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CLIMATE
ACTION PLAN

BRIHANMUMBAI MUNICIPAL CORPORATION

CLIMATE BUDGET REPORT

FY 2024-25

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1. Introduction to Climate Budgeting

"*A climate budget is a governance system that mainstreams climate commitments and considerations into decision-making on policies, actions and budget. This is done by integrating climate targets from the city's Climate Action Plan (CAP) into the financial budgeting process and assigning responsibility for implementation, monitoring, evaluation and reporting across the city government*"[1]

Brihanmumbai Municipal Corporation published the Mumbai Climate Action Plan (MCAP) on 13 March 2022, with a commitment to make Mumbai net-zero and climate-resilient. MCAP is a roadmap for the city to achieve the goals of the Paris Agreement to reduce Mumbai's greenhouse gas emissions and integrate climate adaptation strategies to better manage increasing climate risks in Mumbai. BMC acknowledges that the climate crisis is already affecting us all, although in varying ways, and the time for action is now to secure a better future for all. The climate budgeting process for Mumbai seeks to take forward implementation of MCAP and build on the knowledge base and momentum it has created.

1.1. Objectives

The climate budget report would help the city's decision makers, government authorities, climate professionals, community-based organisations, researchers, businesses and commercial establishments, students, and citizens at large know Mumbai's climate priorities and activities for the upcoming financial year. The report can also be useful for multilateral financial institutions, banks and other external funders and financiers understand if and how they can potentially extend climate funding and green financing support to help Mumbai meet its climate goals.

The key objectives for Mumbai's climate budgeting process are to:

1. Disseminate Mumbai's climate commitments and priorities through an official governance-based process.
2. Ensure implementation of actions and recommendations highlighted in the Mumbai Climate Action Plan (MCAP) and identify current budget items that already align with the climate action plan.
3. Understand BMC's existing municipal budget using a 'green, climate lens' to assess potential for mainstreaming and gain practical insights on how existing budget items can be made more climate friendly when implemented on-the-ground.

4. Enable monitoring, tracking and evaluation of progress of MCAP's goals and targets on an annual basis.
5. Identify potential climate projects and activities that can be cross financed through external financing mechanisms.

1.2. Process

Mumbai is one of 13 global cities that has been part of C40 Cities' climate budget pilot program since September 2021, while the city was still developing MCAP.[2] The objective of joining the pilot was to investigate, develop, implement, and improve the use of climate budgeting in operationalizing MCAP and mainstreaming climate action using an existing governance process and tool.[3] Mumbai's climate budgeting process is anchored by BMC's Environment department and supported by WRI India and C40 Cities. The climate budget team carried out ex-post assessments of BMC's municipal budgets for financial years 2022-23 and 2023-24. Insights from this ex-post climate budget assessment exercise helped shape Mumbai's climate budgeting process.

BMC's finance department integrated the climate budget template into the budget circular for Financial Year 2024-25[4] and shared it with all climate-relevant departments. Three rounds of inter-departmental meetings and consultations were led by the Environment department wherein 20 climate-relevant departments[i] were explained the relevance and importance of this exercise, and how to fill out the climate budget template. The climate budget team carried out one-on-one engagements with all relevant departments to help them understand the process better and support them in filling out the climate budget template. Departments were asked to refer to MCAP's action tracks (refer to Annexure 1) and map relevant budget items to one of the 24 action tracks and explain how they are planning to carry out implementation in terms of quantity, timeline, phase, location, impact etc.

Based on the data and information received, the climate budget team has grouped and categorised budget items into *direct and enabling* actions. Direct actions have further been divided into *quantified and not quantified* actions. Climate impact assessment of the measures

[i] BMC's climate-relevant departments include Environment, Disaster Management, Solid Waste Management, Education, Storm Water Drains, Mechanical and Electrical, City Engineers, Development Planning, Gardens, Markets, Public Health, Information Technology, Transport, Roads and Traffic, Bridges, Hydraulic Engineer, Water Supply Project, Sewerage Project, Sewerage Operations, and Mumbai Sewerage Disposal Project.

has been done in terms of potential emission reduction for *direct – quantified* actions and in terms of co-benefits for *direct – not quantified* actions (refer to Chapter 3). This report focuses on highlighting budget items aligned with MCAP and their climate impact assessment. It is estimated that INR 10,224.24 crores i.e. 32.18% of the capital budget expenditure is towards activities that align directly with MCAP, while INR 2,163.8 crore i.e. 6.81% of the capital budget expenditure is for activities that integrate some components of the MCAP, elaborated in Chapter 4. To know disaggregated budgetary allocations for budget items, refer to budget books A, B, E & G.

2. Mumbai Climate Action Plan (MCAP) Overview

MCAP provides a detailed understanding of Mumbai's context; greenhouse gas inventory; climate risks and vulnerabilities; future emission scenarios and pathways to a 1.5°C scenario for Mumbai; sectoral priorities, goals, actions, and implementation strategies; governance and institutional structures; and how to track progress. [5] This section focuses on and summarises Mumbai's climate baseline, future emission scenarios and 24 key action tracks as highlighted in MCAP.

2.1. Greenhouse Gas Inventory

The Greenhouse Gas (GHG) Inventory for Mumbai includes an analysis of sectors and sources that emit carbon dioxide, methane and nitrous oxide and can enable the city to build evidence-based mitigation actions and policies and monitor progress.

In 2019, Mumbai's GHG emissions were 23.42 million tonnes CO_2e of which, the Stationary Energy sector is responsible for 16.9 million tonnes CO2e (72% of total emissions). Most of the city's emissions come from energy use in residential buildings followed by commercial buildings, transport, and waste. Electricity consumption contributes significantly to total emissions (64.3%), due to the city's predominantly coal-based grid.

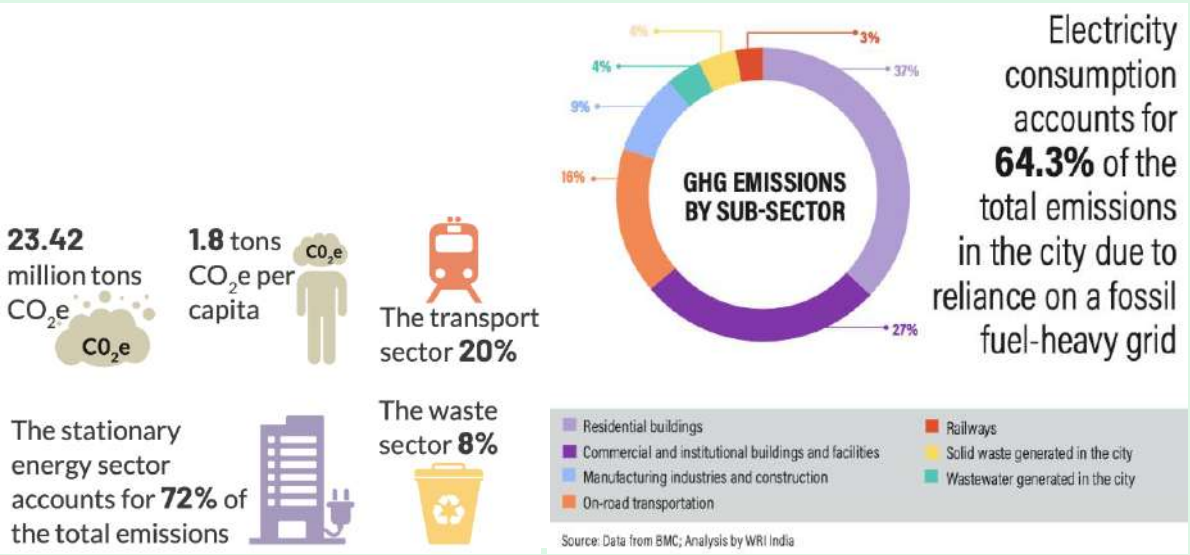

Figure 1: Sectoral contribution to GHG emissions in Mumbai, 2019

2.2 Key climate risks

The climate and air pollution risks and vulnerability assessment helps evaluate the city's climate risk based on historic data. It uses a complex framework of indicators to quantify and spatialise differential vulnerabilities based on socioeconomic and demographic characteristics as well as service accessibility that increase risk exposure and vulnerability in the poor and

underdeveloped neighbourhoods of the city. MCAP 2022 identifies five key climate risks in the context of Mumbai:

1. **Urban heat:** Mumbai has seen a warming trend since 1973 with an increase of 0.25°C per decade, with 200+ days annually classified as extreme caution events since the mid-90s. Dense settlements, low vegetation cover and reflective building materials increase the risk of heat exposure.
2. **Urban flooding:** Mumbai has been witnessing a steady increase in extreme rainfall events. Over 35% of Mumbai's population lives within a 250m radius buffer of BMC-reported flooding hotspots.
3. **Landslides:** Settlements on unstable slopes face increased prospects of rainfall-induced landslides. As per the data recorded by the Disaster Management Department at BMC, there are 287 locations within Greater Mumbai that are landslide-prone out of which 209 locations fall within the extent of informal settlements characterized by unstable structures and societal vulnerabilities.
4. **Coastal risks:** As per the India Meteorological Department (IMD) Mumbai and other areas along the Arabian Sea were subjected to 18 cyclone events between 2011 to 2021. This is due to a slow, but steady, increase in annual mean sea surface temperature of the Arabian Sea. The western coastline of Mumbai doesn't show a dramatic change over years, in the form of erosion or accretion, due to 'tetra pods' that absorb strong tidal impacts.
5. **Air pollution:** Average annual concentrations of PM2.5 and PM10 have been increasing over the years and need to be reduced through mitigation measures. Nitrogen dioxide is a major pollutant in Mumbai and mean concentration levels of pollutants Sulphur Dioxide, Carbon Monoxide and Ammonia were below the NAAQ permissible limits till 2019. Ozone also exhibited a gradual decreasing trend in annual concentration from 2015 to 2020. Several measures are being taken to control air pollution, including strengthening air quality monitoring systems and devising comprehensive mitigation plans to combat the increasing levels of pollutants.

