model is designed to explicitly state the consequential chain of steps between an action being taken and reduced climate risk. By considering the chain, monitoring indicators can be situated along each step to track progress. Indicators may be developed to assess the outputs and impacts of an action. Output indicators depend on the nature of the adaptation action, but should be a direct result of the action, measured from a set baseline. Outcome indicators should measure the change from the output with reference to the hazard considered. Impact monitoring indicators shall consider tangible elements (e.g. people, assets or the environment) and shall be categorised according to:

- **Societal impacts:** relating to hazards impacts on people's health/wellbeing.
- **Economic impacts:** relating to loss, damage or repair costs associated with assets or the disruption to economic services.
- **Environmental impacts:** negative effects caused by the hazard towards environmental quality.

The Environment and Climate Change Coordination Directorate working under the AAEPGDC has a Climate Change Mainstreaming Team that is mandated to coordinate the climate change actions in the city. The team has organized training for selected focal persons from city institutions and distributed manuals that explain some of the adaptation and mitigation baselines and climate actions expected from the institutions to reduce GHG emissions and build resilience in Addis. The team is building a reporting and evaluation system with 15 selected sectors in the city. The team has already been receiving monthly reports from some of these sectoral institutions on how they are mainstreaming climate change in their sectoral plans.

7.2.1.

Monitoring, Evaluation & Reporting Recommendations

The Climate Change Coordination Directorate is in its infancy and its current capacity to drive and deliver climate action is not sufficient. In addition, the bureaus, responsible for delivering projects, need to integrate climate action in their plans and report the status. Most institutions can report but so far are not doing so due to lack of institutional capacity.

The AAEPGDC needs to determine the capacity and systems required for implementation of an effective MER system for its climate change response activities at a city-wide scale, so that the benefits of all sectoral actions can be tracked and reported. Capacity is improving, but the capacity of the individuals staff working in the city needs to be built further.

7.2.2.

Reviewing and Updating the Climate Action Plan

The Addis CAP document is a 'living' document which will undergo periodic review and assessment. The CAP will be updated based on the city planning cycles which occur every 5 years.

The CAP is aligned with the city's 10 Years' Perspective Plan which will run from 2020 to 2030. This is updated in 5-year intervals. The generic contents of the CAP are included in the city's 10-Year's Perspective Plan in different sectors with the main target of reducing GHG emissions and creating a more resilient city to current and future climate change. The CAP will be updated based on the achievement and lessons learnt from the 10-Years' Perspective Plan implementation.

The CAP review and update will take evidence from the ongoing review and update of the GHG emissions inventory which will be done every 2 years and the Climate Change Risk Assessment report will be updated within 5 years.

In addition, the CAP will ensure it aligns with other related work, including integration with the Air Quality Management Plan[52].

The GHG inventory baselines, targets and trajectories will also be updated based on the implementation of the CAP actions factoring in key changes in methodologies, techniques, technologies and approaches in cutting down GHG emissions and climate impacts. The continuous review and updating of the CAP, GHG inventory and CCRA reports will ensure that the city moves towards a carbon neutral, resilient, equitable city by 2050.

The proposed MER reporting structure is summarized as follows:

Categories	Monitoring	Evaluation
Timing	Quarterly	Yearly
Scope	Indicators of the activities, outputs and outcomes	Outcome indicators
Main participants	AAEPGDC, AACA, City Planning and Development Commission & Sectoral CRGE institutions, as well as steering committee	External evaluators/facilitator, project staff, donors, stakeholders
Process	Regular meetings, interviews, monthly and quarterly reviews, etc.	High-level meetings, additional data collection exercises, etc.
Written outputs	Regular reports monthly, quarterly reports	Evaluation report with recommendations for changes to projects presented in workshops to various stakeholders

[52] For instance, the AQMP requires an air pollutant emission inventory to be created. This will ensure consistency between the two and will be more cost-effective, and ensure actions can be aligned to maximise co-benefits.

8

8. Covid-19 recovery strategy in Addis Ab

The COVID-19 pandemic has severely disrupted the world economy and, as a result, countries are actively seeking to rebuild their economies from the disastrous impacts of the pandemic while focusing on key sectors which have been severely impacted including energy, transport, water and agriculture.

Climate change continues to cause unprecedented risk to humanity with increased climate risks brought about by extreme weather events which enhance the gap between the rich and the poor, jeopardizes food security and enhances the spread of diseases. Now in the face of COVID-19, many people around the world are struggling to cope and survive in both crises which have tremendous impacts on health, well-being and livelihoods especially for the vulnerable urban populations. Channeling investments in these sectors will help boost jobs and jumpstart recovery. Steering the recovery process towards a sustainable path requires integrating climate action planning tools into the economic recovery process. Integrating climate change mitigation and adaptation strategies into the process fosters a recovery that will promote the creation of green jobs, improve public health and enhance food security.

The Addis Ababa Health bureau is updating the resident with COVID 19 information such as precaution to the pandemic, number of laboratory tests, death rates, the recommendation etc. The bureau with the lead from the city administration coordinating various social and economic impact by the pandemic. COVID-19 in Addis is impacting the urban poor in tremendous ways. With about 1.9 million self-employing businesses in Ethiopia's cities including Addis Ababa, 750,000 jobs could be lost due to the COVID-19 crisis. Loss of jobs is anticipated to affect about a quarter of the population in the city, most of whom working in the informal sector. Those in the informal sector normally live hand-to-mouth, and loss of jobs could translate into many people being unable to put food on the table and cater for other basic needs.

The city administration in coordination with Addis Ababa Health Bureau has therefore put in place the most ambitious Urban COVID-19 Response Plan that focuses on the screening of the most vulnerable, commissioning a city administration resource mobilization committee and mobilizing funds from the Urban Safety Net kit.

