EXECUTIVE SUMMARY

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Context Setting

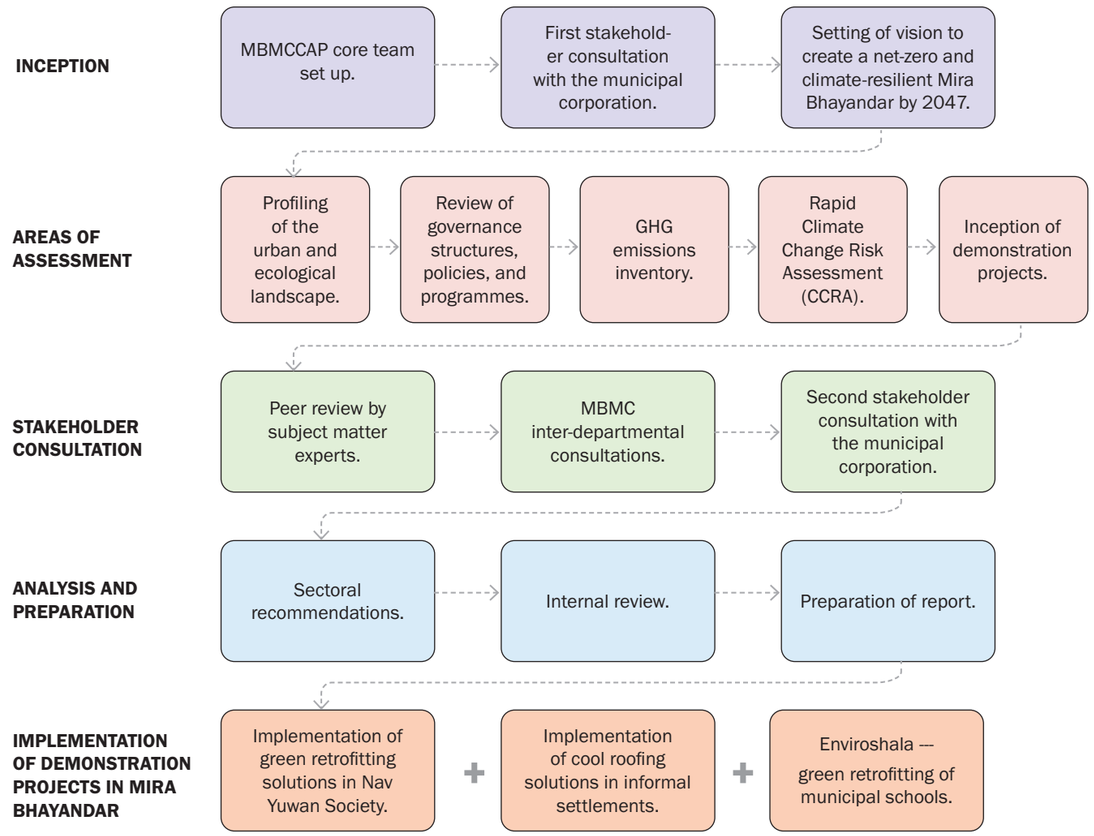
Globally, Greenhouse Gas (GHG) emissions have reached alarming levels, with approximately 53.82 billion tonnes of CO_2e emitted in 2023. The rise of anthropogenic activities, mainly from fossil fuels, industry, and agriculture, are the leading causes of these emissions. India has committed to reducing the emissions intensity of its GDP by 45% by 2030 and achieving net-zero emissions by 2070, as outlined in its updated 2022 commitment to the Nationally Determined Contributions (NDCs) under the Paris Agreement.

In keeping with the ambitious target, the Maharashtra State Climate Action Plan has directed AMRUT cities to create climate action plans and achieve Net-Zero targets by 2050. Mira Bhayandar, a key urban centre in the Mumbai Metropolitan Region (MMR) and one of the 42 cities in Maharashtra under the Central government's ambitious Atal Mission for Rejuvenation and Urban Transformation (AMRUT) scheme, has taken an ambitious step towards addressing the dual challenges of urbanisation and climate change. The city, nestled between the Vasai Creek to its north, the Sanjay Gandhi National Park (SGNP) to its east, and the Arabian Sea to the west, spans an area of 79.40 square kilometres (7,940 hectares), and has a population of 8.09 lakh as per the 2011 Census.

