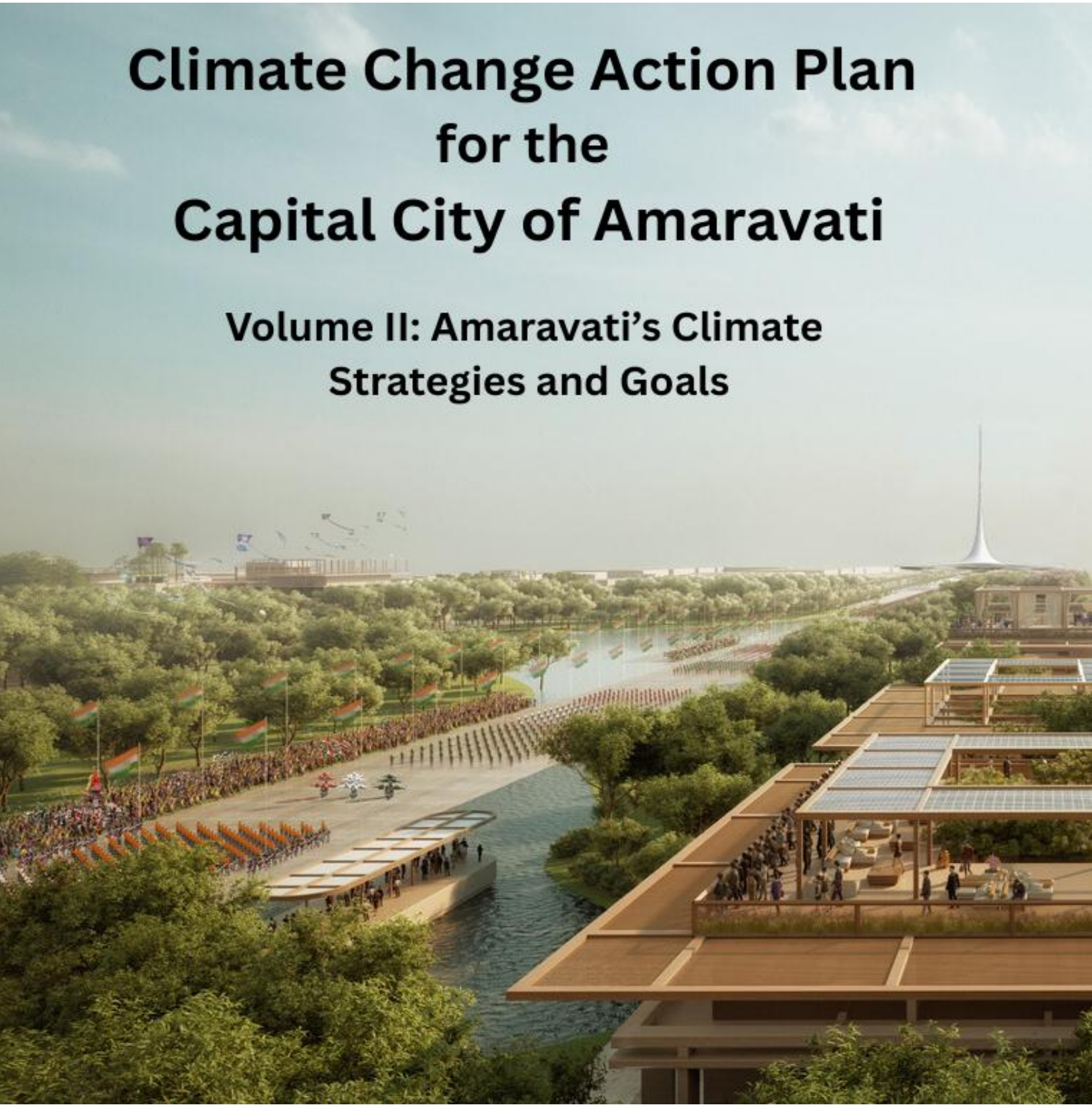
Climate Change Action Plan for the Capital City of Amaravati