Annex I: KPI, Type of Actions and Resource Planning

Priority CAP Actions	Key Performance Indicators (KPIs)	Type of Action	Lead Agency	Resource Planning
#M1: Campaign to promote waste hierarchy	• Waste production (tonnes/year) • Recycling rates (tonnes per type/year) • Amount of waste dumped and burned (tonnes/year)	Programme / Policy	Addis Ababa Solid Waste Management Agency	Addis Ababa City Administration (AACA), NGOs
#M2: Construct composting facilities	• Waste production (tonnes/year) • Recycling rates (tonnes by type/year) • Composting rates (tonnes/year organic waste treated) • Number of composting facilities (up to 4 facilities are proposed)	Project / Programme	Addis Ababa Solid Waste Management Agency	AACA, NGOs
#M3: Enhance sewage/ wastewater treatment system	• Number of misconnected sewers fixed (no. repairs/year) • Amount of sewage collected (m3/year) • Volume wastewater treated (m3/year) • Length of new sewer line installed (km/year) • Number of vacuum trucks (number operational/reduced/year) • Number of households connected to sewage network (households/year)	Programme / Project	Addis Ababa Solid Waste Management Agency	AACA, NGOs
#M4: Enhance landfill management and install gas capture	• Finished construction of a 'Fukuoka' landfill • Quantity of leachate generated and treated (m3) • Quantity of gas collected and utilized (m3)	Project	Addis Ababa Solid Waste Management Agency	Government of Japan, JICA, AFD
#M5: Improving vehicle efficiency via emissions standards	• Number of cars replaced per year with more efficient model (vehicle registrations/licensing – numbers/year) • Amount of fuel reduced (litres fuel sold or consumed/year) • GHG emissions (tCO2e/year - from GHG inventory II.1.1 road transport)	Policy / Programme	Addis Ababa Transport Bureau	Financing from AACA and Government, potential overlap with C40-funded projects
#M6: Improve public transport networks	• Personal motor vehicle (PMV) use (Vehicle Kilometers Travelled – VKT/year) • BRT use (no. of passengers/year; average journey length) • LRT use (no. of passengers/year; average journey length)	Programme	Addis Ababa Transport Bureau	AACA, NGOs, donors
#M7: Promote modal shift to non-motorized transit (NMT)	• Mode share walking (%) • Mode share cycling (%)	Programme	Addis Ababa Transport Bureau	AACA, NGOs, CRGE Facility
#M8: Enhancing fuel efficiency via switch to hybrid/ electric vehicles	• Share of hybrid and electric vehicles (% vehicle sales/year) • Number of charging stations installed per year • Amount of fossil fuel reduced (liters consumed or sold /year)	Programme	Addis Ababa Transport Bureau	AACA, NGOs, CRGE Facility

#M9: Improve permitting process for new builds: enhancing ISO Certified Energy Efficiency Green Building Standards	• Solar water heating (% homes with technology installed; number of new units installed/year) • High efficiency appliances (% homes with technology installed; number of new units installed/year) • Advanced building envelope (% homes with new technologies installed - retrofit programme undertaken; number of homes retrofitted/year) • LED lighting (% homes with LEDs installed; number homes upgraded/year) • HVAC upgrades (% homes with high efficiency HVAC systems installed; number HVAC systems upgraded/year)	Project	AACA	Budget from international donors, national Government
#M10: Improve energy efficiency (and uptake of small-scale renewables) in existing buildings	• Solar water heating (% homes with solar systems installed; number installed/year) • High efficiency appliances (% homes with high efficiency appliances installed; number sold/ year; number appliances traded in or recycled/ year) • LED lighting (% homes with LED lighting installed; number of bulbs by type sold/year) • Grid connectivity (% homes connected to the grid; number of new connections/year)	Policy/Programme	AACA	National Government, NGOs
#M11: Improve energy efficiency in industrial facilities	• Uptake of energy efficiency equipment (spend/ sales per year) • Energy consumption in industrial sector (MWh or litres fuel/year) • Energy efficiency of production (energy use/ unit output)	Programme/Policy	AACA	EEA / AACA, AAEPGDC
#M12: Increase/ diversify renewables in electricity generation	• Diesel generator use (% buildings recording usage; total fuel consumption/year for generation) • Coverage of grid connections (total area (ha); expansion of new connection areas in ha/year)	Policy	AACA	EEA / AACA, AAEPGDC
#M13: Transition to efficient, low-emissions cooking fuel	• Number of efficient stoves distributed	Programme	AACA	Federal Government ,AACA Initiatives (World Bank etc.)
#M14: Upgrade streetlighting	• LED streetlights installed (% total streetlights; number installed/year)	Programme/Project	AACA	AACRA, Public tender (bidding by private firms)
#A1: Require new development permitting (new building / development codes) to account for increasing resilience to flood, drought and extreme temperatures	• Reduced flooding of properties (trend in $ value insurance claims/ city repairs required) • Enhanced/net increase in urban green space (10% net increase by 2025: 20% by 2030) • Improved access to clean and potable water (% population) • Reduced incidence of heat stroke (No. incidents/ mortalities)	Policy / Programme / Planning /Action	Urban Planning and Development Commission, AAEPGDC	. AACA · NGOs · UNEP · World Bank
#A2: Increase green vegetated buffers between urban settlement and hazardous areas prone to flooding, landslide and subsidence	• Increase in net green coverage by 10% in the short term (by 2025) and by 20% in the medium term (2030) • Reduced: *- Incidence of flooding and flood related loss in $* *- Property damage ($ value insurance claims/city repairs)* *- Loss of human life (% decrease year on year)* *- Land degradation (e.g. % land cover lost to soil erosion)* *- Water pollution levels across all water quality variables measured* *- Improved food security (fewer incidences of malnutrition, hunger and mortality recorded)* • No. permanent jobs created	Policy / Planning / Action	Urban Planning and Development Commission, AAEPGDC	-AACA · NGOs · UNEP