While India is the third-largest emitter of GHGs, its per capita emissions are relatively low compared to developed nations, standing at about 2.9 tonnes of CO_2e per year, compared to the global average of 6.7 tonnes of CO_2e.

The Aga Khan Agency for Habitat (AKAH) India has partnered with the Mira Bhayandar Municipal Corporation (MBMC) as a knowledge partner to develop the Mira Bhayandar Climate Action Plan (MBMCCAP). Mahatma Phule Renewable Energy & Infrastructure Technology Limited (MAHAPREIT) and the National Institute of Urban Affairs (NIUA) played a pivotal role in shaping the plan, serving as advisory and technical partners to AKAH India. In March 2024, the first stakeholder consultation meeting facilitated vision-setting and identified key priority areas for action. By implementing the Climate Action Plan, Mira Bhayandar is not only contributing to India's climate targets but also setting an example for other cities to follow in their efforts toward sustainability and resilience.

Mira Bhayandar Climate Action Planning Process

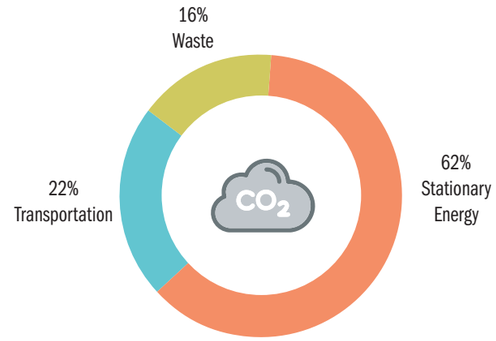


Baseline Assessment

GHG Emissions Inventory Of Mira Bhayandar

The BASIC approach calculations reveal that in 2023, Mira Bhayandar GHG emissions were **1.34 million tonnes of CO_2e or 1.12 tonnes of CO_2e per person,** an increase from 0.89 million tonnes of CO_2e in 2020. The stationary energy sector contributes to 0.83 million tonnes of CO_2e and accounts for 62% of the total emissions. **The findings show that the energy sector accounted for 62% of total emissions. Residential electricity use is a significant contributor, responsible for 40.5% of emissions.**

The transport sector contributes to 0.27 million tonnes of CO_2e and accounts for **22% of the total emissions**. **The waste sector** contributes to 0.22 million tonnes of CO_2e which accounts for **16% of the total emissions** in the city.



GHG emissions of the city

Photo credit: www.freepik.com

Rapid Climate Change Risk Assessment

The Rapid Climate Change Risk Assessment (CCRA) of Mira Bhayandar meets the minimum requirements for evidence-based decision making, providing a qualitative assessment of risk. It has been conducted in four parts *(table below).*

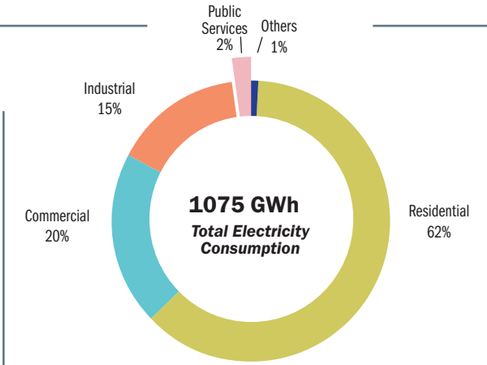
CLIMATIC HAZARDS			
URBAN HEAT	**URBAN FLOODING**	**COASTAL RISKS**	**AIR POLLUTION**
The built-up area in the city has increased by 50.05% between 2005 to 2022 and the vegetation cover was reduced to 13.6%. This resulted in the annual temperature rise by 0.46 degree celsius	The city is facing major urban flooding challenges due to waterlogging. This is caused due to an undulated and clogged drainage system as well as a poor discharging capacity of accumulated water during peak rainfall	The coastline of Mira Bhayandar has eroded by 0.5 km in the past 15 years (2008 to 2023). The climate-induced coastal risks not only threaten the livelihoods and food security of the vulnerable communities but also displace them, leading to social instability	The city has 1 ambient air quality monitoring station under the National Air Quality Monitoring Programme. The air pollution data reveals that the city's PM2.5 and PM10 levels exceed the WHO's air quality standards by 14 and 9 times, respectively
EXPOSURE	**WARD-LEVEL VULNERABILITY ANALYSIS** AREAS TO BE MOST AFFECTED DUE TO: • **Population Density:** Wards 3, 4, 5, 6, 7, 20, and 22 • **Building Density:** Wards 2, 3, 4, 5, 6 and 7 • **Susceptibility of Informal Settlements:** Wards 1, 2, 11, 13, 15, and 16		
VULNERABILITY	**WARD-LEVEL VULNERABILITY ANALYSIS** AT-RISK AREAS AND AT-RISK POPULATIONS TO BE AFFECTED: • **Access to Healthcare:** Ward 23 • **Access to Education:** Wards 10 and 22 • **Access to Gardens and Public Parks:** Wards 2,4, 5, 9, 11 and 12 • **Access to Public Transport:** Wards 4, 6, 13, 21, and 24 • **Access to Disaster Shelters:** Wards 3, 5, 6, 9, 20, and 22		
RISK ANALYSIS	**WARD-LEVEL RISK ANALYSIS** ASSESSMENT OF HAZARDS, EXPOSURE, AND VULNERABILITY OF AREAS AND POPULATIONS: • **Very high risk:** Wards 4 and 5 • **High risk:** Wards 6, 17, 20, and 22 • **Moderate Risk:** Wards 2, 7, 8, 9, 10, 15, 18, and 19		