Volume II: Amaravati's Climate Strategies and Goals



AMARAVATI
THE PEOPLE'S CAPITAL

ICLEI
Local Governments for Sustainability
SOUTH ASIA

October 2025

Message from APCRDA Commissioner

Message from APCRDA Additional Commissioner

Message from Executive Director, ICLEI South Asia

Acknowledgement

Developing the Amaravati City Climate Change Action Plan (CCAP) for Andhra Pradesh Capital Region Development Authority (APCRDA) marks a significant step towards developing a climate-resilient and net-zero capital city over the coming decades. This plan represents a united effort to address the impacts of climate change and enhance Amaravati's resilience. APCRDA has engaged ICLEI - Local Governments for Sustainability, South Asia, for the preparation of a comprehensive city-level CCAP for Amaravati city. This collaborative effort has been instrumental in shaping the CCAP, bringing in internationally accepted climate action planning approaches that enhance its scope and feasibility, helping lay out ambitious yet attainable targets. Heartfelt gratitude is extended to all the departments and staff within APCRDA, as well as to all the stakeholders who contributed towards developing this plan. APCRDA is committed to leading by example, implementing the strategies outlined in this plan, and continuing the collaborative efforts to build a climate-resilient, net-zero and inclusive Amaravati for present and future generations.

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The project team wishes to thank officials of APCRDA and all other government departments and stakeholders from the state for their support and contribution to the data collection and successful compilation of the document.

Disclaimer:
This report is based on information extracted from the Master Plan, Zoning Plan, Infrastructure Plans, Detailed Project Reports (DPRs), and other related documents and datasets shared by APCRDA, some of which are currently under revision or being updated. Accordingly, the analyses, inferences, findings, and interpretations presented herein are subject to change in line with future updates to these source documents and the receipt of additional data during the project period. The contents of this report may be revised based on further data sharing and continued consultation with APCRDA and Amaravati Development Corporation Limited (ADCL). No conclusions should be regarded as final until all relevant information has been comprehensively updated, reviewed, and validated.
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List of Abbreviations

ADB	Asian Development Bank
ADCL	Amaravati Development Corporation Limited
AGC	Amaravati Government Complex
AI	Artificial Intelligence
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AP DTCP	Andhra Pradesh Directorate of Town and Country Planning
APCPDCL	Andhra Pradesh Central Power Distribution Company Limited
APCRDA	Andhra Pradesh Capital Region Development Authority
APFC	Automatic Power Factor Correction
APGENCO	Andhra Pradesh Power Generation Corporation Limited
APMRC	Andhra Pradesh Metro Rail Corporation
APPCB	Andhra Pradesh Pollution Control Board
APSECM	Andhra Pradesh State Energy Conservation Mission
APSRTC	Andhra Pradesh Road Transport Corporation
APTRANSCO	Andhra Pradesh Power Transmission Corporation Limited
AQI	Air Quality Index
BAU	Business as Usual
BCC	Behavior Change Communication
BEE	Bureau of Energy Efficiency
BIPV	Building-Integrated Photovoltaics
BLDC	Brushless Direct Current Motor
BMTPC	Building Materials Technology Promotion Council
BoQ	Bill of Quantities
BRT	Bus Rapid Transit
BWG	Bulk Waste Generator
CAPEX	Capital Expenditure
CBI	City Biodiversity Index
CCAP	Climate Change Action Plan
CCC	Command Control Centre
C&D	Construction and Demolition
CNG	Compressed Natural Gas
CPCB	Central Pollution Control Board
CRVA	Climate Risk and Vulnerability Assessment

CSR	Corporate Social Responsibility
D2D	Door-to-Door
DMA	District Metered Area
DPR	Detailed Project Report
EBWGR	Extended Bulk Waste Generator Responsibility
ECBC	Energy Conservation and Building Code
ECSBC	Energy Conservation and Sustainable Building Code
EDGE	Excellence in Design for Greater Efficiencies
EE	Energy Efficiency
EESL	Energy Efficiency Services Limited
EMS	Energy Management System
EPC	Energy Performance Contracting
EPI	Energy Performance Index
EPR	Extended Producer Responsibility
ESCOs	Energy Service Companies
ETM	Electronic Ticketing Machine
EV	Electric Vehicle
FC	Finance Commission
FRS	Facial Recognition System
FSTP	Faecal Sludge Treatment Plant
GEF	Global Environment Facility
GeM	Government e-Marketplace
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
GRIHA	Green Rating for Integrated Habitat Assessment
HVAC	Heating, Ventilation, and Air Conditioning
IEC	Information, Education, and Communication
IGBC	Indian Green Building Council
IIT	Indian Institute of Technology
IMD	Indian Meteorological Department
IPT	Intermediate Public Transport
IT	Information Technology
LBSAP	Local Biodiversity Strategy and Action Plan
LED	Light Emitting Diode