#A3: Ensure climate change representation on the dedicated Megaprojects Office	. Representation on / composition of mega projects office (No. individuals in Megaprojects office with a climate-related adaptation/ mitigation/dual mandate) . Content of meeting agendas and minutes . No. of project plans and outcomes with climate action	Planning /Action	Addis Ababa Solid Waste Management Agency, AAEPGDC	· National Government,AACA · NGOs · World Bank · UNDP
#A4: Enhance urban greenery with heat and drought tolerant vegetation to combat the loss of green spaces	. % green coverage stable or increasing . Lower incidence of flooding and flood related loss in $. Reduced water pollution levels across all water quality variables measured . Improved food security (fewer incidences of malnutrition, hunger and mortality recorded) . No. permanent jobs created	Policy / programme	AA Planning and Development Commission, AAEPGDC	· AACA · NGOs · UNEP · World Bank · Green Development Fund
#A5: Rehabilitate deforested areas/ water sheds to reduce soil erosion, enhance biodiversity and offer better ecosystem resilience	. No. of planted trees . Planted tree survival rate (%) . Area of rehabilitated land (target 100% rehabilitation of deforested areas by 2030) . No net loss of forested areas	Programme / Project	AAEPGDC	· NationalGovernment budget, AACA · Donors · Corporate social responsibility funds · Community mobilization · PPP
#A6: Provide water for irrigation of nature and greenspaces during heatwaves and droughts	. No. water collection/rainfall collection systems in place . Area maintained (in hectares) . Access to well maintained, viable green spaces (% population)	Programme / Action	AAEPGDC, AA Water and Sewerage Authority	· National Government,AACA · NGOs · Community
#A7: Establish sustainable Agricultural Urbanism systems	. Area (ha) of urban agriculture systems . Local (city-level) agricultural production output (in $ or tonnes) . Reduction in % poverty levels	Policy / Planning / Programme / Action	Farmers and Urban Agricultural Development Commission	· AACA
#A8: Technical and capacity building activities for urban agriculture farmers	. No. of urban farmers trained on climate risks, weather monitoring and sustainable and climate-friendly farming	Programme / Action	Farmers and Urban Agricultural Development Commission	· AACA · Aid organisations · Private corporations (CSR budgets)
#A9: Improve water security through rainwater harvesting and irrigation management for urban agriculture	. No. rainwater collection systems in place . % population with/serviced by rainwater tanks . Reduction in No. water mains dedicated to the use of urban agriculture/irrigation	Policy / Programme / Action	AA Construction Bureau and Farmers and Urban Agricultural Development Commission	· AACA · Aid organisations · Private corporations (CSR budgets)
#A10: Improve access to, and quality of, wastewater and sanitation infrastructure	. Water quality metrics . Decrease in diseases related to poor sanitation and hygiene (water-borne diseases) . Access to sanitation constructed . No. of drains available . No. of landfills constructed for utilization . Length of sewer line constructed . No. of misconnections repaired . % of population with access to sanitation services	Planning / Programme / Action	AAWSA (Addis Ababa Water and Sewerage Authority), AARA (Addis Ababa City Roads Authority) and AASWA Addis Ababa Solid Waste Management Authority)	· AACA · World Bank · Other NGOs
#A11: Awareness raising of public health and climate change issues	. No. of people educated on vector-borne diseases (VBD) . No. of people educated on water-borne diseases . Case numbers	Programme / Project	Health Bureau	· AACA · NGOs · CRGE Facility · Other - TBD

#A12: Provision of preventative healthcare services in relation to vector-borne diseases	. No. of individuals from target groups vaccinated . Real time reporting tool established . Reduction in no. of cases of vector-borne diseases	Planning / Programme / Action	Health Bureau	· AACA · NGOs
#A13: Update infrastructure design standards for improved resilience in order to undertake a programme of improvements to the infrastructure networks	. No. of/coverage of installed sensors on sewage network . Proven effectiveness of updated design standards/technologies/materials used . No. of design standards updated to include climate change resilience	Project / Action	AAWSA, AACRA	· AACA · World Bank · Community · NGOs · Africa Bank
#A14: Undertake more detailed hazard mapping of risk areas to infrastructure	. Appropriate identification of risks and risk areas . No. of risk areas addressed . Area of unplanned and planned built development in risk areas	Project / Planning	AA Fire and Disaster Risk Management Commission	· AACA · Donors
#A15: Improve the City's urban maintenance response and emergency response capacity	. % of critical evacuation routes protected or strengthened . Number of maintained infrastructure assets . Performance of critical infrastructure during extreme events . Timeframe for response to emergency calls	Planning / Project	AAEPGDC	AACA
#A16: Smart Grid to create energy efficient electricity distribution networks within the City	. LED lighting (% homes with LED lighting installed; number of bulbs by type sold/year) . Grid connectivity (% homes connected to the grid; number of new connections/year)	Programme / Project	MoWIE (Ministry of Water, Irrigation and Energy)	· AACA · NGOs
#A17: River basin and watershed management to protect both hydropower potential and water resources	. % coverage of watershed . % of catchment management plans including options for improved resilience . Area of restoration and maintenance of natural resources surrounding basins and sheds . Frequency of contingency options used	Policy / Planning / Action	AAEPGDC, AAWSA	· NationalGovernment -AACA · NGOs
#A18: Protecting rivers from solid waste, debris and harmful diffuse / pollution discharges	. Reduction in concentration/amount of harmful pollutants entering the watercourses . Reduced amount of debris in the water . % of uncollected waste	Policy / planning / Programme / Action	Government and AAWSA	· AACA · NGOs
#A19: Efficient wastewater treatment and stormwater management	. Concentration of harmful pollutants entering the water . Reduced amount of debris in the water . % of uncollected waste	Programme / Project	Government and AAWSA	· AACA · NGOs
#A20: Accelerate urgently required water supply investments into water insecure and underserved areas	. % of population with access to potable water . % of population in different vulnerable groups with access to potable water . Increase in new businesses in water stressed areas	Programme / Action	Government and AAWSA	· AACA · Bilateral and multilateral cooperation · NGOs

Annex II: Adjustment to the GHG Emissions Inventory for Addis Ababa for Scenario Development

Addis Ababa's 2016 GHG inventory has informed the mitigation elements of this plan, as follows:

Base year emissions: the 'adjusted' 2016 GHG inventory
The Addis Ababa 2016 inventory has been used as the base year for the emission scenarios developed in this CAP. However, it was necessary for the inventory to be adjusted to better support scenario planning. This was in two main areas:

1. Exclusion of international emissions from aviation and scope 3 transport emissions (road transport crossing the boundary). This is because they are outside of the control and scope of the city and of the modelling tools available. International aviation is also considered an item outside the scope of national action, and as Addis Ababa is a major airport hub for Africa, it would not be feasible for the city at this time to set targets and actions for aviation.