Key Recommendations for Priority Sectors

Energy and Buildings | **Water Supply Managemment** | **Urban Flooding** | **Urban Greening and Biodiversity** | **Mobility and Air Quality** | **Waste Management**

Energy and Buildings

Mira Bhayandar consumed approximately 1075 GWh of electricity in 2023, and this consumption is fuelled by rapid urbanisation, population growth, and expansion of economic activities. A steady rise in energy requirements has been seen over the years across residential, commercial, industrial, and public services. Currently, there are 3,40,000 residential metered connections, and the consumer base is increasing by 4% on a yearly basis (2% increase in per capita consumption annually). The average annual consumption per household is 1,967 kWh, which indicates that a major share of the households is dependent on electrical appliances.



Electricity consumption by different sectors (2023)

164 kWh
Monthly Average Consumption Per Household

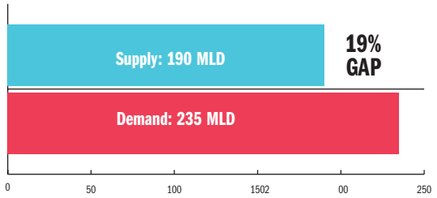
1,967 kWh
Average Annual Consumption Per Household

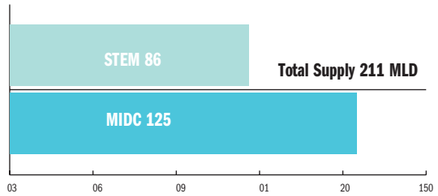
3,40,000
Residential Metered Connections

51,000
Commercial Metered Connections

Recommendations	Action	Timeline
Green Retrofitting of Buildings	The city can mandate retrofitting in non-residential buildings. The process typically includes upgrading HVAC systems, installing energy-efficient lights such as LEDs and BLDC fans, installing motion sensors for electricals in common toilets and common areas, and improving insulation and incorporating water-saving technologies like low-flow fixtures and water-efficient irrigation systems	Mid-term (2040)
Cooling Solutions in Informal Settlements	Collaborate with Corporate Social Responsibility (CSR) programmes, NGOs, and relevant organisations to implement cool roofs and other sustainability measures in informal settlements. Additionally, facilitate skill development by training locals in cool-roof installations and maintenance, and conduct workshops and awareness drives to educate residents and gather support	Short Term (2030)
Solar Initiatives	The administration should encourage adoption of Rooftop Solar Systems (RTS) city-wide. Moreover, expand renewable energy capacity by installing the innovative and self-sustaining solar tree structures in public parks, alongside roads, or in open spaces	Short to Mid-term (2030-2040)

Water Supply Management





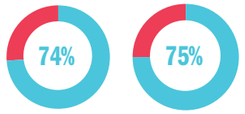
8 functional STPs (115 MLD)