LEED	Leadership in Energy and Environmental Design
LPS	Land Pooling Schemes
LRT	Light Rail Transit
MNRE	Ministry of New and Renewable Energy
MRF	Material Recovery Facilities
MRT	Mass Rapid Transit
MSW	Municipal Solid Waste
NBC	National Building Code
NDC	Nationally Determined Contributions
NFC	Near Field Communication
NGT	National Green Tribunal
NIT	National Institutes of Technology
NMT	Non-Motorized Transport
NREDCAP	New and Renewable Energy Development Corporation of Andhra Pradesh
OPEX	Operational Expenditure
PAYT	Pay As You Throw
PBS	Public Bicycle Sharing
PIBOs	Producers, Importers and Brand Owners
PPP	Public-Private Partnership
PV	Photovoltaic
QR	Quick Response
RCP	Representative Concentration Pathways
RDF	Refuse Derived Fuel
RE	Renewable Energy
REFIT	Renewable Energy Finance and Investment Tool
RESCOs	Renewable Energy Service Companies
RFID	Radio Frequency Identification
RPO	Renewable Purchase Obligation
RWA	Resident Welfare Association
RWH	Rainwater Harvesting
SAC	Swachh Andhra Corporation
SBM	Swachh Bharat Mission
SCADA	Supervisory Control and Data Acquisition
SDGs	Sustainable Development Goals
SHG	Self-Help Group

SOPs	Standard Operating Procedures
SPA	School of Planning and Architecture
STP	Sewage Treatment Plant
TPD	Tonnes Per Day
UDAG	Urban Design and Architectural Guidelines
UDC	Urban Design Committee
UJALA	Unnat Jyoti by Affordable LEDs for All
VFDs	Variable Frequency Drives
WHO	World Health Organization
WtE	Waste to Energy

1 Amaravati's Goals and Strategies for Climate Resilient, Net-zero Development

Amaravati, the planned greenfield capital of Andhra Pradesh, has been proactively steering its development towards becoming a climate-resilient, inclusive and sustainable city from the very outset, recognizing the growing urgency to address climate change and its impacts. The city 's Master Plan and development are being implemented in a phased manner with a plan period of 30 years, from 2028 to 2058. The first phase, until 2028, includes the construction of essential trunk infrastructure, which is currently underway, encompassing road networks, public transportation systems, measures for flood prevention, and wastewater management. These developments are being implemented by integrating innovative, environmentally friendly technologies and design practices. Infrastructure and development will continue thereafter until the interim milestone of 2043, to help accommodate a population of 17.9 lakh people. The full build-out of the city and its infrastructure is expected to be completed by 2058, capable of housing 39.95 lakh inhabitants.

Within this context, the Amaravati Climate Change Action Plan (CCAP) provides a comprehensive, data-driven roadmap to guide the city's development towards a net-zero and climate-resilient future. While Volume 1 of the CCAP presented the analytical foundation, including the Urban system analysis, Climate Risk and Vulnerability Assessment (CRVA), GHG emissions inventory, and future emissions modelling. Volume 2 translates these findings into sectoral strategies, targets and actions for implementation across key sectors such as water, wastewater, stormwater, solid waste, energy and buildings, transport, biodiversity and urban greening, health and air quality. The plan adopts an integrated mitigation and adaptation approach, ensuring that the city not only reduces emissions but also strengthens its resilience to climate risks such as urban flooding, heat stress and other climate risks.

The CCAP has been developed through a collaborative, multi-stakeholder approach involving Andhra Pradesh Capital Region Development Authority (APCRDA), Amaravati Development Corporation Ltd (ADCL), various state departments, research institutions, NGOs and community representatives to ensure inclusivity and local relevance. One-to-one discussions and two rounds of joint stakeholder consultations were held, virtually and in person in September 2025 to integrate stakeholder feedback into the Action Plan.