2. Adjustment of stationary energy in order to include biogenic emissions from wood and charcoal within the projections: It is standard practice to exclude biogenic CO2 from inventory totals to avoid double counting of emissions with the land use changes sub-sector. However, for policy purposes, given the level of wood and charcoal consumption in Addis Ababa and the importance of actions to address this which would not be otherwise reflected, biogenic CO2 is being reported as non-biogenic CO2 in the modelling for Addis Ababa's CAP. This has a significant impact on the inventory totals and emissions profile for 2016, adding 9.4 mtCO2e.

The net change is that the adjusted 2016 inventory for Pathways is 4.8 mtCO2e higher than the official inventory, going from 14.5 mtCO2e to 19.3 mtCO2e.

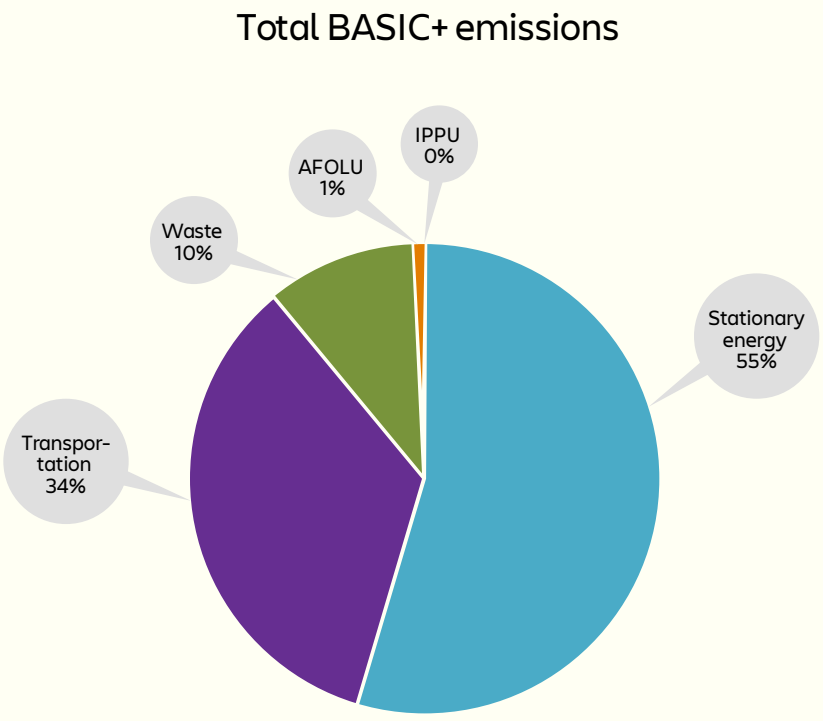


Figure 19: Addis 2016 adjusted GHG Emissions by Sector

Annex III: Addis Ababa CAP-AQ Technical Annex Summary

Air pollution levels in Addis Ababa negatively affect residents' health and exceed World Health Organization ambient air quality guidelines. Many sources of air pollution are also sources of climate pollutants, so reducing these sources can have the dual benefits of improving air quality and mitigating climate change. By implementing its CAP, Addis Ababa has the opportunity to improve air quality, while contributing to global climate change mitigation and ensuring the well-being of its citizens.

Addis Ababa's CAP actions and scenarios were analyzed using Pathways-AQ, a rapid, accessible scoping tool created to understand the air quality and health implications of city climate policies. Pathways-AQ is a combined GHG and air quality scoping tool. It creates an air quality emissions inventory by applying air pollutant emission factors to "activity" (fuel use) data. In addition to modelling emissions of carbon dioxide equivalent (CO_2e), it models direct emissions of $PM_{2.5}$ along with four pollutants that combine in the atmosphere to produce $PM_{2.5}$: nitrous oxides (NO_x), sulphur dioxide (SO_2), ammonia (NH_3), and volatile organic compounds (VOC).

To calculate emissions, Pathways-AQ uses a bottom-up approach to model activity within the city for the residential, commercial, industrial, transport and waste sectors, then multiplies each activity by an emission factor (emissions per unit of activity) to estimate the mass of pollutants generated[53].

Pathways-AQ then uses spatial analysis from an external tool, the InMAP **(Intervention Model for Air Pollution)** model[54] , to convert emissions of $PM_{2.5}$ and other precursor pollutants into an annual average $PM_{2.5}$ concentration within the area of the city's boundary. Finally, Pathways-AQ uses baseline population health data from the Global Burden of Disease Project, coupled with relative risk curves, to estimate city-wide mortality from six diseases that are linked to air pollution ($PM_{2.5}$).

Currently, the four largest contributors to annual average $PM_{2.5}$ concentrations in Addis Ababa are 1) the residential sector, which includes solid fuel burning for cooking and heating; 2) on-road transport, including high-emitting cars and buses; 3) the waste sector, including waste incineration and open burning; and 4) manufacturing and construction emissions.

Addis Ababa can improve its air quality by fully implementing its climate action planning scenarios, averting hundreds of premature deaths each year through climate actions that benefit air quality as well (Table 17). The estimated changes in air pollution and premature mortality presented in Table 17 provides an indication of the reductions in $PM_{2.5}$ concentrations and the associated premature deaths over the modelled time horizons, under the existing and planned and ambitious scenarios.

	Change in air pollution (Annual average reduction in PM2.5 concentration)	Change in premature mortality (Deaths avoided per year)
Existing and Planned Scenario		
2030	13 μg/m^3	212
2040	23 μg/m^3	284
2050	43 μg/m^3	142
Ambitious Scenario		
2030	20 μg/m^3	364
2040	43 μg/m^3	712
2050	94 μg/m^3	1036

Table 17. Estimated changes in air pollution and premature mortality associated with implementation of Addis Ababa's Climate Action Plan scenarios

[53] Note, importantly, that only emission sources included in the GHG inventory are reflected in this analysis. Pathways-AQ generates mass emission estimates for GHGs as well as PM2.5 and precursor pollutants. This analysis does not include all emission sources within the city.