5 MLD tertiary plants exist

Underutilised Treatment Plants

Water is supplied with seasonal inconsistencies for

2-3 Hours Daily



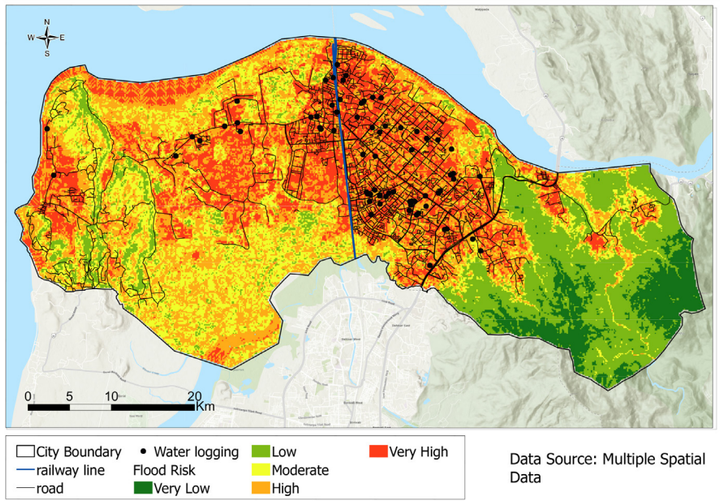
Water Supply Coverage for Households

Metered Connections

Recommendations	Action	Timeline
Eco Sewage Treatment Plants	Construct Eco STPs, which will use natural, low-energy biological processes for treating wastewater, particularly for informal settlements and areas lacking robust infrastructure	Short-term (2030)
Zonal Distribution Systems	Establish zonal distribution and bulk metering systems to ensure targetted interventions that directly address water loss and support equitable water supply	Short-term (2030)
Non-Revenue Water Reduction Strategy	Develop and implement a comprehensive NRW Reduction Strategy through a public-private partnership model to maximise resource utilisation and enhance service reliability	Mid-term (2040)

Urban Flooding

There are a total of **72 waterlogging points** in the city, with **wards 13, 20, 23, 10, and 4 at higher risk** of urban flooding than the rest. The city's stormwater **drainage network system is aged and covers only 50.24%** of the total road network. Many parts of the system have lower discharge capacity, which hinders efficient handling of the runoff during peak rainfall. On an average, Mira Bhayandar has experienced 3 very heavy events, 7 heavy events, 26 moderate events, and 40 light events. The years 2005, 2010, and 2019 have received the peak rainfall.



Map of High-Risk waterlogging zones in Mira Bhayandar

5 HIGH RISK WARDS

3 VERY HEAVY EVENTS

7 HEAVY EVENTS

40 LIGHT EVENTS

Peak Rainfall
2005, 2010, & 2019

Recommendations	Action	Timeline
Upgrade of Drainage Infrastructure and Implement Nature-Based Solutions	Invest in the expansion and modernisation of the city's drainage systems, especially in the 'high' and 'very high' risk wards – 4, 10, 13, 20, 23. This includes increasing the capacity of existing drains, constructing new drainage channels, and ensuring regular maintenance to prevent blockages	Mid-term (2040)
Enforce Urban Planning Regulations	Enforce strict zoning regulations to prevent development in flood-prone areas, and integrate Sustainable Urban Drainage Systems (SuDS) into urban planning so that new developments are designed to manage water sustainably	Short-term (2030)
Establish Early Warning Systems	Introduce real-time flood monitoring and early alert mechanisms and employ flood forecasting models to prepare for impending rainfall and flooding	Mid-term (2040)

Greening and Biodiversity

With the rapid expansion of the **built-up area from 5.52% in 2005 to 11.28% in 2022,** there has been a significant loss of vegetation cover which stands at 13.6% within the urban agglomeration. There are 79 gardens and public parks in the city and **almost 28% of the population (buffer area: 400 metres) have physical access to these green public spaces.** Within the main built-up area, **the city has only 77 hectares of green space, with an average of 0.7 square metres per person.** This is much lower than the 10 square metres per person that the URDPFI 2014 guidelines specify.