The implementation of the CCAP will be led by APCRDA, in coordination with ADCL, key line departments and agencies responsible for infrastructure and service delivery. A well-coordinated institutional mechanism is essential to ensure alignment, effective decision making, and smooth implementation, particularly for actions beyond APCRDA's direct purview.

1.1 Climate Vision and Goals

The CCAP includes 37 strategies across 9 sectors to achieve Amaravati's vision of transitioning towards a net-zero emissions future and strengthening the climate resilience of the city's urban systems, stakeholders, and communities. The CCAP is aligned to national climate change commitments and state-level efforts and goals, while also contributing to global initiatives like the Paris Agreement and SDGs.

Vision for a Net-Zero Climate Resilient Future: Amaravati envisions becoming a climate resilient, net-zero and inclusive capital city by 2058, balancing sustainable urban growth with low carbon infrastructure, adoption of renewable energy, climate smart mobility and nature-based solutions. The city seeks to protect communities from climate risks, foster green economic opportunities as well as ensure a livable, equitable and sustainable future for all.

Climate Adaptation Goal: Amaravati aims to develop as a climate-resilient capital city by integrating nature-based solutions, climate-smart urban design, and resilient infrastructure to enhance adaptive capacity against urban flooding, heat stress and extreme weather events, while strengthening ecosystem services, risk-informed spatial planning and institutional preparedness.

GHG Emissions Mitigation Target:

- GHG emissions in 2028: 17.5% lower than projected business-as-usual emissions
- GHG emissions in 2043: 58.8% lower than projected business-as-usual emissions
- GHG emissions in 2058: 80.2% lower than projected business-as-usual emissions

APCRDA shall update its targets in future climate action plan revisions to further minimize its GHG emissions through adoption of emerging technologies and additional strategies to advance towards net-zero emissions by 2058.

Wider Benefits of Climate Action Plan

The CCAP recognizes that while addressing GHG emissions and climate risks is essential, targeted climate actions integrated into the city's ongoing development can unlock multiple co-benefits for people, environment and economy. As a greenfield capital city, Amaravati has the unique opportunity to embed low-carbon, resource-efficient, and climate-resilient principles into its planning, design, and infrastructure from the very beginning, ensuring long-term sustainability and livability.

Many of the interventions outlined in the CCAP have been strategically prioritized to align with Amaravati's phased development plan and contribute to the sustainable development goals (SDGs). The recommended actions across key sectors such as energy-efficient buildings, sustainable mobility, integrated water and wastewater management, solid waste management, and biodiversity are designed to conserve resources, improve air quality, enhance resilience to flooding and heat stress, and foster a healthier and safer urban environment.

The successful implementation of the action plan will bring significant socio-economic benefits, drive innovation and the adoption of clean technologies, while enhancing energy and water security. Approximately 40,500 green jobs are expected generate through adoption of renewable energy, clean technologies and green mobility solutions. Encouraging citizen participation through initiatives such as energy-efficient practices, waste segregation adoption of sustainable mobility options, will play a vital role in shaping Amaravati's transition into a climate-resilient and sustainable capital city. As a developing greenfield city, active public engagement from the outset will foster a sense of shared ownership and

environmental responsibility, ensuring that sustainability becomes an integral part of the city's lifestyle and governance.

By embedding these benefits into its strategies from the planning stage, Amaravati is setting a foundation for climate-resilient and low-carbon urban development that enhances quality of life, promotes equitable economic growth and fosters social inclusion. This integrated approach ensures that the city's transition aligns with its long-term vision and contributes to achieving the SDGs outlined below through the CCAP.

1.2 Overview of Sectoral Climate Targets and Strategies

Amaravati aspires to become a people's capital with sustainable, modern and inclusive urban infrastructure. This requires well-informed design, planning and implementation of policies and projects, while keeping environmental performance and livability at the center and maintaining ecological balance to promote sustainable and harmonized lifestyle.