2.3 GHG emission scenarios

The pathways scenario exercise provides an evidence base on which the city has set emission reduction targets for energy, transport, and waste sectors. Mumbai has an overarching mitigation target of reaching net-zero emissions by 2050. Interim and long-term targets include 30% emission reduction by 2030, 44% by 2040 and net zero by 2050 against base year

emissions (2019). If no actions are taken, emissions are expected to increase **170% between 2019 and 2050.** The most 'ambitious yet achievable' trajectory for Mumbai's scenario forecasts emissions to **reduce by 27% by 2030 and 72% by 2050,** as highlighted in MCAP**.**

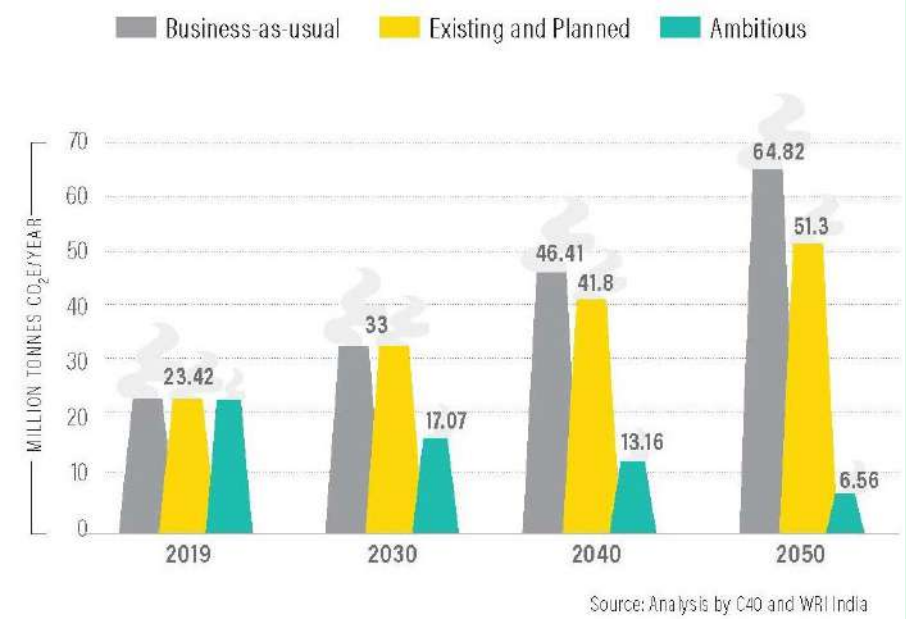

Figure 2: Graph showing future GHG emission scenarios

2.4 Priority Sectors and Action Tracks

MCAP identified six key sectors and 24 action tracks across the six sectors to focus on addressing impacts and causes of climate change in Mumbai. The six sectoral action tracks include: Energy & Buildings, Integrated Mobility, Sustainable Waste Management, Urban Greening and Biodiversity, Air Quality, Urban Flooding & Water Resource Management. The list of sectors and action tracks are provided in Annexure 1. These sectors and action tracks have served as a basis in the BMC's budget circular for FY 2024-25 to anchor and identify climate measures across BMC's departments throughout the climate budgeting process.

BMC will aim to use annual climate budgeting as a function for planning, adopting and reporting to inform management with the objective to systematically reduce emissions and improve climate resilience in the city. It will enable the city to mainstream climate-forward thinking in its decision making and governance systems.

3. List of climate measures for FY 2024-25

The Environment Department undertook a timely, systematic, and collaborative approach to formulate Mumbai's first climate budget. Climate impact of mapped budget activities submitted by various departments, linked to MCAP action tracks were assessed, grouped, and categorised into the following types of actions –

1. Direct Actions
    a. Quantified
    b. Not Quantified
2. Enabling Actions

3.1. Direct Actions – Quantified

Direct Action - Quantified encompasses the measures and activities planned to be carried out by the climate-relevant departments of the BMC for the FY 2024-25, directly leading to greenhouse gas emission reduction. Based on the data and specifications available through consultations with the departments, the table below includes the activities for which it has been possible to estimate quantified potential greenhouse gas emission reductions using methodologies highlighted in Greenhouse Gas Protocol for Cities (GPC), CIRIS tool and Intergovernmental Panel on Climate Change (IPCC) emission factor database.

Table 1 includes direct actions that we can quantify, their alignment with MCAP action tracks and associated emission reduction potential.

Direct Actions – Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Potential emission reduction metric tonne tCO_2e/ year** [ii]
Solid Waste Management (SWM) Department			
1	Solid Waste Management at Deonar Dumping Ground - Development of Waste to Energy (WTE) Project at the Deonar Dumping Ground (DDG) - Biomining project at Deonar Dumping Ground	3.3. Remediation and scientific management of landfills	2,11,378.8 1.106 per MT of landfill waste bio-mined*

[ii] *"tCO_2e" represents metric tons of carbon dioxide equivalent, a unit measuring greenhouse gas emissions. It enables comparison of various gases' global warming potentials by equating them to the amount of CO_2 that would cause equivalent warming over a standard timeframe, often 100 years.*

Direct Actions – Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Potential emission reduction metric tonne tCO_2e/ year [ii]**
	* Over the complete lifecycle of a biomining project.		
2	Dumpsite Reclamation Project at Mulund Dumping Ground (MDG) ** Calculated for the complete lifecycle of the dumpsite reclamation project	3.3. Remediation and scientific management of landfills	51,66,000**
Mechanical and Electrical (M&E) Department			
3	Upgradation of the High Mast System	1.2. Transition to clean fuels and resource efficiency	1244
4	Installation of solar panel systems at various peripheral hospitals	1.2. Transition to clean fuels and resource efficiency	798
5	Carbon Cutter system	5.1. Curb the pollution concentration level by 20-30% by 2030	903.18
6	Setting up of eco-friendly wood pyre cremation system		4054.95
7	Replacing existing AC units with comparatively more energy efficient AC units in various municipal office and hospital buildings	1.2. Transition to clean fuels and resource efficiency.	36.1
Markets			
8	Setting up Organic Waste Convertor at 64 municipal market buildings	3.2. Decentralized waste management, Recycle/Compost at the local level	14,50,656
9	Fitting LED lights in municipal markets	1.2. Transition to clean fuels and resource efficiency in buildings	Incandescent bulb with LED- 0.11 tCO_2e per bulb CFL bulb with LED- 0.014 tCO_2e per bulb
10	Installation of solar panels on rooftop of 3 market buildings	1.1. Decarbonizing Mumbai's	311

Direct Actions – Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Potential emission reduction metric tonne tCO_2e/ year [ii]**
		electricity generation mix	
Water Supply Projects (WSP) Department			
11	Development of Renewable Hybrid Energy Project Facilities at HSBT Middle Vaitarna Dam	1.1. Decarbonizing Mumbai's electricity generation mix	52,461
Transport Department			
12	Procurement of 20 EV Sedan cars	2.3. 100% municipal and private zero emission vehicles by 2050	12.8 – 17
Hydraulic Engineers (HE) Department			
13	Setting up of Solar Power Generation Plant on the Rooftop of New Master Balancing Reservoir (MBR) at Bhandup Complex	1.1. Decarbonizing Mumbai's electricity generation mix	1037

3.2. Direct Actions – Not Quantified

Direct Action – Not quantified encompasses measures and activities vital for reinforcing climate initiatives within the city. These planned actions over the next year shall contribute to long-term climate action by strengthening the city's infrastructure and service distribution systems, thereby bolstering resilience to climate risks, and laying the groundwork for future emission reductions. The table below, Table 2, compiles activities and city work undertaken by the climate-relevant departments at BMC. Each entry is aligned with the corresponding MCAP action track it fulfils and outlines the potential co-benefits that can be achieved through these initiatives. Co-benefits have been identified using the United Nations' 17 Sustainable Development Goals (SDGs) framework and internal expertise.

Table 2 will include direct actions towards building climate resilience and that cannot be quantified, their alignment with MCAP action tracks and associated co-benefits.

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
Disaster Management Department			
1	Setting up and operating Viewing Centre in 24 Wards	6.6. Disaster risk and impact reduction	Sustainable communities and city
Education Department			
2	Upgradation of toilets in all Municipal Schools	6.5. Clean, safe, and accessible toilets	Quality education, good health and wellbeing, gender equality
3	Repairs and upgradation of Municipal School playgrounds	4.3. Equitable access to green open spaces	
Solid Waste Management (SWM) Department			
4	Provision of toilets in all wards	6.5. Clean, safe and accessible toilets	Good health and wellbeing, gender equality
5	Synthetic vinyl sheet pilling at Deonar Dumping Ground	6.3. Reducing pollution and restoring aquatic ecosystems	Clean water, improved health
6	Plantation in landfill site at Kanjurmarg Dumping Ground	4.1. Increase vegetation cover and permeable surface	Enhanced biodiversity, better quality of life, improved health
7	Measures to ensure survival of mangroves within Kanjurmarg Dumping Ground	4.4. Restore and enhance biodiversity in the city	Flood resilience and protecting forest ecosystem
8	Decentralisation and upgradation of Solid Waste Management process	3.2 Decentralized waste management, Recycle/Compost at the local level	Sustainable communities and city

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
9	Provision for solar lighting at Deonar Dumping Ground and Gorai Dumping Ground	1.2. Transition to clean fuels and resource efficiency.	
City Engineers (ESP) – Environment Department			
10	Measures for prevention of air pollution in Mumbai	5.1. Curb the pollution concentration level by 20-30% by 2030	Good health, productivity, overall well-being
11	Setting up of A.Q.M&R laboratories and installation of Automatic Air Quality Monitoring Mobile Van for A.Q.M&R Laboratory	5.2. Increase information availability through monitoring	
12	Installation of Continuous Ambient Air Quality Monitoring Stations (CAAQMS)		
City Engineers Department			
13	Construction of public hall (Samajik Sabhgruh) at Murar Road • Rainwater Harvesting • Use of LED bulbs	1.2 Transition to clean fuels and resource efficiency. 6.2 Localise water conservation and efficiency.	Sustainable buildings and city
14	Provision for construction of various community infrastructure at various locations in Mumbai		
15	Construction of Project Affected Persons housing on private land		
16	Measures for control of pollution and rejuvenation of water bodies	6.3. Reducing pollution and restoring aquatic ecosystems	Sustainable city, improved health

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
Fire Brigade Department (As reported under City Engineers)			
17	Construction, reconstruction of fire brigade stations at various locations in Mumbai • Use of LED bulbs • Rainwater Harvesting • Greening within the site	1.2 Transition to clean fuels and resource efficiency. 6.2 Localise water conservation and efficiency. 4.1. Increase vegetation cover and permeable surfaces	Sustainable buildings and city
Markets Department (As reported under City Engineers)			
18	Construction and redevelopment of municipal market buildings at various locations in Mumbai • Rainwater Harvesting • Use of LED bulbs • Installation of solar panels • Greening in new market building compounds	1.1. Decarbonizing Mumbai's electricity generation mix 1.2 Transition to clean fuels and resource efficiency. 6.2 Localise water conservation and efficiency 4.1. Increase vegetation cover and permeable surfaces	Sustainable buildings, cities, and communities
Improvement schemes (As reported under City Engineers)			
19	Planning and redevelopment of residential tenements in M/E ward • Rainwater Harvesting • Use of LED bulbs • Installation of solar panels		
20	Redevelopment of Municipal Property at Vikhroli Parksite Layout in N ward • Rainwater Harvesting • Use of LED bulbs • Installation of solar panels • Layout open space greening • Setting up a Sewage Treatment Plant (STP)		
Storm Water Drains (SWD) Department			
21	Widening and training of the stormwater drains, and operation and maintenance of the SWD network across the city	6.1. Build flood resilient systems and infrastructure	Reduction in externalities to livelihoods,