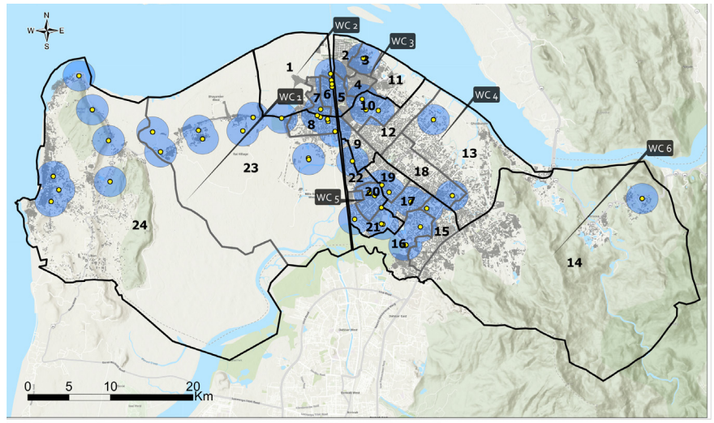
79
Parks and Playgrounds

120+
Waterbodies consisting of lakes and wetlands

21%
Sanjay Gandhi National Park

15%
Mangroves

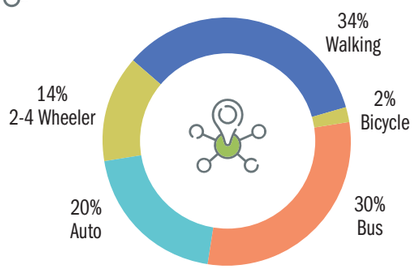
23.8 km
Shoreline



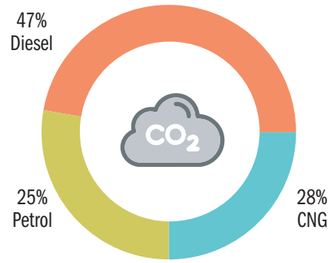
Map of Access to Green Public Spaces in Mira Bhayandar

Recommendations	Action	Timeline
Promote and Conserve Green Spaces	Promote community-led development of greenery in spaces between road dividers, upcoming metro lines, and any new construction to mitigate the urban heat island effect	Mid-term (2040)
Establish Ward-Level Biodiversity Management Committees (BMC)	Mandate to involve the local stakeholders, such as wildlife conservationists and rescuers in the BMC, who can bring in valuable insights on species-specific needs, habitat conservation, and rescue efforts, particularly for marine and urban wildlife. A standing committee member should serve as the chairman of the central BMC to ensure alignment with municipal priorities and effective governance	Short-term (2030)
Biodiversity Booklet	Develop an informative booklet based on the findings of the People's Biodiversity Register (PBR) and distribute it in both MBMC and private school libraries. The register can act as a guide to Local Biodiversity Action Plan (LBSAP)	Short-term (2030)

Mobility and Air Quality



Modal split of vehicles in Mira Bhayandar



5% increase in emissions between 2015 and 2023

Total transportation emissions in 2023

The emissions from the transport sector comprises of 47% Diesel, 28% CNG and 25% Petrol. A significant 20% of the city's population are pedestrians. Only 5% of people use bicycles. However, nearly 60% of the roads have no dedicated footpaths for pedestrians, particularly in densely populated neighbourhoods.

1
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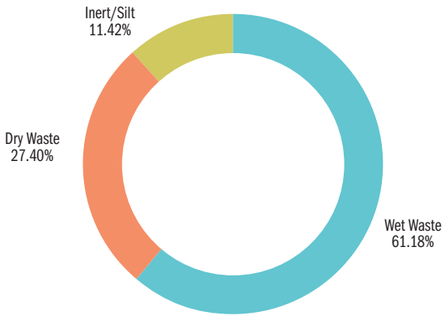
Ambient air monitoring station

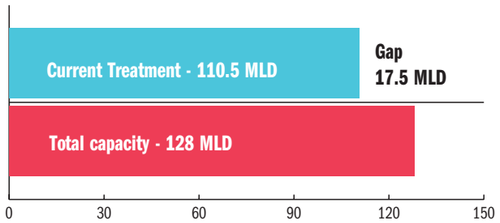
Mira Bhayandar, a non-attainment city, has already implemented a City Clean Air Action Plan. At present, it has one ambient air quality monitoring station installed under the National Air Quality Monitoring Programme. The city's PM2.5 and PM10 levels exceed the WHO's air quality standards by 14 and 9 times, respectively.