[54] Tessum et al., 2017. See also Thakrar et al., submitted.

In both scenarios (E&P and ambitious), residential sector climate mitigation strategies–such as switching from unclean energy sources (solid fuel combustion) to electricity–have high potential to mitigate GHG emissions and reduce air pollution. Other climate mitigation strategies with potential to markedly reduce both air pollution and GHG emissions include: shifting away from high-emitting on-road vehicles to walking and cycling; switching to cleaner on-road transport fuels; improving waste management infrastructure and systems; and switching toward cleaner fuels in the commercial sector and in manufacturing industries.

Under the existing and planned scenario, Addis Ababa can reduce its annual average population-weighted $PM_{2.5}$ by 43 µg/m³ by 2050 (for $PM_{2.5}$ attributable to sectors included in Pathways, the climate action planning modelling tool) (Figure 1), preventing 142 early deaths in 2050 (Figure 2). The actions that will be particularly helpful in improving air quality under this scenario are related to improving buildings and switching to cleaner sources of energy, in the residential sector.

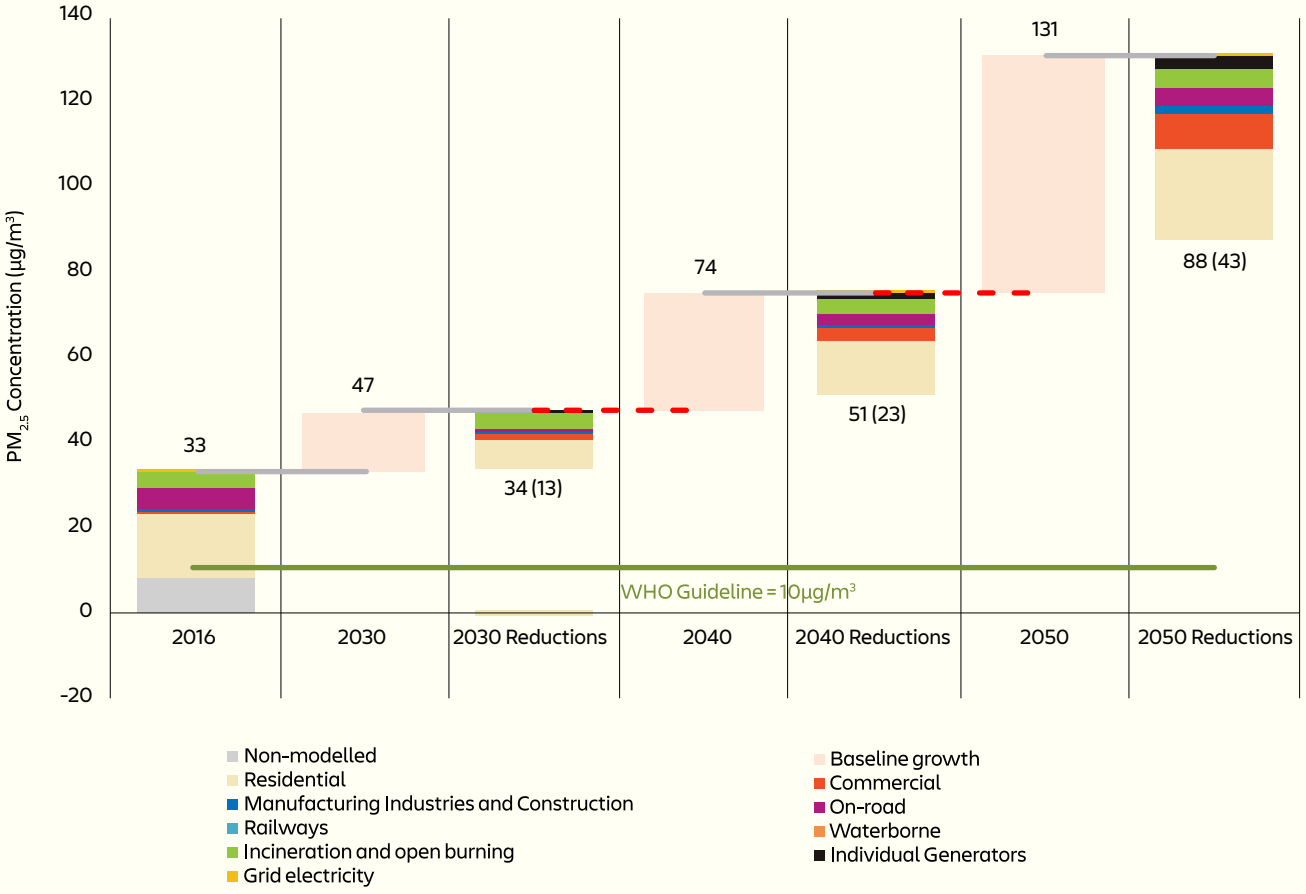


Figure 20. Air quality implications of climate actions in the E&P scenario

The top numbers show the projected baseline $PM_{2.5}$ concentrations in a given year. The lower numbers represent the $PM_{2.5}$ concentration expected after implementation of the E&P scenario. The difference between the top and lower numbers equates to the reduced $PM_{2.5}$ concertation in a given year and is represented in brackets next to each lower number.