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
22	Augmentation of box drain to abate flooding at various locations	6.6. Disaster risk and impact reduction	employment, homes.
23	Planning and construction of balance stretches		
24	Construction of holding tanks		
25	Diversion/Loop construction in various drains		
26	Improvement and upgradation work in existing stormwater drainage network		
27	Laying of box drains at various locations, expanding the drainage network		
28	Treatment of Storm Water Drains using N-Treat Technology		
29	Construction of retaining walls		
30	Construction of Pumping Stations and improvement of floodgates		
31	Design and construction of modernized and fully automated package/ Modular Sewerage Treatment plants based on MBR technology along Dahisar, Poisar and Oshiwara-Walbhat rivers.	6.3. Reducing pollution and restoring aquatic ecosystems	Better ecosystem
Mechanical and Electrical (M&E) Department			
32	Setting up of Sewage Treatment Plant/ Effluent Treatment Plant at major hospitals and various speciality hospitals	6.3. Reducing pollution and restoring aquatic ecosystems	Improved hygiene, prevent spread of diseases
33	Replacing Air Handling Units (AHUs) in several main and peripheral hospitals	1.2. Transition to clean fuels and resource efficiency in buildings	Sustainable buildings
34	Air Pollution Control Systems	5.1. Curb the pollution concentration level by 20-30% by 2030	Better ecosystem, good health, productivity, overall well-being
Garden Department			
35	Development of new gardens		

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
36	Beautification of central medians & traffic islands	4.1. Increase vegetation cover and permeable surface	Better air quality, enhancing groundwater, good health, and increased biodiversity
37	Upgradation of existing gardens	4.3. Equitable access to green open spaces	
38	Beautification along rivers, talaos, beaches & forts		
39	Open Space Management Scheme		
Roads and Traffic Department			
40	Improvement of footpaths	2.2 Access to non-motorized transport (NMT) and infrastructure	Road safety, universal access, quality of life
Bridges Department			
41	Reconstruction, repairs and maintenance of bridges over nallas, rivers, Road Over-Bridges, Flyovers, Foot Over-bridges, FOBs on Railways, Vehicular Subway, Pedestrian Subway	2.2 Access to non-motorized transport (NMT) and infrastructure	Road safety, universal access, quality of life
Water Supply Projects (WSP) Department			
42	Construction of tunnels for water conveyance	6.4. Safe and affordable drinking water	Reduction in wastage of fresh water, prevention of water-borne diseases
43	Replacement of old mains		
44	Re-engineering & reconstruction of Tulsi Water Treatment Plant		
45	Development of new Water Treatment Plant at Bhandup Complex		
46	Desalination Plant for augmentation of Mumbai's water supply		
47	Construction of new Chlorine Contact Tank and Chlorine Motive Water Line		
48	Construction of pumping station to transfer Vihar overflow to Bhandup Complex Water Treatment Plant		
49	Replacement of twin Tansa mains by single main and other maintenance works		
50	Floating Aerator Fountains in Powai Lake	6.3. Reducing pollution and restoring aquatic ecosystems	Prevention of mosquito-borne diseases
51	Prevention of sewage ingress in Powai Lake		Methane emission reduction

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
52	Recycling/ reuse of wastewater to potable water at Colaba and Powai Wastewater Treatment Plant	6.2. Localized water conservation and efficiency	Resource efficiency
Hydraulic Engineers (HE) Department			
53	Laying/ replacing water mains at various locations across the city	6.4. Safe and affordable drinking water	Reduction in wastage of fresh water, prevention of water-borne disease
54	Construction of storage tanks with pumping arrangements		
55	Work of attending leakages and contamination within the water distribution system		
56	Provision for providing services to Urban Poor in Greater Mumbai		
57	Improvement and plantation in various garden plots at Bhandup complex and along Trunk Mains	4.1. Increase vegetation cover and permeable surface	Enhanced biodiversity, quality of life, improved health
58	Hill slope stabilization and construction of retaining walls at various locations	6.6. Disaster risk and impact reduction	Reduction in externalities to livelihoods, employment, homes.
59	Providing LED streetlights in pumping station premises	1.2 Transition to clean fuels and resource efficiency.	Sustainable cities
Sewerage Operations (SO) Department			
60	Rehabilitation of lagoons using bioremediation technology	6.3. Reducing pollution and restoring aquatic ecosystems	Avoid water-borne disease, better health
61	Rehabilitation of sewer lines		
62	Rehabilitation of rising mains at various sewage pumping stations		
63	Systematic cleaning of sewer lines		
Sewerage Projects (SP) Department			
64	Diversion of dry weather flow	6.3. Reducing pollution and	
65	Providing and laying of sewer lines		

Direct Actions – Not Quantified			
Sr No.	**Activity**	**Alignment with MCAP**	**Co-benefits**
66	Planning of sewer line network and STPs at various locations in Mumbai	restoring aquatic ecosystems	Avoid water-borne disease, better health
67	Rejuvenation of Poisar, Dahisar, Walbhat and Oshiwara rivers		
Mumbai Sewerage Disposal Project (MSDP)			
68	Design, construction, operation, and maintenance of Wastewater Treatment Facility at various locations	6.3. Reducing pollution and restoring aquatic ecosystems	Better health and ecosystem
69	Planning and Project Management Consultant for Mithi river Sewage Treatment Plant		
70	Design and implementation of Malad and Versova Influent Pumping Stations		
71	Diversion of Dry Weather Flow from Bapat Nalla and Safed Pul Nalla to Dharavi Wastewater Treatment Plant		
72	Work of conversion of sludge to bio-fertiliser		
73	Recycling and reuse of wastewater	6.2. Localized water conservation and efficiency	Energy efficiency, better groundwater and aquifers
74	Setting up a Sewage Treatment Plant at Veermata Jijabai Bhosale Botanical Udyan and Zoo		
75	Planning, Designing & Construction of Community Toilet Block	6.5. Clean, safe, and accessible toilets	Good health and wellbeing, gender equality
76	Slum Sanitation Programme Implementation		

3.3. Enabling Actions

Enabling actions encompass measures implemented by various departments at an institutional level to develop climate-forward and focused policies. This entails increasing capacity and mainstreaming climate into the existing governance system and facilitate progress towards climate resilience. Additionally, it involves encouraging research and external expertise aimed at climate innovation and to allow adoption of nature-based solutions such as green-blue infrastructure, transitioning to cleaner fuels, exemplified by the integration of electric vehicles (EVs), solar panels, and similar technologies, and sustainable sewerage management, and so on.

Table 3 includes enabling actions and their alignment with MCAP action tracks.

Enabling actions		
Sr. No.	**Activity**	**Alignment with MCAP**
Environment Department		
1	Preparation of plan for air pollution control in Mumbai	5.1. Curb the pollution concentration level by 20-30% by 2030
2	Climate Change Cell	All MCAP Action Tracks
Mechanical and Electrical (M&E) Department		
3	Installation of IOT Enabled Automated Distribution System at BMC Head Office.	1.2. Transition to clean fuels and resource efficiency in buildings
Development Planning (DP) Department		
4	Land acquisition for planning of new reserved open spaces (Recreation Grounds/ Playgrounds- R.G./P.G.)	4.3. Equitable access to green open spaces
Water Supply Project (WSP) Department		
5	Feasibility Studies for integration of recycled potable water into existing water distribution system.	6.2. Localized water conservation and efficiency
Sewerage Operations (SO) Department		
6	Condition assessment of Gravity Sewer Lines	6.3. Reducing pollution and restoring aquatic ecosystems
Mumbai Sewerage Disposal Project (MSDP)		
7	Consultancy services for planning and implementation of solutions to efficient sewerage management	6.3. Reducing pollution and restoring aquatic ecosystems

The detailed description of the above measures and activities can be found in Annexure 2. Calculations of potential emission reductions for the Direct Actions- Quantified can be found in Annexure 3.

4. Budgetary Allocation for Climate Measures in FY 2024-25

BMC has allocated INR 31,774.59 crores for capital expenditure in FY 2024-25, of which an estimated INR 10,224.24 crores has been allocated for climate-relevant activities, which makes up 32.18% of the total capital expenditure budget. An additional INR 2,163.8 crores has been allocated towards activities that integrate some components of the Mumbai Climate Action Plan (MCAP) such as utilizing LED lights, plantations/landscaping, rooftop solar, and sewage treatment plants in new constructions, which makes up 6.81% of the capital expenditure budget. The table below shows how budgetary allocation is split across MCAP's six sectors:

Sr. No.	Sector	Budgetary Allocation B.E. (2024-25) (in thousands)	% split w.r.t. total capital budget
1	Energy & Buildings	3,24,790	0.10%
2	Integrated Mobility	84,000	0.03%
3	Sustainable Waste Management	26,21,600	0.83%
4	Urban Greening and Biodiversity	17,78,426	0.56%
5	Air Quality Management	3,53,840	0.11%
6	Urban Flooding & Water Resource Management	9,70,79,774	30.55%
Total		10,22,42,430	**32.18%**

The *Urban Flooding & Water Resource Management* sector has the highest proportion of allocation. It covers budgetary allocation under SWD, SP, SO, MSDP, WSP, and sanitation related activities under SWM department. Within this sector, the distribution of resources across various action tracks is detailed as follows- build flood resilient systems and infrastructure (5.74%), localized water conservation and efficiency (0.07%), reducing pollution and restoring aquatic ecosystems (18.38%), safe and affordable drinking water (6.09%), clean, safe, and accessible toilets (0.2%), and disaster risk and impact reduction (0.07%). The departmental activities aligned to these action tracks are listed in Chapter 3.

In addition to the above-mentioned activities in the climate budget, there are other steps that the city is taking towards making the city low carbon and climate resilient. For example, BEST has effectively transformed 83% of their total fleet of 3225 buses to CNG and electric buses.[6] The operation of electric buses has contributed to a reduction in emissions of

approximately 26,900 tons of CO_2. The entire fleet of BEST undertaking will transition to electric buses by 2026, further reducing pollution in Mumbai as the emission of 75,000 tons of CO_2 per year will be curtailed by the operation of these buses. BEST has also deployed 185 electric vehicles for its departmental work.