Recommendations	Action	Timeline
Establish Comprehensive Emissions Inventory	Develop an air pollution emissions inventory to identify major pollution sources, establish a baseline for air-quality management, and support the development of targeted mitigation strategies	Mid Term (2040)
Complete Street Concept	Integrate all modes of transportation, including walking, cycling, and public transport, with a focus on safety, efficiency, and environmental health	Short-term (2030)
Variable Parking Mechanism	Implementation of time-based Variable Parking Mechanism / Zonal parking pricing on the different parking zones identified based on traffic density, land use and availability of public transport. High-density areas will have higher parking charges whereas peripheral zones would have lower rates	Short-term (2030)

Waste Management



The city has 10 Sewage Treatment Plants (STP), 8 of which are operational. They collectively treat 110.5 MLD which includes the tertiary treatment plant which has a 5 MLD capacity. Although, the total installed capacity of the 10 STPs is 128 MLD, there exists a gap of 17.5 MLD in the existing treatment capacity.



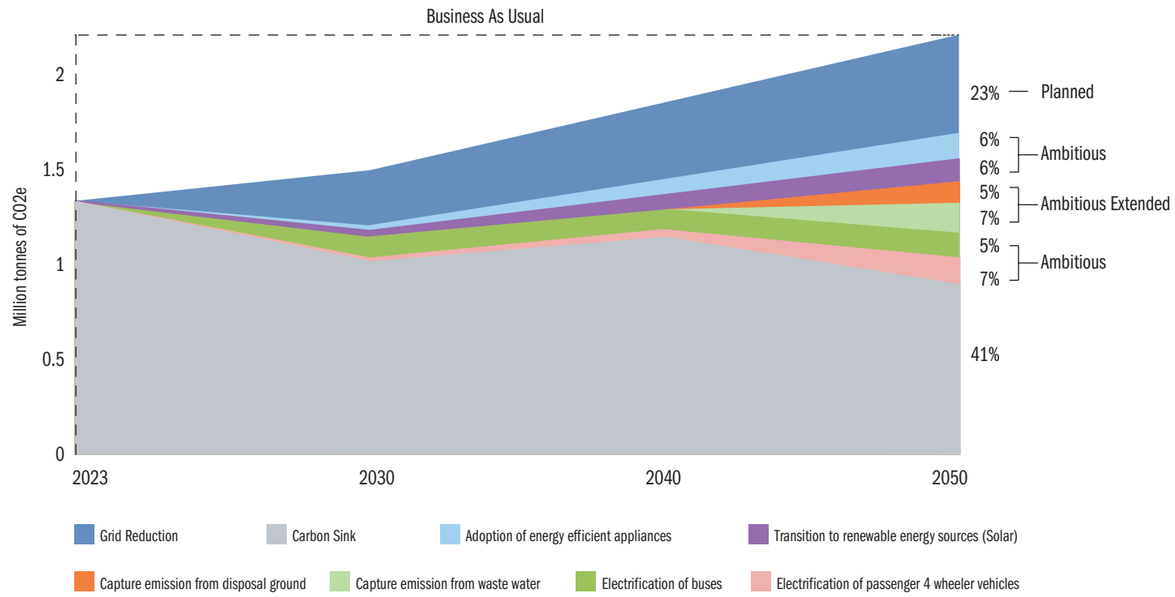
Current Scenario Of Wastewater Treatment Capacity

Recommendations	Action	Timeline
Construction and Demolition Waste	Construction and demolition (C&D) waste accounts for nearly half the solid waste generated globally each year. This type of waste includes materials such as concrete, wood, metals, glass, and plastics, which are produced during the construction, renovation, and demolition of buildings and infrastructure. Currently, Mira Bhayandar lacks a comprehensive strategy to manage this waste	Mid-term (2040)
Comprehensive Wastewater Management and Sustainable Sludge Treatment Strategy	Ensure 100% coverage within the city limits with a fully closed and underground sewer collection network and transition all domestic wastewater treatment plants to aerobic systems either by constructing new or upgrading existing anaerobic STPs	Mid-term (2040).
Waste Collection And Management		
Furniture Waste	Establish specific monthly collection days for registered bulky furniture waste, ensuring items are segregated for reuse, recycling, or processing into biochar and compost to decrease landfill pressure	Short-term (2030)
Poultry Waste	Establish designated collection points at poultry markets and shops with a daily collection schedule, using specialised vehicles to process collected waste through composting for organic fertiliser and anaerobic digestion for biogas production	Short-term (2030)

Summary of Mitigation Actions

In order to meet the internationally agreed-upon goal of net-zero emissions by 2050, there are a number of key priority actions and recommendations broken down by sector that could help lower greenhouse gas emissions.