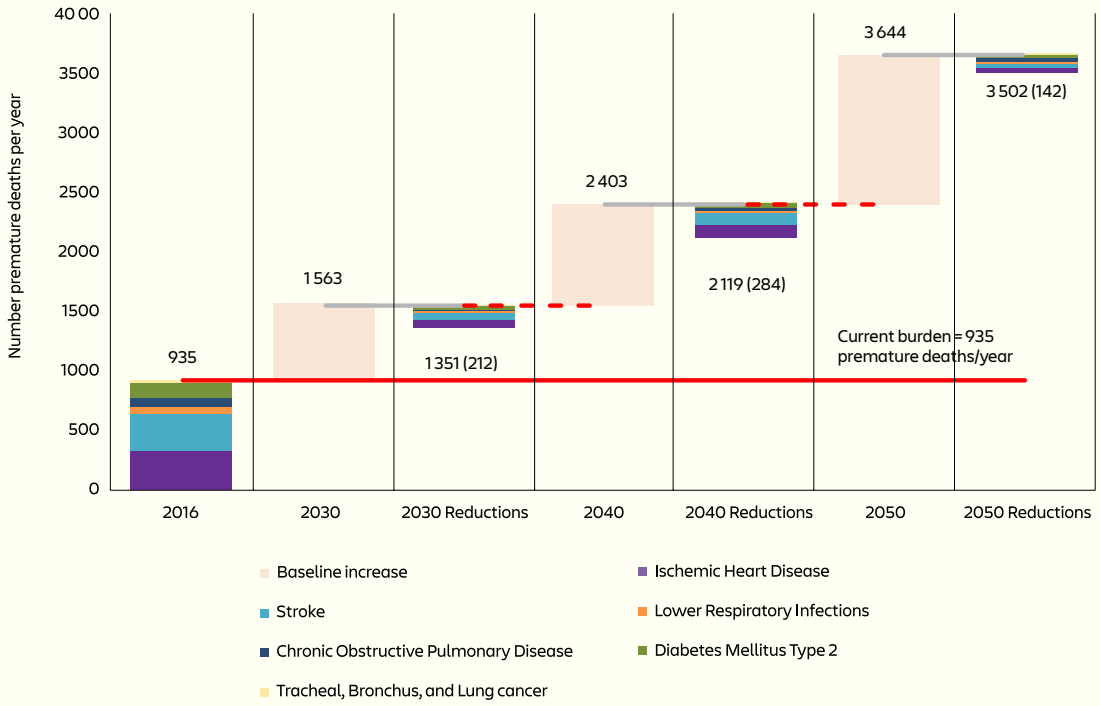


Figure 21. Health implications of climate actions in the E&P scenario

The top numbers show the projected baseline premature mortality due to ambient $PM_{2.5}$ exposure in a given year. The lower numbers represent the number of premature deaths expected after implementation of the E&P scenario. The difference between the top and lower numbers equates to the premature deaths avoided in a given year, and is represented in brackets next to each lower number.

Implementing the ambitious scenario is projected to reduce annual average population-weighted PM2.5 by 94 µg/m³ in 2050 (Figure 3); which would prevent 1036 early deaths in 2050 (Figure 4). The sectors that have the highest potential to reduce $PM_{2.5}$ in that year are new residential energy efficiency for cooking and space heating, (as a result of decreased solid fuel use), industrial energy efficiency and fuel switching measures, and commercial energy efficiency, followed by conversion of buses from diesel to electric. The majority of health benefits are expected to accrue from changes in new residential buildings (cooking and water heating improvements), new commercial buildings (space heating improvements), and as a result of industrial energy efficiency measures.

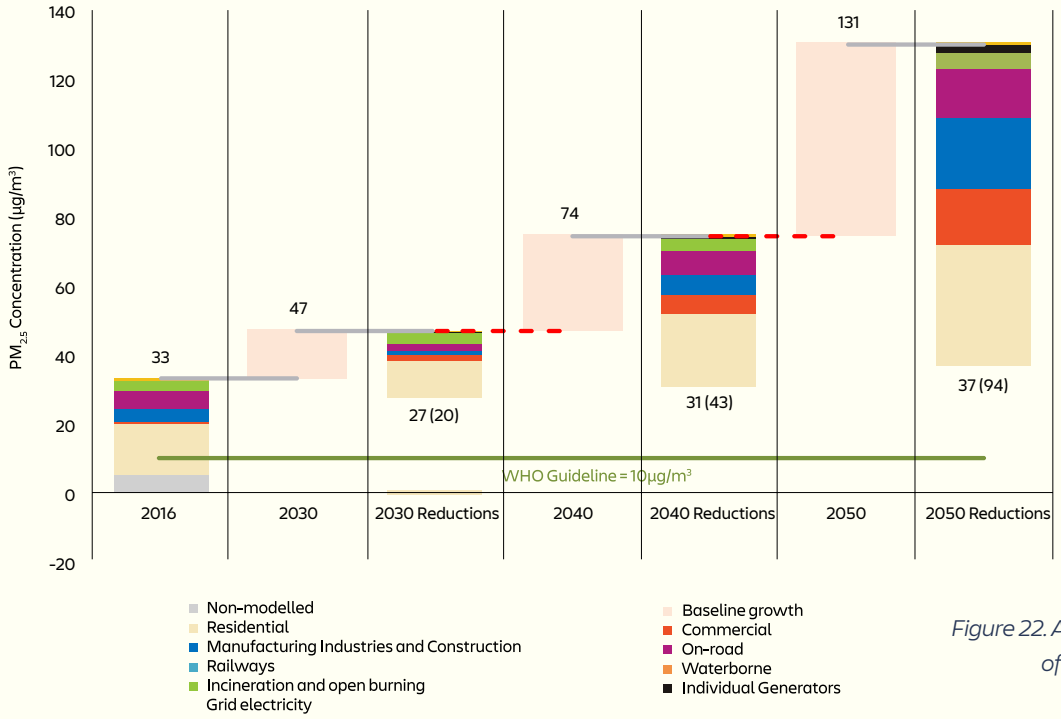


Figure 22. Air quality implications of climate actions in the ambitious scenario

The top numbers show the projected baseline $PM_{2.5}$ concentrations in a given year. The lower numbers represent the $PM_{2.5}$ concentration expected after implementation of the Ambitious scenario. The difference between the top and lower numbers equates to the reduced $PM_{2.5}$ concertation in a given year and is represented in brackets next to each lower number.