BMC is supporting implementation of climate activities across the city through other measures, like the Greening Mumbai manual[7], Mumbai Air Pollution Mitigation Plan[8], up to 15% subsidies on property taxes for in-situ waste management and rainwater harvesting[9], rainwater harvesting manual[10], Standard Operating Procedure (SOP) for EV charging stations in multistorey buildings for two/ three/ four wheelers[11] and so on.

5. Way Forward

Mumbai has ambitious climate objectives and climate budgeting can help the city move towards MCAP goals and targets in a planned and organised manner. This is BMC's first attempt at developing a climate budget and there have been challenges and limitations throughout this process. The climate budgeting process in Mumbai required participation of over 20 BMC departments. Building capacity, providing technical support, understanding information requirements, and coordinating data collection was an extensive exercise. Gaps in some instances either due to difficulty in collation of relevant datasets or projects being in early planning stages, can make quantification and assessment of climate impact difficult for certain activities. BMC is consistently working towards improving monitoring across sectors such as waste, air quality, water management etc. and creating important data repositories.

BMC seeks to embed climate budgeting into the existing municipal budget cycle, work towards developing a robust monitoring, evaluation, and reporting (MER) system and strengthen climate impact analysis to measure progress towards the city's emission reduction and resilience targets over time. As per commitments in MCAP, BMC is currently working towards updating Mumbai's greenhouse gas (GHG) inventory and putting together a report to understand progress since the Mumbai Climate Action Plan (MCAP) was launched. Climate budgeting is an iterative process, and BMC seeks to improve and refine this governance process and make subsequent climate budget reports more comprehensive through robust data and information; greater coordination and collaboration across departments; deeper integration and mainstreaming into BMC's existing budgeting process; and continued cross-departmental engagement, capacity building and workshops.

Annexure 1:

MCAP Goals and Targets

MCAP Sector	MCAP Action Track	Target	2030	2040	2050
Energy & Buildings	1.1 Decarbonising Mumbai's electricity generation mix to renewable sources	% share of total grid electricity from renewables	50%	70%	90%
	1.2 Transition to clean fuels and resource efficiency in buildings	% of total buildings with solar PV installed	10%	20%	40%
		Residential water flow technology in buildings (% low flow fixtures)	20%	40%	60%
		LED lighting in commercial and residential buildings (%)	100%	100%	100%
		Commercial cooling system technology (% of high efficiency chillers)	38%	59%	80%
	1.3 Low carbon buildings				
	1.4 Passive design strategies to improve resilience in buildings				
Integrated Mobility	2.1 Improve public transport ridership				
	2.2 Access to non-motorized transport (NMT) and infrastructure	% Mode share for public transport and NMT	73%	78%	85%
	2.3 100% municipal and private zero emission vehicles by 2050	% Electrification of passenger automobiles	35%	70%	96%
		% of electrification of all buses	100% (2026-27)	100%	100%
		% of electrification of all two-wheelers, taxis and autorickshaws	40%	70%	100%

MCAP Sector	MCAP Action Track	Target	2030	2040	2050
		% of electrification of all private four-wheelers by 2050	35%	60%	96%
	2.4 Zero emission freight	% Electrification of light duty freight	29%	70%	100%
		% of electrification of light duty trucks and 2W freight	40%	70%	100%
		% of electrification of medium and heavy-duty trucks	15%	30%	46%
Sustainable Waste Management	3.1 Reducing landfilled waste	% of Reduced waste disposed to landfill sites	30%	40%	50%
	3.2 Decentralized waste management - Recycle/Compost at the local level	% of paper recycled	20%	40%	80%
		% of plastic recycled	20%	40%	80%
		% of organic waste composted	20%	40%	60%
		% Wastewater treated by tertiary treatment	10%	15%	17%
		% of recovery through Decentralized waste management (segregation, recycling and composting)	40%	60%	80%
	3.3 Remediation and scientific management of landfills	% of Remediation of all existing dumpsites and scientific disposal of waste	100%	100%	100%
		% landfill gas captured	20%	30%	50%
Urban Greening and Biodiversity	4.1 Increase vegetation cover and permeable surface	% of Increase in vegetation cover and permeable surface of the city surface area to tackle flood- and	30-40%	45%	47%

MCAP Sector	MCAP Action Track	Target	2030	2040	2050
		heat-related disaster risk			
	4.2 Reduce urban heat island effect	Reduce heating effect and increase permeable surface to 100% by 2050 along the city streetscape	40%	60%	100%
	4.3 Equitable access to green open spaces	Equitable distribution of open spaces and increase per capita open space	4 sqm per capita	6 sqm per capita	6 sqm per capita
	4.4. Restore and enhance biodiversity in the city				
Air Quality	5.1 Curb the pollution concentration level by 20-30% by 2030	% of curbing the pollution concentration to improve air quality, keeping 2019 as the base year	20%-30%		
	5.2 Increase information availability through monitoring				
	5.3 Community health resilience through decentralized planning and awareness				
Urban Flooding & Water Resource Management	6.1 Build flood resilient systems and infrastructure				
	6.2 Localized water conservation and efficiency	% of city's water demand met through localized water conservation and efficient use initiatives	50%		
	6.3 Reducing pollution and restoring aquatic ecosystems				
	6.4 Safe and affordable drinking water	Access to safe and affordable drinking water for all	100%		
	6.5 Clean, safe and accessible toilets	Provide clean, safe and accessible toilets to all	100%		
	6.6 Disaster risk and impact reduction				

Annexure 2:

Detailed description of climate measures for FY 2024-25

Solid Waste Management (SWM) Department	
Direct Actions – Quantified	The work of *Development of Waste to Energy (WTE) Project at the Deonar Dumping Ground (DDG)*_undertaken by the SWM department, includes design, construction, operating and maintenance of waste to energy plant being set up at Deonar Dumping Ground across 10.47 Ha of land and capacity of converting 600 TPD of municipal solid waste to generate about 8 MW electricity daily. The *Bio-mining Project at Deonar Dumping Ground* uses a scientific bio-mining method, certified by the Central Pollution Control Board, of excavation, treatment, segregation and utilize aged municipal solid waste also known as legacy waste. Along with its purpose of reducing the greenhouse gases emissions and being a zero-emission process itself, the method also allows for resource recovery by extracting recyclable components of waste like metal, recyclable plastic, etc. One MT of legacy waste has the potential to prevent 1.106 tCO_2e potential emission reduction. An area of 24 ha of landfill land will be reclaimed using bioremediation method under the *Dumpsite Reclamation Project at Mulund Dumping Ground (MDG),* clearing 70 lakh MT of waste resulting in potential emission reduction of 51,63,480 tCO_2e.
Direct Actions – Not Quantified	The Solid Waste Management department has undertaken the work of *provision of toilets in all wards,* including planning, designing and construction of community toilet blocks, individual toilets with sanitation services, public toilets for in transit population, toilets alongside highways, etc. This also includes providing sanitary napkins vending machines in various public toilets. As a practice, based on the site context, bio-toilets with bio-digester tanks will be used within these toilet blocks. These toilets use biodegradation processes to break human waste into effluent (treated water) and gas, both of which are safe to release into the environment or can be reused for irrigation and as a biogas respectively. Biodigester tanks are a good alternative to conventional septic tanks as they provide better treatment to biological waste through waste decomposition and are sludge free eliminating the risk of clogging and the need for frequent pump-outs. At Deonar Dumping Ground, the department have planned on *pilling of synthetic vinyl sheets* to control land sliding (garbage mound sliding) and prevent leachate seepage into the adjacent Thane creek, thereby preventing creek water pollution. In efforts of increasing green cover the work of *plantation in landfill site at Kanjurmarg Dumping Ground* is undertaken. To enable unobstructed flow of water for *survival of Mangroves within the Kanjurmarg Dumping Ground*, two culverts will be constructed by the SWM

	department, resulting in efforts towards conservation of mangroves within the dumping ground. The department is undertaking several initiatives aimed at *decentralizing and upgrading the solid waste management process*, making it cost and resource efficient. This comprehensive approach entails establishing dry waste collection and processing centres, municipal waste segregation centres, composting facilities, waste recovery centres for electric and electronic waste, waste to energy project, plans for incentivizing localized waste management, and other such measures. In addition to these efforts, as part of the transition to renewable energy, the department has undertaken *the provision of solar lighting* at both the *Deonar and Gorai Dumping Grounds.*
Mechanical & Electrical(M&E) Department	
Direct Actions – Quantified	Under *upgradation of the High Mast System*, the M&E department will replace approximately 2400 nos. of 400-Watt metal halide/ High Pressure Sodium Vapour (HPSV) bulb streetlights with 150-Watt Smart LED Flood Light High Mast streetlights, saving upto 70% energy. [12] The department has also undertaken the work of *installation of solar panel systems at various peripheral hospitals.* A total of 385KW of solar panel system will be installed across rooftop area of approximately 38,500 sq.m generating 140.5 MW of energy yearly, reducing 113.83 tCO_2e of potential emissions annually. *Carbon cutting system*, referred to as Retrofit Emission Control Device (RECD), is a machine device that works on the principal of electrostatic precipitation. It captures particulate matter of 2.5 microns and 10 microns and has efficiency of CCM (cubic centimetres per minute) of 80-90 % as per Automotive Research Association of India (ARAI) certification. This net zero machines reduces the gases emitted at source like Carbon Monoxide by 90 %, Carbon Dioxide by 70 %, Hydrocarbons by 46 %, Sulphur Oxide by 67 %, Nitrogen Oxide by 65%, and it captures carbon dioxide and converts it into calcium. Additionally, the department will be setting up eco-friendly wood pyre cremation system in various cemetery, reducing 50% pollution as compared to conventional pyre set by reducing consumption of wood by approx. 160 kg per cremation. A total of 55 nos. of existing AC units using R-22, a commonly used refrigerant with an Ozone Depletion Potential (ODP) of 0.06 and Global Warming Potential of 1810, will be replaced with units working on R-134a refrigerants under the activity *replacing existing AC units with comparatively more energy efficient AC units in various municipal office and hospital buildings*. In comparison, R134a has an ODP of zero and Global Warming Potential of 1430, making it an environmentally friendly alternative to R-22.[13] Additionally, R134a is more energy efficient as it can absorb and release heat better than R22.