Owing to limitations in methodology and data, the MBMCCAP has only enumerated the mitigation potential of 7 recommendations. The city can support the ongoing Grid Reduction efforts at the national level by enhancing its local energy mix and reducing 23% of emissions by 2050. This comes under the Planned Scenario. By adopting rooftop solar infrastructure across residential, commercial, and industrial buildings, solarising municipal infrastructure like streetlights and facilities, and promoting energy-efficient appliances such as BLDC fans and BEE star-rated devices, the city can reduce emissions by 24% by 2050 under the Ambitious Scenario. Furthermore, under the Extended Ambitious Scenario, the city can achieve an additional 12% reduction in emissions from the waste sector.



Mitigation Actions Under the MBMCCAP

Implementation of Demonstration Projects to Mitigate Urban Heat Island Effect in Mira Bhayandar

GREEN RETROFITTING

1. Nav Yuwan Housing Society

The findings show that the energy sector accounted for 62% of total emissions. Residential electricity use is a significant contributor, responsible for 40.5% of emissions. To address this, the Aga Khan Agency for Habitat (AKAH) has implemented energy-efficient retrofitting solutions substantially reducing by over 60% emissions. As a pilot initiative, these solutions have been successfully deployed at Nav Yuwan Housing Society, delivering tangible outcomes, and serving as a replicable model to drastically bring down emissions in India and the world. The project has received IFC Edge Advanced Certification which serves as a credible recognition and is the first existing society to receive the IFC EDGE certification in the world.

IMPLEMENTATION

The Nav Yuwan CHS project focussed on a multi-pronged approach:

Energy Efficiency:

BLDC Fans: Installed in all 280 households, resulting in up to a 65% reduction in electricity consumption for cooling

LED Lighting: Replaced traditional incandescent bulbs across all units, significantly lowering energy demand for lighting

Solar PV System: A 44 KWp solar PV system was installed to power common areas, reducing reliance on grid electricity by 8-10%

Water Conservation:

Low-Flow Fixtures: Installed in bathrooms and kitchens across the 280 households to minimise water usage

Water-Saving Practices: Promoted water-efficient habits among the 1,120 residents (assuming an average of 4 residents per household), such as the use of bucket baths, which can save up to 30% of water

Community Engagement:

Workshops and Training: Conducted workshops on sustainable living practices to empower the 1,120 residents to make informed choices

Kitchen Gardening: This training has offered residents, specially senior citizens, gentle exercise, stress relief, and a sense of purpose. Growing one's own food improves nutrition intake as it reduces reliance on processed options. The gardens generate compost, which minimises waste, and benefits the environment

Results & Impact

THE NAV YUWAN CHS PROJECT ACHIEVED SIGNIFICANT POSITIVE OUTCOMES

Energy Savings 62% overall: Substantially reduced energy consumption across all 280 households, leading to lower electricity bills for residents

Water Savings 40% overall: Achieved a significant reduction in water consumption across households, contributing to water resource conservation

Environmental Impact: Reduced carbon emissions associated with energy consumption across 280 households, mitigating the impact of climate change

Social Benefits: Improved resident comfort and wellbeing through enhanced indoor air quality and reduced energy costs for all 1,120 residents. Fostered a sense of community through shared sustainability goals and initiatives

MUNICIPAL SCHOOLS

In addition to residential projects, AKAH is retrofitting 3 selected schools located in heat-stressed zones to enhance their sustainability and resilience. As part of this initiative, 159 BLDC fans, 35 motion sensor lights and 60 dual-flush cisterns were installed to achieve a target of minimum 20% improvement in energy and water efficiency. Among the key measures implemented is the use of BLDC fans, which has the potential to reduce electricity consumption by 53% as compared to traditional fans, significantly cutting energy use. Furthermore, 47% water efficiency can be achieved with the installation of dual-flush cisterns.

Cooling Solutions In Informal Settlements

In informal settlements, AKAH is addressing thermal comfort challenges by introducing cooling solutions such as Solar Reflective Index (SRI) paints, alufoil, and wood wool panels with ventilation cores, which is being implemented in 105 household units. These measures are expected to lower indoor temperatures by 3–4°C and reduce rooftop surface temperatures by approximately 20°C, delivering immediate and perceptible relief to residents.