To realise this vision, Amaravati's climate change action plan includes climate strategies across nine sectors to help reduce its GHG emission footprint and advance to net-zero emissions, while simultaneously ensuring climate-proofing and readiness to climate change impacts. The sectoral strategies have actions further delineated along with targets.

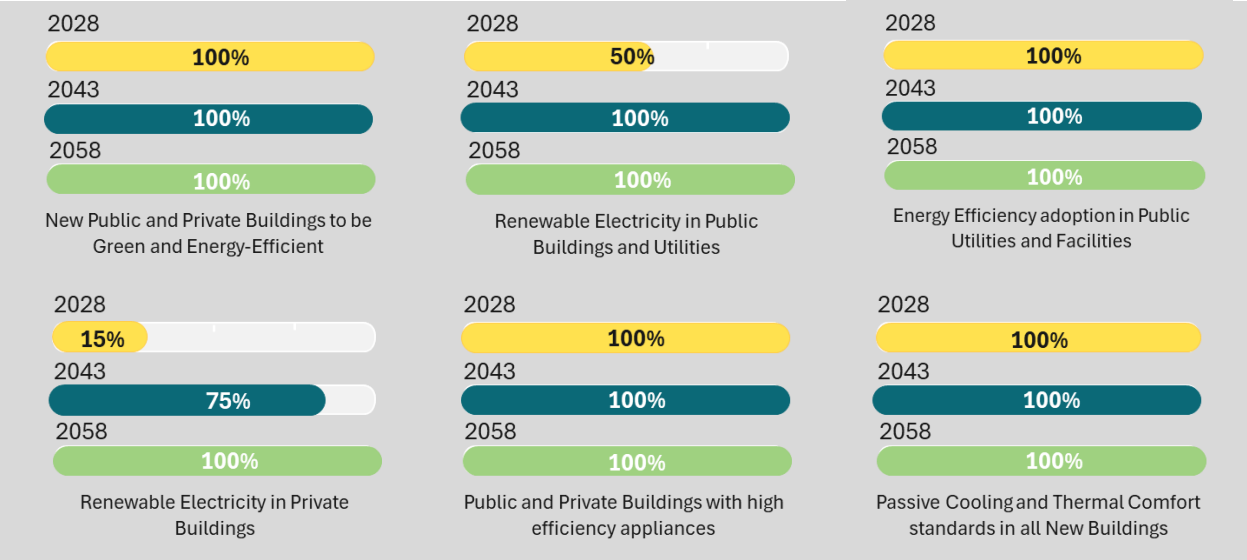
Climate mitigation strategies and actions are identified to reduce or prevent the emission GHGs into the atmosphere from conventional energy use and sources such as waste and wastewater management. **Climate adaptation** strategies and actions to help protect and adjust systems, infrastructure and communities to the actual or expected impacts of climate change, aiming to reduce their vulnerability and enhance climate resilience are outlined for each sector as well. **Quantifiable targets** for high-impact actions have been identified across sectors to reflect the city's ambition and help steer appropriate level of action. Phase-wise targets are delineated over Amaravati's planning horizon of 2028 to 2058, with 2043 as an interim milestone as per the city's planned build-out.

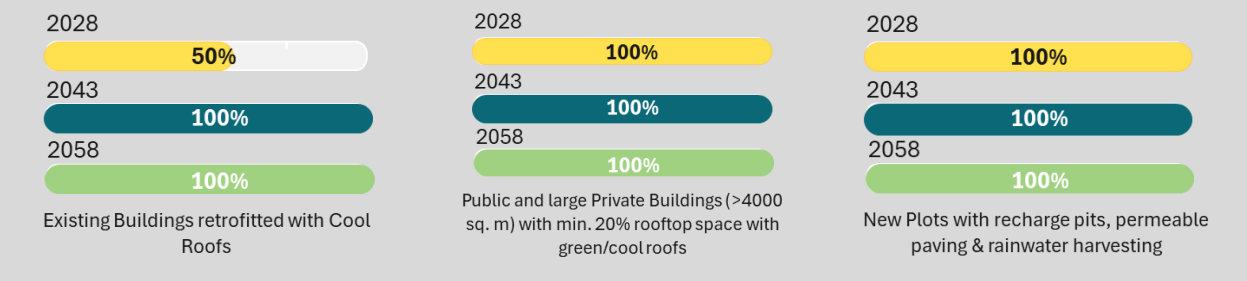
The strategies, actions and targets have been determined based on proposed plans and measures outlined in Amaravati's planning and infrastructure documents, while supporting achievement of sectoral goals and implementation of envisaged sustainable and climate-oriented interventions. Goals and targets of national and state policies, programmes, and missions have been considered for alignment and to enable ambitious and practical target setting.