Direct Actions – Not Quantified	The Mechanical and Electrical department has undertaken the activity of setting up of *Sewage Treatment Plant/ Effluent Treatment plants at major hospitals and various speciality hospitals* with an objective of localised disinfections and treatment of hospital sewage and wastewater. The work of replacing Air Handling Units (AHUs) in several main and peripheral hospitals will include changing the existing AHUs working on belt driven motors with more energy efficient plug fan driven air handling systems. Additionally, the department has also undertaken the work of *Installation and refurbishment of Air Pollution Control Systems (APCS)* for the several pyres sets at cemeteries across the city to reduce air pollution by controlling the dust particle suspension. This activity includes setting up and refurbishment of APCS at Charai Cemetery, Chunnabhatti- L ward Cemetery, Sonapur Cemetery, Kurla, and Navapada Cemetry, Santacruz.
Enabling Actions	The Mechanical and Electrical Department has undertaken *the installation of an IoT Enabled Automated Distribution System at the BMC Head Office* aimed at energy efficient distribution and enhancing electrical safety within the premises. IoT systems enable real-time monitoring and control, allowing for optimization of energy usage within buildings. By leveraging IoT devices, such as sensors and smart controls, energy consumption can be managed efficiently by regulating lighting, HVAC systems, and other appliances based on factors like occupancy and ambient conditions. IoT systems also have the capability to integrate renewable energy sources such as solar panels. The level of automation through these systems can ensure that energy is utilized only when necessary, leading to significant cost savings and responsible resource utilization. The implementation of an IoT distribution system at the BMC Head Office will help optimize energy usage throughout the building, resulting in substantial savings and improved resource efficiency.
Water Supply Project (WSP) Department	
Direct Actions – Quantified	*Facilities of Hydro Electric Power Plant & Floating Solar PV Power Project are being developed at 'Hinduhridaysamrat Shivsenapramukh Balasaheb Thackeray Middle Vaitarna Dam'* on "Build, Operate & Transfer" basis. The preliminary and financial closure works for the project are in progress. Out of the 26.5 MW capacity of the Hybrid Power plant, the capacity of Hydro Electric Power Plant is 20 MW and that of Floating Solar PV Power Plant is 6.5 MW. In addition to generating clean energy from the photovoltaic (PV) floating solar systems and increasing the dam's capability to generate electricity, placing solar panels over the reservoir will also potentially reduce evaporation losses. Since the floating solar system is planned over existing reservoir water, it eliminates the need for utilization of additional land for power generation.
Direct Actions – Not Quantified	The Water Supply Project department is tasked with the distribution and supply of water within the city through its established water supply network. As part of its regular operations, the WSP department will engage in *constructing tunnels for water supply* and *replacing old mains* to ensure an

	efficient water supply system that meets the basic needs of the public and promotes overall well-being. It is proposed to construct water conveyance tunnel from Yewai to Kasheli and further from Kasheli to Mulund with enhanced capacity. The Kasheli to Mulund Tunnel is under tendering process. Ongoing projects include a water conveyance tunnel from Amar Mahal (Chembur) to Wadala and further up to Parel (9.70 Km). After completion of this work, it is expected to improve the water supply of F/North, F/South & part of E & L Wards and will also cater to the requirement of future development at Mumbai Port Trust land and Wadala Truck Terminus areas. For the water conveyance tunnel from Amar Mahal (Chembur) to Trombay Reservoir (5.5 km) project. On completion, this tunnel will improve water supply conditions in the M/East and M/West wards. During monsoon, in case, the high tide in sea is accompanied by heavy rains and the overflow of Vihar Lake is discharged in Mithi River, flood like situation occurs in Mumbai. To provide relief, construction of 200 MLD pumping station is proposed to pump the overflow of Vihar Lake to inlet bay of Bhandup Complex Water treatment plant. The department has undertaken the *re-engineering and reconstruction of the Tulsi Water Treatment Plant* and development of new 2000 MLD Water Treatment Plant at Bhandup Complex: The 1910 MLD capacity Water Treatment Plant is nearing its designed life. It is therefore, proposed to build a new 2000 MLD capacity Water Treatment Plant. BMC has proposed to construct a 200 MLD *Desalination plant* expandable to 400 MLD in future, to augment the water supply of Mumbai City with a reliable and climate change resilient source. The final detailed project report (DPR) incorporating provisions for operational flexibility and utilization of 100% Green power for operation of plant has been completed in September 2023. Furthermore, the department is undertaking *construction of a new chlorine contact tank* (CCT), a water treatment solution that offers primary disinfection for surface water and ground water systems. CCTs play a crucial role in the final stage of the water treatment process before distribution, providing benefits such as taste and odour control, prevention of algae growth, removal of iron and manganese, biofilm control, and water main sterilization. To enhance and automate water treatment processes, the department is undertaking the work of *setting up a chlorine motive water line*. This system, comprising motive water sets with pre-assembled fittings and booster pumps, ensures a constant supply pressure for chlorine gas injectors. This, in turn, injects a measured amount of chlorine into the water, producing a residual sufficient to eliminate bacteria and viruses.

	The work of replacement of *old 1450 mm diameter twin Tansa Mains by laying single 2000 mm diameter MS pipeline* from Maroshi to Sahar Village is in progress. Seven *floating aerator fountains* will be installed in Powai Lake, serving to improve the lake's environment by acting as aerators. These devices reintroduce oxygen into the water, maintaining balanced oxygen levels essential for aquatic life. Aeration also prevents the growth of algae, eliminates foul odours, enhances fish habitat, reduces mosquito activity, and minimizes the accumulation of bottom sediment. Powai lake has around 15 sewage ingress points, out of which 4-5 are active, the department will identify these and divert them to the nearest sewerage lines to *prevent sewage ingress into Powai Lake*, ensuring water quality maintenance and biodiversity restoration. BMC is exploring various possibilities for augmenting Mumbai's Water Supply by non-conventional methods to tide over the current demand - supply deficit and providing sustainable alternative to the same. Considering this, it is proposed to carry out 12 MLD pilot project for *conversion of Wastewater to potable wate*r at the Colaba Wastewater Treatment facility having capacity 37 MLD.
Enabling Actions	The Water Supply Project department will be carrying *out feasibility studies for integration of recycled potable water* from the seven Sewage Treatment Plant, viz. Worli, Bandra, Dharavi, Versova, Malad, Ghatkopar and Bhandup, into existing water distribution system.
Transport Department	
Direct Actions – Quantified	The transport department is responsible for providing and maintenance of municipal vehicles. The department has undertaken the work of *procuring 20 nos. of EV Sedan cars* resulting in reduction of approximately 12.8 - 17 tCO_2e. Additionally, the department has already procured 15 EV Sedan cars in the year 2023-24.
Hydraulic Engineers Department	
Direct Actions- Quantified	The rooftop of the new Master Balancing Reservoir (MBR) at Bhandup Pumping Station Complex will be leveraged for generating energy to be utilised with in the Bhandup Complex by setting up a 2.5 MWp solar generation plant, potentially reducing 1,037 tCO_2 in emissions.
Direct Actions – Not Quantified	The Hydraulic Engineers Department oversees the water supply to Mumbai from the city's water reservoirs. The department has undertaken the work of *laying and replacing water mains at multiple locations throughout Mumbai, providing services to Urban Poor in Greater Mumbai* and undertaken the responsibility of *constructing water storage tanks*. Additionally, to ensure responsible transfer/ carrying of water and minimise wastage, the department has also undertaken the *work of addressing leakages and contamination within the water distribution system*. These essential activities establish a robust foundation to ensure the availability of basic needs to the citizens while promoting water conservation efforts within the distribution system.

	Furthermore, the department will conduct *improvement and plantation activities in various plots at Bhandup complex and along Trunk Mains* to enhance green cover. Additionally, *LED streetlights will be installed in pumping station* premises at Panjrapur. *Hill slope stabilization and construction of retaining walls* will also be undertaken at various locations across the city to fortify water distribution infrastructure resilience.
Markets Department	
Direct Actions – Quantified	For the year 2024-25, the Markets Department has undertaken the work of *setting up Organic Waste Convertors to manage waste disposal of 64 municipal market buildings*. 69MT of organic waste generated from vegetable, fruit, and non-veg section is being converted to manure daily, enabling decentralised waste management by segregation and composting at source. O.W.C. contractor responsible for daily collection, segregation and monitoring has been appointed to ensure continual and systematic operation of the convertors. Each O.W.C. has a potential of preventing 16,11,840 MT of landfill waste every year, resulting in emission reduction equivalent to 14,50,656 tCO_2e. In addition to O.W.C, the rooftop terraces of municipal market buildings will be leveraged to generate electricity that can be utilized within the market. *Installation of solar panels* on rooftops of four municipal market buildings have been planned. The rooftop of Babu Genu Market, Dockyard Road will be utilized to set up three 25kW solar system i.e., 75kW of solar system across the roof area. Two 25kW solar systems at Dr. Shirodkar Mandai and 25kWs at Mahatma Jyotiba Phule Market (Crawford Market). The potential annual emission reduction due to this measure will be 311 tCO_2e. Replacement of existing conventional incandescent and CFL lights with energy-efficient LED lights within various municipal markets will be carried out by the department, reducing potential emission of 0.13 tCO2e per LED replaced.
Direct Actions – Not Quantified	The Department has allocated funding for the redevelopment/reconstruction of municipal markets and transit camps, Babu Genu Market, Mahatma Jyotiba Phule Market, Laxman Babu More Municipal Market in Govandi, and B.H. Chemburkar Market along with the construction of new municipal market buildings at Bhandup, Mahul Village, and Tungwe in Kurla.[#] The Markets department, along with License and Shops and Establishment departments is enforcing the use of cloth bags to discourage plastic use, through imposition of fines in municipal markets.
City Engineers Department	
Direct Actions – Not Quantified	The City Engineers Department has undertaken the work of carrying out development of numerous municipal buildings across the city. This encompasses various projects, such as construction of Samajik Sabhagruh at Murar Road, Mulund, Community Hall at Barve Nagar, Ghatkopar (West),