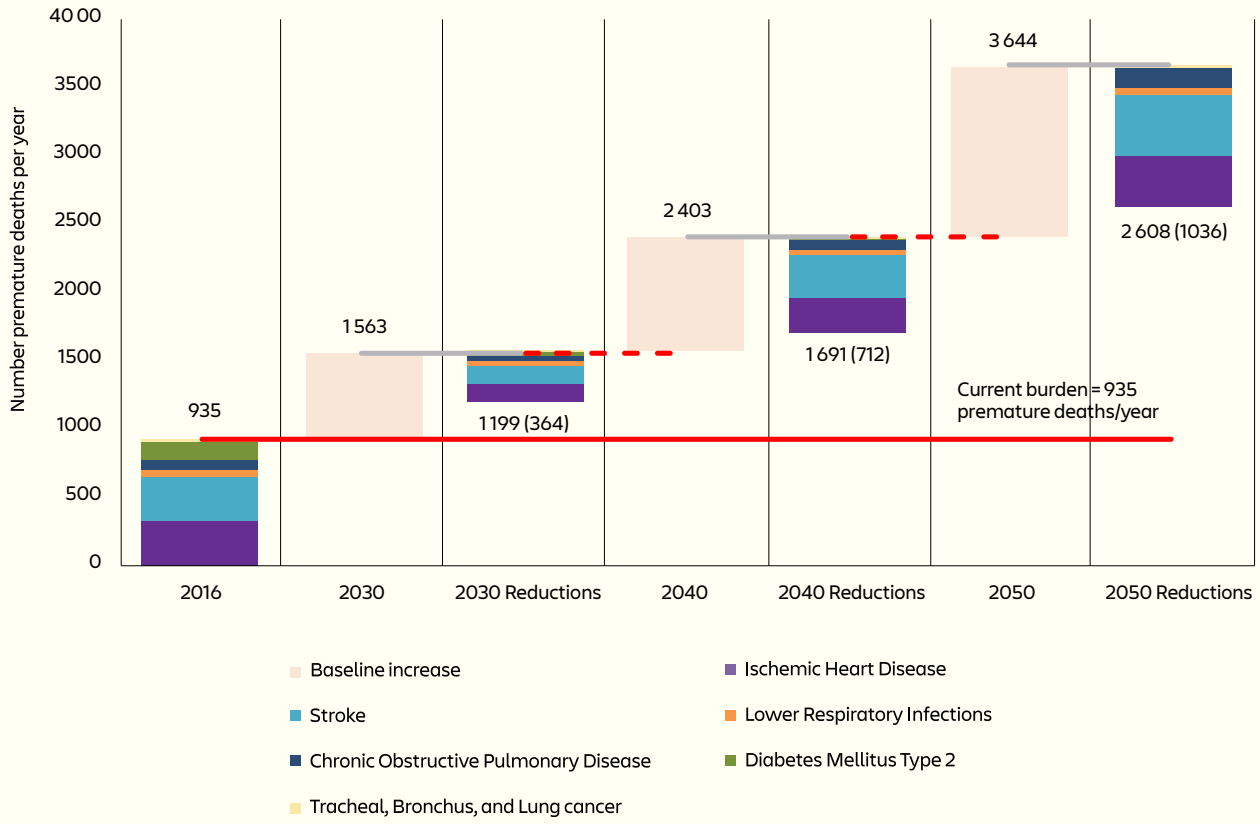


Figure 23. Health implications of climate actions in the ambitious scenario

The top numbers show the projected baseline premature mortality due to ambient $PM_{2.5}$ exposure in a given year. The lower numbers represent the number of premature deaths expected after implementation of the Ambitious scenario. The difference between the top and lower numbers equates to the premature deaths avoided in a given year, and is represented in brackets next to each lower number.

Importantly, the analysis finds that $PM_{2.5}$ concentrations could increase if residents shift from using motor cars to using diesel buses, highlighting the importance of establishing vehicle emission standards and policies that promote electric or low-emitting buses.

Mainstreaming air quality work across all relevant city departments will encourage better coordination and effective use of resources to accomplish the city's stated air quality management and climate change-related goals. With a steering committee responsible for implementation of both the Climate Action Plan and Air Quality Management Plan (AQMP), Addis Ababa can serve as an example of the effectiveness of co-managing air quality and climate change action to realize health benefits for residents while meeting ambitious environmental goals.

Although air pollution may seem like a future issue, the reality is that it is creating health effects and causing early death now. As Addis Ababa grows, air pollution does not need to get worse. Taking action now will prevent early deaths every year.

Abbreviations & Acronyms

AA CA	Addis Ababa City Administration
AA CB	Addis Ababa Construction Bureau
AA CRA	Addis Ababa City Roads Authority
AA EPA	Addis Ababa Environmental Protection Authority
AA EPGDC	Addis Ababa Environmental Protection and Green Development Commission
AA HDAB	Addis Ababa Housing and Development Administration Bureau
AA SWMA	Addis Ababa Solid Waste Management Agency
AA RTB	Addis Ababa Road and Transport Bureau
ACCP	African Clean Utility Platform
AA TIB	Addis Ababa Trade and Industry Bureau
AFOLU	Agriculture, Forestry and Other Land Use
AFD	Agence Française de Dévelopment
BAU	Business-As-Usual
BMUB	German Ministry for the Environment, Nature, Conservation, Building and Nuclear Safety
BRT	Bus Rapid Transit
CAP	Climate Action Plan
CCRA	Climate Change Risk Assessment
CIRIS	City Inventory Reporting and Information System
CRGCP	Integrated Climate Change Response Investment Plan
CRGE	Climate Resilient Green Economy
EAs	Energy Audits
EE	Energy Efficiency
EEA	Ethiopian Energy Authority
EEPCo	Ethiopia Electric Power Corporation
EEU	Ethiopian Electric Utility
EFCCC	Environment Forests, and Climate Change Commission
EPA	Environmental Protection Authority
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPC	Global Protocol for Community-scale Greenhouse Gas Emission Inventories
GTP	Growth and Transformation Plan
HoDs	Heads of Departments
HVAC	Heating, Ventilation and Air Conditioning
INDC	Intended Nationally Determined Contribution
ITCZ	Inter Tropical Convergence Zone
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
JICA	Japan International Cooperation Agency
KPI	Key Performance Indicators
LEDs	Light-emitting diodes
LRT	Light Rail Transit
MCA	Multi-Criteria Analysis
MoF	Ministry of Finance
MoUDH	Ministry of Urban Development and Housing (MoUDH)
MoWIE	Ministry of Water, Irrigation and Energy
M&E	Monitoring and Evaluation
MER	Monitoring, Evaluation and Reporting
MPR	Monitoring and Progress Report
MRV	Monitoring, Reporting and Verification
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NMT	Non-Motorized Transport Strategy
SEA	Sustainable Energy Africa
SDGs	Sustainable Development Goals
SLCPs	Short-Lived Climate Pollutants
TCO_2e	Tonnes of carbon dioxide equivalent
TRANSIP	Transport Systems Improvement Project
TVET	Technical and Vocational Education and Training Agency
FTA	Federal and Transport Authority
PMV	Personal Motor Vehicles
VKT	Vehicle Kilometres Travelled
WASH	Water, Sanitation and Hygiene (UNICEF)
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Glossary of Terms