	Saint Rohidas Bhavan at Dharavi, Dabbewala Bhavan, and the Urdu Bhavan in E Ward[#]. Additionally, the department will be carrying construction of houses for Project Affected Persons. It will also take measures for control of pollution and rejuvenation of water bodies within BMC limit.
Fire Brigades Department (As reported under City Engineers)	
Direct Actions – Not Quantified	Along with the City Engineers department, the department is undertaking *construction and redevelopment fire brigade stations*[#] at Kanjurmarg, Deonar, Chembur, and other locations.
Improvement Schemes (As reported under City Engineers)	
Direct Actions – Not Quantified	The department is involved in planning and redeveloping residential tenements at Deonar, M/E Ward, and a municipal property at Vikhroli Parksite Layout in N Ward.[#]
[#] *In ensuring adoption of sustainable practices across these projects, the departments will adhere to a set of core principles:* *- Utilizing LED lights to enhance energy efficiency and reduce electricity consumption.* *- Designating areas within sites for plantation and landscaping to increase green cover and promote local biodiversity.* *- Implementing systems to capture and utilize rainwater effectively and manage stormwater runoff.* *- Installing rooftop solar panels on selected buildings to harness solar energy for electricity generation, contributing to renewable energy adoption and lowering carbon emissions.* *- Establishing Sewage Treatment Plants (STPs) to conserve and efficiently manage water by treating wastewater onsite and reuse for irrigation or flushing.*	
Disaster Management Department	
Direct Actions – Not Quantified	Under the Mumbai City Surveillance (MCS) Project, the department has completed the work of *supplying, installing, training and construction and operation of Viewing Centres in all 24 wards*, one in each ward. Operational 24/7, these viewing centres at the ward offices will enable close surveillance to ensure that quick action can be taken in case of any disaster.
Education Department	
Direct Actions – Not Quantified	To ensure access to gender sensitive, inclusive, and effective learning environments through safe sanitation and ensuring proper menstrual hygiene, the Education Department's under the work of *upgradation of toilets in all 469 Municipal School buildings*. The work will comprise of repair of toilets and installation of sanitary pad vending machine with disposal facility in all 469 municipal school buildings. In addition, since sanitary pads are the on-site sanitary pad disposal facility will also prevent mixing of soiled pads in municipal solid waste and being landfilled. Similarly, the work of *repairing and upgrading municipal school playgrounds* will foster improved and equitable access to open spaces. Access to playgrounds not only contributes to the physical development of

	children but also has the potential to positively influence their mental well-being. In addition to stronger bones and muscles, enhanced instincts, and balance through engagement in outdoor activities, unstructured play offers invaluable opportunities for the development of various capacities, including coordination, language skills, motor skills, and cognitive abilities, thereby promoting the overall good health and holistic development of children.
City Engineers (ESP)- Environment Department	
Direct Actions – Not Quantified	The environment department is undertaking a range of *measures for reduction of air pollution in Mumbai*. These include the adoption of sustainable and clean practices in construction and demolition, implementing road dust reduction strategies, promoting sustainable and clean transport solutions, incorporating measures for sustainable waste management, undertaking ecologically sustainable urban greening projects, ensuring effective monitoring, and conducting communication and awareness campaigns for disseminating information about the various measures undertaken to combat air pollution and foster a healthier environment in the city. To enhance the monitoring of air quality, the department has undertaken the work of *setting up Automated Air Quality Monitoring (AQM&R) laboratories and mobile vans* dedicated to efficient data collection. These will enable the department to gather comprehensive and real-time data for informed decision-making and tailoring interventions based on localized air quality indices. Similarly, *Continuous Ambient Air Quality Monitoring Stations (CAAQMS) will be installed* strategically across the city. These stations will continuously monitor air quality parameters round the clock, providing a comprehensive understanding of the city's air quality trends over time. The data collected from these stations is vital for assessing air quality trends, identifying pollution hotspots, and evaluating the effectiveness of air quality management strategies. By leveraging AQM&R and CAAQMS, the department aims to establish a robust air quality monitoring network to support evidence-based decisions and targeted interventions aimed at improving air quality and safeguarding public health.

Enabling Actions	Based on the data enabled through the air quality monitoring process, the Environment Department will be formulating a comprehensive *plan for air pollution control in Mumbai*. This plan will adopt a localized approach and employ strategies proven to be effective in improving air quality, thereby enabling the department to combat air pollution and safeguard the health of the citizens. In alignment with its role as the key coordinating body for initiatives like Mumbai Climate Action Plan, Majhi Vasundhara Abhiyan, Women for Climate, Cities4Forests, National Climate Action Plan, and sustainable development projects funded under the 15th Finance Commission, the Department of Environment recognizes the necessity of establishing a dedicated *Climate Action Cell*. This cell will operate across three verticals: Environment Protection, Knowledge and Information, and Environment and Climate Change. To ensure grassroots involvement, a Sub Engineer will be assigned to each ward to focus exclusively on environmental matters. Additionally, Sub Engineers will be stationed at key central agencies engaged in pertinent fields such as Solid Waste Management, Sewerage Operations, and City Engineering. The establishment of the Climate Action Cell will bolster the Environment Department's efforts in meeting the targets outlined in the Mumbai Climate Action Plan.
Storm Water Drains (SWD) Department	
Direct Actions- Not Quantified	The city of Mumbai experiences an average rainfall of approximately 2300 mm, characterized by high spatio-temporal variability. Given this, effective stormwater management is crucial to mitigate the risk of flash floods, which can significantly impact the city's population. The Storm Water Drains Department is tasked with ensuring the sufficiency and efficiency of the city's drainage system, aimed at building flood resilient infrastructure. To address flooding at various identified location across the city, the department is undertaking the work of *widening and training of the stormwater drain* wherein the existing drains are widened to increase their carrying capacity. Similarly, the department will *augment size of box drains* to tackle flooding at hotspots such as St. Paul Road, Vakola river upstream area, Motilal Nagar road, M.C. Chagla Road, Marol Bhandar, near Bandra railway colony, and other such locations, resulting in higher carrying capacity of drain and faster disposal of stormwater. Augmentation of drains will also help in reduction of risk due to dilapidated condition of existing drains, culverts and nallas, and avert flood-like situations in case of heavy rainfall. Additionally, *diversions and loops* will be constructed at several flooding hotspots. Along with *making improvements and upgradation work in existing stormwater drainage network*, the department will also *construct box drains at various locations*, expanding the drainage network.

	The department has also identified several locations with slums along the banks of nallahs, where *balance stretches and retaining walls* will be constructed to safeguard lives and property in case of heavy monsoon and flooding, reducing disaster risk and impact. Furthermore, *three holding tanks are planned for construction* at strategic locations: one at Milan Subway, Andheri (30,000 cubic meters capacity), another at Pramod Mahajan Garden, Dadar (36,000 cubic meters capacity), and a third at St. Xavier playground, Dadar (28,000 cubic meters capacity). The integration of IIT-B's N-Treat technology within the stormwater drainage system will involve a seven-stage process to treat sewage in nullahs, utilizing screens, gates, silt traps, coconut fibre curtains for filtration, and disinfection using sodium hypochlorite. This technology will be instrumental in improving water quality without requiring additional space. Moreover, *the design and construction of modernized and fully automated package/ Modular Sewerage Treatment plants on MBR technology along Dahisar, Poisar, and Oshiwara-Walbhat rivers* will involve the construction of sewer networks, access roads, roadside drains, and interceptors. These plants follow sewage disposal guidelines mandated by the Pollution Control Boards of the Government of India, monitored by the National Green Tribunal (NGT).
<u>Gardens Department</u>	
Direct Actions- Not Quantified	The Garden Department within BMC is responsible for the development and maintenance of gardens, recreational grounds, playgrounds, and the conservation of trees as per 'The Maharashtra (Urban Areas) Protection & Preservation of Trees Act, 1975'. As part of the *development of new gardens*, the Garden Department will establish a garden in L ward, thereby increasing the number of green open spaces and enhancing vegetation cover. Green open spaces play a vital role in carbon sequestration, mitigating heat risks through local cooling effects, and promoting local and soil biodiversity. Similarly, the department is undertaking the work of *beautification of central medians and traffic islands* across 19 wards to augment vegetation cover on streets. The activities under *upgradation of existing gardens* will include repair and maintenance work, adequate illumination, repair, and upgradation of facilities provided within the gardens such as benches, dustbins, drinking water facilities, etc. ensuring safe and equitable access to open spaces within the city. This work will be carried out all 24 wards. Additionally, the work of *beautification along rivers, talaos, beaches and forts*, undertaken by the department will include various greening interventions using native plants and trees. Allied facilities such as seating and lighting will also be provided along these biodiverse stretches of the city. Furthermore, the Garden Department will adopt and implement the *Open Space Management Scheme*, aiming to allow equitable access to well-equipped sports facilities within municipal playgrounds across 22 wards.

Roads and Traffic Department	
Direct Actions- Not Quantified	To ensure access to safe and inclusive pedestrian infrastructure as well as road safety, the Roads and Traffic department is undertaking the *work of improvement of footpaths*. This work will include increasing illumination of footpaths, improving footpaths and drainage system alongside at various locations in Mumbai and retrofitting footpaths to make them universally accessible by equipping existing footpaths with tactile markings, pedestrian ramps, adequate footpath illumination, and safe traffic medians with refuge areas.
Bridges Department	
Direct Actions- Not Quantified	The Bridges Department is tasked with the construction, repairs, and maintenance of bridges across the Mumbai city. Department must fulfil its duties of *construction, reconstruction, repairs and maintenance of bridges over nallas, rivers, Road Over Bridges (ROBs), flyovers, Foot Over Bridges (FOBs), FOBs on Railways, Vehicular Subways and Pedestrian Subways.* The aim is to ensure structurally-sound, safe, non-motorized transport and vehicular infrastructure and enhance the life of the infrastructure with periodical monitoring, structural audit, repairs, and maintenance.
Sewerage Operations Department	
Direct Actions- Not Quantified	Maintaining the sewerage network, sewage pumping stations, sewage treatment plants (STPs), and wastewater treatment facilities (WWTF) is a key responsibility of the Sewerage Operations department. The sewage is conveyed through the existing underground sewer network, collected at various satellite pumping stations, treated at eight different sewage treatment plants, and disposed of into nearby seas/creeks. The department also handles repairs and rehabilitation of existing sewer lines. Additionally, sewage recycling plants of smaller capacity have been installed at the premises of sewage pumping stations for the reuse of sewage water for non-potable purposes. Thereby, the department will be *implementing rehabilitation of sewer lines, rehabilitation of rising mains at pumping stations, and systematic cleaning of sewer lines*. These activities aim to ensure the efficient transport of sewerage, thereby minimizing the risk of leakages, damage, and obstruction due to silting within the sewer lines. Undertaking *the rehabilitation of lagoons using bioremediation technology* is another significant initiative of the department. This technology involves the use of microorganisms to break down pollutants, effectively cleaning up contaminated sites. These microbes can be specifically designed to remove pollutants without adversely affecting local biodiversity. The rehabilitation efforts will take place at Versova, Ghatkopar, Bhandup, and Malad.
Enabling Actions	The gravity sewer system within the city comprises a network of underground pipes that rely on gravity to transport raw wastewater to the wastewater

	treatment plants. To ensure the smooth functioning and facilitate the conveyance of wastewater produced by the city to the treatment plants, the Sewerage Operations department has undertaken a vital task. This task involves conducting a comprehensive *condition assessment of the gravity sewer lines* to identify any damage or repairs needed within the sewer network. This will enable the department to take timely and appropriate actions based on these assessments to maintain the efficiency and integrity of the sewer system.
Sewerage Projects Department	
Direct Actions- Not Quantified	The sewerage system of Greater Mumbai is organized into seven zones: Colaba, Worli, Bandra, Versova, Malad, Bhandup, and Ghatkopar. The function of Sewerage Projects Department includes planning and laying new sewer lines, as well as upsizing existing ones. For the F.Y. 2024-25 Sewerage Projects Department has appointed a consultant to undertake the activity of *diversion of dry weather flow* entering storm water drains and divert the same to existing sewer network. However now the said work is handed over to Ch.E. (S.O.) department. As per Sewerage Projects Department responsibility, the work of providing and *installing of maximum new sewer lines* will be carried out by using micro-tunnelling system. Micro- tunnelling is a trenchless system for laying pipes, utilizing the pipe jack technique. This method drastically reduces environmental damage, including disturbance to existing soil ecosystems and ground cover, when compared to traditional open-cut construction techniques. There is the crucial task of *planning the sewer line network at various locations throughout Mumbai.* Effective wastewater management is essential for reducing the environmental impact on the city. These efforts are being undertaken to ensure the safe conveyance of sewerage from the underground network to the sewage treatment plants for treatment, thereby reducing pollution and preserving aquatic ecosystem. The rejuvenation of Poisar, Dahisar, Walbhat and Oshiwara rivers is carried out in efforts to improve the water quality, river health, and riverine and riparian ecosystems. The said work is being executed by the Storm Water Drains (SWD) department.
Mumbai Sewage Disposal Project (MSDP)	
Direct Actions- Not Quantified	The Mumbai Sewerage Disposal department, responsible for municipal sewerage waste disposal, has initiated works for the *design, building, operation, and maintenance of Wastewater Treatment Facilities across various locations* in Mumbai. These facilities, situated at Worli, Bandra, Dharavi, Versova, Malad, Ghatkopar and Bhandup are being developed to treat municipal wastewater as per the latest effluent discharge standards of Hon. National Green Tribunal (NGT). Total quantity of wastewater that will

	be treated upto secondary level through these 7 Wastewater Treatment Facilities (WwTFs) together is 2464 MLD for disposal to sea/creek as per NGT norms and 50% of it (i.e., 1233 MLD) will be treated further upto tertiary level for recycle and reuse for non-potable purposes. These 7 WwTFs will be commissioned by June 2026 to June 2028. Construction of new Colaba WwTF is completed and commissioned in April 2020 and it is meeting the latest effluent discharge standards of NGT. The *planning of the Mithi river sewage treatment plant* is part of BMC's efforts towards rejuvenating the Mithi river. Mithi serves as a major river in Mumbai, flowing from Vihar Lake to the Arabian Sea. Over time, it has been treated as an open nallah by nearby residents and industries. On the upstream of Mithi River, 8 MLD Sewage Treatment Plant is constructed and commissioned in January 2023 which is meeting the latest effluent discharge standards of NGT. The Mithi STP is BMC's one of the strategies for restoring the river water quality and reducing pollution to safeguard aquatic life. A Sewage Treatment Plant of 0.5 MLD capacity is also set up at Veermata Jijabai Bhosale Botanical Udyan and Zoo. Under the Mithi River rejuvenation Project, MSDP department is also constructing 2.6 m internal diameter Sewer Tunnel by segmental lining method for intercepting and conveying about 168 MLD *Dry Weather Flow entering into Mithi River from Bapat Nalla and SafedPul Nalla to the Dharavi Wastewater Treatment Plant* for treatment. At Dharavi WwtF, the sewage will undergo treatment before being released into the creek at Mahim. Furthermore, the department is *constructing new Malad and Versova Influent Pumping Stations*. and upgrading existing Influent Pumping Stations at Bhandup and Ghatkopar. These pumping stations will receive raw wastewater from the collection system, remove large trash and debris, and lift the wastewater for treatment in the Wastewater Treatment Facilities. To enhance access to sanitation, the *planning, designing, and construction of Community Toilet Blocks* and *implementation of the Slum Sanitation Programme* which aims to deliver high-quality sanitation services to slums in Mumbai. This activity under the MSDP budget is being implemented by Solid Waste Management.
Enabling Actions	The Mumbai Sewerage Disposal Project has also undertaken following works related to storm water drains, under *consultancy service for planning and implementing solutions for efficient sewerage management.* a. In-situ treatment of 25 nalla stretches in western suburbs of Mumbai, using 'N-Treat' technology envisaging in-situ treatment of nalla stretches using screening, sedimentation, bio-curtains, floating rafter, plants, bio-culture, growth hormones and disinfection, etc. b. Feasibility Study and preparation of Detailed Project Report (DPR) for treatment of 34 nalla stretches in Eastern Suburbs by Bioremediation/Phytoremediation and such other treatment processes. c. Conducting a comprehensive study of Storm Water Drain (SWD) outfalls and suggesting short term measures for in-situ treatment of

	nallas using bioremediation/phytoremediation and such other methods.
Development Planning Department	
Enabling Actions	The Development Planning Department will carry out the *land acquisition for the planning of new reserved open spaces (R.G./P.G. plots)* to be developed as green open spaces.

Annexure 3:

Calculations for potential emission reduction

Solid Waste Management Department

CH_4 emissions from Per MT of Municipal Waste

The average composition of Brihanmumbai Municipal Waste is as follows-

Food Waste (organic- wet)	72.60 %
Wood, clothing (organic- dry)	3.51 %
Sand, stone, and fine earth	17.37 %
Plastic	3.24 %
Paper and recyclables (including metals)	3.28 %
Management of landfill considered	Uncategorized

(Source- Report of NEERI,2016)

The table below shows the emission reductions for 1 MT of waste.

Source	Total GHGs (metric tonnes CO_2e)
	CH_4
Direct release of landfill gas to atmosphere	0.738

Source: CIRIS tool[14] [15]

Methane generated using methane commitment method (GPC Chapter 8.3.2, Page 92)

Quantity of waste (in MT)	tCO_2e
1	0.738

1. Solid Waste Management at Deonar Dumping Ground

- *Development of Waste to Energy Project at Deonar Dumping Ground*

Specifications:

Waste to Energy Plant capacity- 600 TPD (Tons Per Day)

Estimated energy generation- 8 MW/ day

Calculations:

A. Potential emissions from 600TPD of landfill waste.

600 TPD x 365 days = **2,19,000 tons** annually

CH_4 emissions from per MT of Municipal Waste = 0.738 tCO_2e

The table below shows the emission reductions for 2,19,000 T of waste.

Source	Total GHGs (metric tonnes CO_2e)
	CH_4
Direct release of landfill gas to atmosphere	1,61,622

Therefore, potential emission reduction through preventing 600TPD of landfill waste is **1,61,622 tCO_2e**.

Quantity of waste (in MT)	tCO_2e
1	0.738
2,19,000	1,61,622

B. Potential emission from 8 MW of energy generated,

Weighted average emission factor of Indian Grid for FY 2021-22 (including renewable energy sources) = 0.71 tCO_2/MWh[16]

Total energy generated from 8 MW by the WtE plant per day for a year (assuming that it runs for 24 hours),

8 MW x 24 hours/day x 365 days/year = 70080 MWh

Therefore, projected emission avoided,

= Total energy generated per year x weighted emission factor

= 70080 MWh x 0.71 tCO2/MWh = 49756.8 tCO_2

Therefore, total carbon emission reduction from development of Waste to Energy Project at Deonar Dumping Ground (A + B) is **2,11,378.8 tCO_2e.**

- *Biomining of legacy waste at Deonar Dumping Ground*

Calculations:

Assuming 1MT of legacy waste being bio-mined i.e 1 MT of waste being avoided in the landfill.

The table below shows the emission reductions for 1 MT of waste.

Source	Total GHGs (metric tonnes CO_2e)
	CH_4
Direct release of landfill gas to atmosphere	0.738

Source: CIRIS tool[14 15]
Methane generated using methane commitment method (GPC Chapter 8.3.2, Page 92)

2. Dumpsite Reclamation Project at Mulund Dumping Ground (MDG)

Specifications:

Quantity of waste- 70 lakh MT, 70,00,000 MT

Calculations:

CH_4 emissions from per MT of Municipal Waste = 0.738 tCO_2e

The table below shows the emission reductions for 70 lakh MT of waste, avoided from landfill.

Source	Total GHGs (metric tonnes CO_2e)
	CH_4
Direct release of landfill gas to atmosphere	51,66,000

Therefore, potential emission reduction by removal of 70 lakh MT landfilled waste is **51,63,480 tCO_2e**.

Quantity of waste (in MT)	tCO_2e
1	0.738
70,00,000	51,66,000

Mechanical and Electrical (M&E) Department

3. Upgradation of High Mast System

Specifications:

Number of lights to be replaced – 2400

Metal Halide/ High Pressure Sodium Vapour (HPSV) bulb streetlights- 400 W

Smart LED flood light high mast- 150 W

Calculations:

Weighted average emission factor of Indian Grid for FY 2021-22 (including renewable energy sources) = 0.71 tCO_2/MWh[16]

Electricity saved each mast light= 400 W – 150 W = 250 W

Total energy saved for 2400 number of lights,

= 250 W x 2400 = 60,00,00 W = 0.6 MW

Assuming operation of 8 hrs for 365 days,

Total energy saved for a year = 0.6 MW x 8 hrs x 365 days = 1752 MWh

Therefore, potential emission avoided = 1752 MWh x 0.71 tCO_2/MWh= **1244 tCO_2**

Number of bulbs replaced	Potential tCO_2e reduced
1	0.518
2400	1244

4. Installation of solar panel systems at various peripheral hospitals

Specifications:

Capacity of solar panel system to be installed- 385 KW

Calculations:

Weighted average emission factor of Indian Grid for FY 2021-22 (including renewable energy sources) = 0.71 tCO_2/MWh[16]

For a year,

385 KW x 8 hrs x 365 days = 11,24,200 KW = 1124.2 MWh

Projected emission avoided = 1124.2 MWh x 0.71 tCO_2/MWh= **798 tCO_2**

Solar panel system to be installed (KW)	Potential tCO_2e avoided
1	2.07
385	798

For wood utilised in the cremation-

Emission Factor for wood

Units	CO_2	CH_4	N_2O
tCO_2e/TJ	112	7.5	1.192

Source : IPCC[17]

Fuel mass to energy conversion factors

From	To	Conversion factor
Tonne	TJ	0.02032932

Source: International Energy Agency[18]

5. Carbon Cutter System

Specifications:

Retrofitted to wood pyre cremation system.