Adaptation capacity. 'Technical and financial ability and willingness of the city's key stakeholders at various levels - local, regional, and national - to cope with the adverse impacts of climate change. A quick measure of institutional awareness is the presence of a comprehensive analysis of climate risks for the city and corresponding adaptation and mitigation initiatives. [55]

Adaptation options. The array of strategies and measures that are available and appropriate for addressing adaptation. They include a wide range of actions that can be categorised as structural, institutional, ecological or behavioural.

Abatement potential. A measurement of the potential to decrease greenhouse gas (GHG) emissions from a particular sector or through an action. The abatement potential is measured in GHG emissions (e.g. tonnes of carbon dioxide equivalent). Also referred to as Emission Reduction Potential.

Baseline scenario goal. Mitigation goal that aims to reduce emissions by a specific quantity relative to a projected emissions baseline scenario or forecast.

BASIC level of reporting. The GPC Protocol inventory reporting level that includes all scope 1 sources except from energy generation, imported waste, IPPU (Industrial Processes and Product Use) and AFOLU (Agriculture, Forestry and Other Land Use), as well as all scope 2 sources

Business-as-usual (BAU) scenario. A baseline scenario projecting GHG emissions based on a set of reasonable assumptions and data that best describe events or conditions that are most likely to occur. This scenario is used to understand future emissions in the absence of city mitigation activities and based on historical data, including GDP, population and sectoral energy intensity.

Base year. A historical datum (e.g. year) against which a city's emissions are tracked over time.

Base year emission goal. Mitigation goal that aims to reduce or control the increase of emissions relative to an emissions level in a historical base year.

Carbon neutral. A city that has achieved and demonstrated in a given year, net-zero GHG emissions from:

- Fuel use in buildings, transport, and industry (scope 1)
- The use of grid-supplied energy (scope 2)
- The treatment of waste generated within the city boundary (scope 1 and 3)

And, where a city accounts for additional sectoral emissions in their GHG accounting boundary, net-zero GHG emissions from all additional sectors in the GHG accounting boundary. Also referred to as Emissions Neutral, Net-Zero Emissions or Net-Zero Carbon.

CO_2 equivalent (CO_2e). The universal unit of measurement to indicate the global warming potential (GWP) of each GHG, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate the climate impact of releasing (or avoiding releasing) different greenhouse gases on a common basis.

Climate action. Any policy, programme, project or activity initiated with the intention to provide some contribution to climate mitigation or adaptation.

Climate change. A change in the state of the climate that can be identified (for example, by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use. The UN Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. [56]

Climate adaptation. In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

[55] Mehrotra et al. (2009). Framework for City Risk Assessment

[56] IPCC (2018). Annex I: Glossary. In: Global Warming of 1.5°C

Climate hazard. The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.

Climate-related hazard. 'Hazards affecting the whole city, including all communities. Hazards may include meteorological, climatological, hydrological, geophysical, or biological events and should acknowledge variability in hazard exposure across the city'.

Climate impact. The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives; livelihoods; health and well-being; ecosystems and species; economic, social and cultural assets; services and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.

Climate mitigation. A human intervention to reduce emissions or enhance the sinks of greenhouse gases.

Climate projection. A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases (GHGs) and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative forcing scenario used, which is in turn based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realised.

Climate risk. In broad terms, climate risk is generally described as the 'Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence'. Risk at an urban scale can also be defined as the potential for adverse consequences on lives, health, ecosystems, economic, social and cultural assets, services, and infrastructures. In general, three broad risk categories are usually used: acceptable risks, tolerable risks, and intolerable risks. The uncertainty of this probability increases considerably with climate change. Major risks lie in the failure to adapt to changes in the environment, leading to instability and insecurity of economic system(s) threatening adequate level of societal welfare. Climate change risk depends on climatic factors as well as decisions (intentional or unintentional) of agents governing interdependencies among climatic and socio-economic-environmental systems. Inadequate decisions (adaptation) can cause systemic risk propagating through all systems.

Emission factor. A multiplier that converts activity data into GHG emissions data (e.g., kg CO_2e emitted per litre of fuel consumed, kg CO_2e emitted per kilometre travelled) or other outcomes (beyond GHGs) such as $PM_{2.5}$, SO_2, NO_x, NH_3, etc.

Global Protocol for Community-Scale GHG Emissions Inventories (GPC). The GPC is a protocol developed by C40, World Resources Institute and ICLEI-Local Governments for Sustainability. The GPC outlines standards for developing a GHG emission inventory, establishing a base year, ensuring consistent methods for reporting, enabling aggregation at the national level and facilitating benchmarking

Greenhouse gas (GHG) emissions. Gases that trap heat in the atmosphere by absorbing and emitting solar radiation within the atmosphere, causing a greenhouse effect that warms the atmosphere and leads to global climate change. GHGs include seven gases: carbon dioxide (CO2); methane (CH4); nitrous oxide (N2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF6); and nitrogen trifluoride (NF3).

Mitigation measures. In climate policy, mitigation measures are technologies, processes or practices that contribute to mitigation, for example, renewable energy technologies, waste minimisation processes and public transport commuting practices.

Resilience. The capacity of social, economic and environmental systems to cope with a hazardous event or 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.

Vulnerability. In general terms, vulnerability is described as 'the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt' [57]. As it relates to facing a [urban] climate hazard, people and infrastructures are exposed to the same potential losses but are not vulnerable in the same way. Vulnerability depends on physical, socio-economic, the availability of services, governmental and cultural factors and can be quantified by the degree of loss resulting from a hazard, and the capacity to recover from an event.

[57] IPCC. (2018). Annex I: Glossary. In: Global Warming of 1.5°C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