Flue gases reduction at source

Carbon Monoxide	90%
Carbon Dioxide	70%
Hydrocarbons	46%
Sulphur Oxide	67%
Nitrogen Oxide	65%

Calculations:

Average wood used per cremation = 300 kg = 0.3 T

GHG Emissions = Wood used per cremation x Emission factor for wood

GHG Emissions per cremation:

Units	CO_2	CH_4	N_2O	Total
tCO_2e	0.683	0.046	0.007	0.736

Net zero machines reduces the other flue gases emitted at source, 70% Carbon dioxide and 65% Nitrogen Oxide at source i.e., tCO_2 = 0.683 x 0.70 = **0.4781**

Therefore, total potential **emission reduction per cremation**,

Units	CO_2	CH_4	N_2O	Total
tCO_2e	0.4781	0.046	0.005	0.566

Based on 2022-23 data, the number of cremations at cemetery where installation of carbon cutter system is proposed = 1707

Therefore, the potential emission reduction due carbon cutter system at the proposed cemeteries i.e., tCO_2 = 0.4781 x 1707 = **816.12**

Therefore, total potential emission reduction with proposed carbon cutter system would be **903.18 tCO_2e.**

Units	CO_2	CH_4	N_2O	Total
tCO_2e	816.12	78.52	8.54	**903.18**

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6. Setting up eco-friendly wood pyre cremation system

Specifications:

Ecofriendly pyre set to be installed, reduces 50% pollution as by conventional pyre set by reducing consumption of wood by approx. 160 KG per cremation i.e 140 kg of wood will be used.

Calculations:

Quantity of wood saved per cremation = 140 kg = 0.140 T

GHG Emissions avoided (per cremation) = Quantity of wood saved x Emission factor for wood

Units	CO_2	CH_4	N_2O	Total
tCO_2e	0.319	0.021	0.003	**0.344**

Based on 2022-23 data, number of cremations at cemeteries where installation of eco-friendly wood pyre cremation system is proposed = 11822

Therefore, the potential emission reduction due eco-friendly wood pyre cremation system at the proposed crematoria i.e., tCO_2 = 0.319 x 11822 = **3771.22**

Therefore, total potential emission reduction with proposed eco-friendly wood pyre cremation system would be 4054.95 tCO_2e.

Units	CO_2	CH_4	N_2O	Total
tCO_2e	3771.22	248.26	35.47	**4054.95**

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7. Replacing existing AC units with comparatively more energy efficient AC units in various municipal office and hospital buildings

Calculating greenhouse gas (GHG) emission reductions by replacing R22 refrigerant with R134a refrigerant per unit:

The GWP of R22 over a 100-year timeframe is approximately 1,810, while the GWP of R134a is about 1,430.[13]

Let's assume, replacing 1 unit of R22 refrigerant with 1 unit of R134a refrigerant for a specific application.

Emission reduction per unit = Emissions from R22 - Emissions from R134a

Emission reduction per unit = (GWP of R22 - GWP of R134a) * Quantity of refrigerant used

Emission reduction per unit = (1,810 - 1,430) * 1 unit

Emission reduction per unit = 380 * 1 unit

Emission reduction per unit = 380 kg CO2-equivalent units = **0.38 tCO2e**

40 nos. of 2 Tonne of Refrigerant (TR) inverter AC and 15nos. of 1 TR inverter AC units using R22 refrigerant with R134a refrigerant i.e. total 95 tonnes of refrigerant.

It's important to consider other factors such as leakage rates, energy efficiency, and system performance when evaluating the overall environmental impact of the refrigerant replacement.

No of units of R22 refrigerant replaced with R134a refrigerant	tCO_2e reduction
1	0.38
95	**36.1**

Markets Department

8. Setting up Organic Waste Convertor at various municipal markets

Specifications:

Composition of Waste = **100% Organic**

Management of Landfill considered: Uncategorised

Capacity of O.W.C.= 69 MT/ day

Number of markets= 64

Calculations:

The table below shows the emission reductions for 1 MT of waste.

Source	Total GHGs (metric tonnes CO_2e)
	CH_4
Direct release of landfill gas to atmosphere	0.9

Source: CIRIS tool[14] [15]

Methane generated using methane commitment method (GPC Chapter 8.3.2, Page 92)

Quantity of processed in O.W.C.= Quantity of waste prevented from being landfilled

= 69 MT/day X 365 days X 64 nos. of O.W.C

= 16,11,840 MT per year

The table below shows the emission reductions for 16,11,840 MT of waste avoided from landfill.

Source	**Total GHGs (metric tonnes CO_2e)**
	CH_4
Direct release of landfill gas to atmosphere	14,50,656

Therefore, potential emission reduction by decentralised management organic waste from markets through prevention of 9,69,440 MT of organic waste being landfilled is **14,50,656 tCO_2e**.

Quantity of waste (in MT)	tCO_2e avoided
1	0.9
16,11,840	14,50,656

9. Fitting LED lights in municipal markets

Calculations:

Average watt of electricity used,

Incandescent bulb- 60 watt

CFL bulb- 15 watt

LED bulb- 8 watt

Weighted average emission factor, simple operating margin (OM), of Indian Grid for FY 2021-22 (adjusted for cross-border electricity transfer & including RES), in t CO2/MWh = 0.71

Considering CFL bulb, 15W - 8W = 7W

Assuming operation of 8 hrs for 365 days,

i. By replacing **Incandescent bulb with LED bulb**

Average electricity saved = Watt of electricity used by incandescent bulb – Watt of electricity used by LED
= 60W - 8W = 52W

Total energy saved per year = 52W x 8h x 365 days = 0.15 MWh

Projected emission avoided = 0.15 MWh x 0.71 tCO_2/MWh

= **0.11 tCO_2e** per bulb per year

ii. By replacing **CFL bulb with LED bulb**

Average electricity saved = Watt of electricity used by incandescent bulb – Watt of electricity used by LED

= 15W - 8W = 7W

Total energy saved per year = 7W x 8h x 365 days = 0.02 MWh

Projected emission avoided = 0.02 MWh x 0.71 tCO_2/MWh

= 0.014 tCO_2e per bulb per year

	Energy consumption saved	tCO_2e avoided
Per unit of energy saved	1 MWh	0.71
Per Incandescent bulb	0.15 MWh	0.11
Per CFL bulb	0.02 MWh	0.014

10. Installation of solar panels on rooftop of market buildings

Specifications:

Capacity of one solar system= 25 KW, Number of markets= 3

Calculations:

Total emission reduction = Energy generated per year (MW) X weighted emission factor for electricity (tCO_2 /MWh)

Weighted average emission factor of Indian Grid for FY 2021-22 (including renewable energy sources) = 0.71 tCO_2/MWh[16]

Markets	Number of 25 KW solar (n)	Energy generated daily (e) (25 KW x n) *KW*	Annual energy generation (A) (8h x 365 days x e) *MW*	Emissions (A x weighted emission factor) tCO_2
Babu Genu Market	3	75	219	155.5
Mahatma Jyotiba Phule Market	1	25	73	51.8
Shirodkar Market	2	50	146	103.7
Total		**150**	**438**	**311**

Energy generation	tCO_2e avoided
1 MW	0.71
438 MW	311

Water Supply Project (WSP) Department

11. Development of Renewable Hybrid Energy Project Facilities at HSBT Middle Vaitarna Dam

Specifications:

Capacity of Hydro Electric Power Plant= 20 MW

Capacity of Floating Solar PV= 6.5 MW

Calculations:

Annual Energy generated (MWh) = Capacity (MW) x Hours in a Year x Capacity Factor

For Hydro Electric Power Plant,

Capacity Factor of Hydro Electric Power Plant = 40 %[16]

Therefore, annual energy from 20MW Hydro Electric Power Plant = 20 x 24 x 365 x 0.40 = 70,080 MWh

Projected emission avoided = 70080 MWh x 0.71 tCO_2/MWh = **49,756.8 tCO_2**

For Floating Solar PV System,

Capacity Factor of Solar PV Power Plant = 17-25 %, assuming 20%[16]

Therefore, annual energy from 6.5 MW Floating Solar PV Power Plant = 6.5 x 8 x 365 x 0.20 = 3,796 MWh

Projected emission avoided= 3,796 MWh x 0.71 tCO_2/MWh **= 2,695.16 tCO_2**

The total potential emission reduction by developing the hybrid power plant at Middle Vaitarna Dam is **52,460.76 tCO_2.**

	Energy Generation (MWh)	**Projected emission (tCO_2) avoided**
	1	0.71
Hydro Electric Power Project	70080	49,756.8
Floating Solar PV Project	3796	2695.16

Transport Department

12. Procurement of EV Sedan cars

Specifications:

Number of EV cars to be procured= 20

Calculations:

Assume an average annual of 10000 km use.[19]

Considering use of Sedan (<1400 CC Category),

	Gasoline (Petrol)	Diesel
Emission factor (kg CO_2 /km)	0.142	0.121
Emissions (kg tCO_2) =number of km use x emission factor	1420	1210
Emissions (tCO_2) per Sedan car	1.42	1.21
For 20 Sedan Cars (tCO_2)	**28.40**	**24.20**

GHG Emissions from EVs,

The average efficiency of the electric vehicle, typical value for city driving conditions = 0.08 kWh/km[20]

Electricity Consumption (kWh) = Average Annual km x Efficiency of EV (kWh/km)

= 10000 km x 0.08 kWh/km = 800 kWh = 0.8 MWh

Weighted average emission factor of Indian Grid for FY 2021-22 (including renewable energy sources) = 0.71 tCO_2/MWh[16]

CO_2 Emissions from EV (tCO_2) = {Electricity Consumption (kWh) x {Emission Factor (t/kWh)}

= 0.8 MWh x 0.71 tCO_2/MWh= 0.57 tCO_2

CO_2 Emissions from 20 nos. EV (tCO_2) = 0.57 tCO_2 x 20 = **11.4 tCO_2**

Therefore, potential emission reduction by switching to EV,

For 20 Sedan Cars using Petrol (Gasoline) = 28.40 – 11.4 = **17 tCO_2**

For 20 Sedan Cars using Diesel = 24.20 – 11.4 = **12.8 tCO_2**

Hydraulic Engineers Department

13. Setting up of Solar Power Generation Plant on the Rooftop of New Master Balancing Reservoir (MBR) at Bhandup Complex

Specifications:

Capacity of Solar power generation plant= 2.5 MW

Calculations:

Annual Energy generated (MWh) = Capacity (MW) x Hours in a Year x Capacity Factor

Capacity Factor of Solar PV Power Plant = 17-25 %, assuming 20%[16]

Therefore,

Annual Energy from 2.5MW Solar Power Plant = 2.5 x 8 x 365 x 0.20 = 1460 MWh

Projected emission avoided = 1460 MWh x 0.71 tCO_2/MWh **= 1,037 tCO_2**

Energy generation	tCO_2e avoided
1 MWh	0.71
1460 MWh	1,037

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