The following section provides an overview snapshot of Amaravati's climate strategies and key targets across the nine sectors to help realize Amaravati's vision and its overarching climate goals and targets. Detailed information on each of the sectoral strategies and actions along with implementation details can be found in section 2.

1.2.1 Energy and Buildings

Key Climate Targets

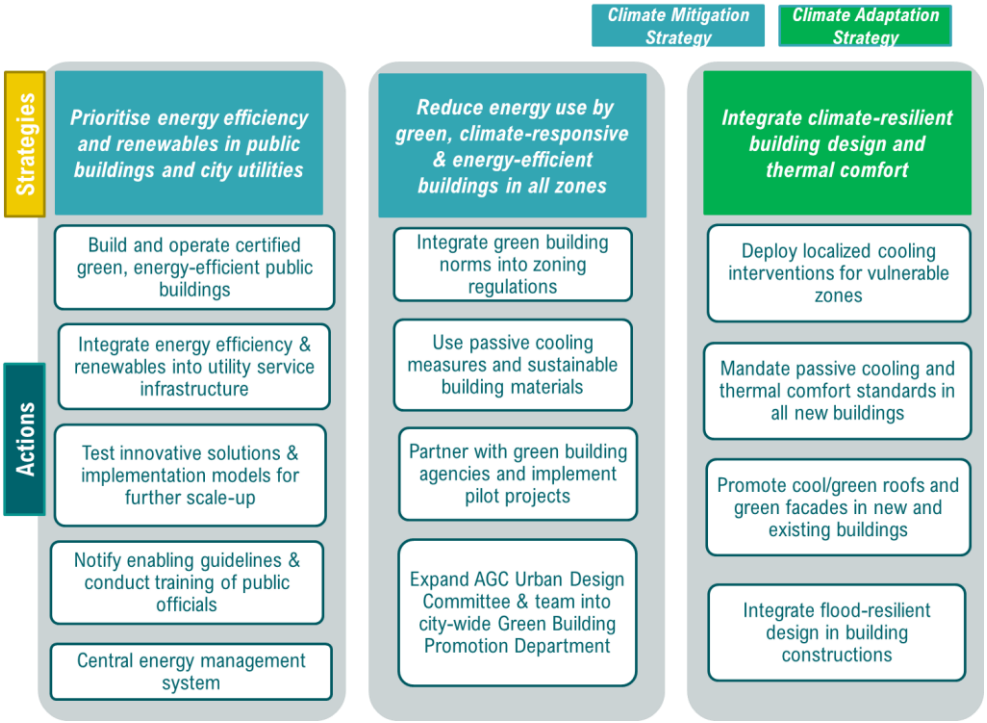




Amaravati aims to become a fully renewable-powered city by 2058, with 100% of electricity for buildings and infrastructure met through green energy. Its strategy prioritizes reducing energy demand first, followed by renewable integration. This will require large-scale adoption of climate-responsive, energy-efficient building designs, high-energy performance appliances, and sustainable construction practices.

The public sector will need to take the lead initially, ensuring all government buildings are designed and operated sustainably. Both on-site and off-site renewable solutions will be scaled up to power buildings, while urban services and utilities integrate efficiency and clean energy from the outset through procurement and planning. Achieving this vision will demand strong coordination between state agencies, urban planners, and power sector institutions.

City-wide deployment of energy efficiency and renewables will lower overall energy use and GHG emissions. Complementary measures such as urban cooling, green and cool roofs, rainwater harvesting, flood-resilient designs, and regulated development will improve thermal comfort, enhance resilience to heat stress and flooding. Together, these Energy and Buildings sector strategies and actions will support Amaravati to become an energy-smart, renewable-powered and climate-responsive capital city.



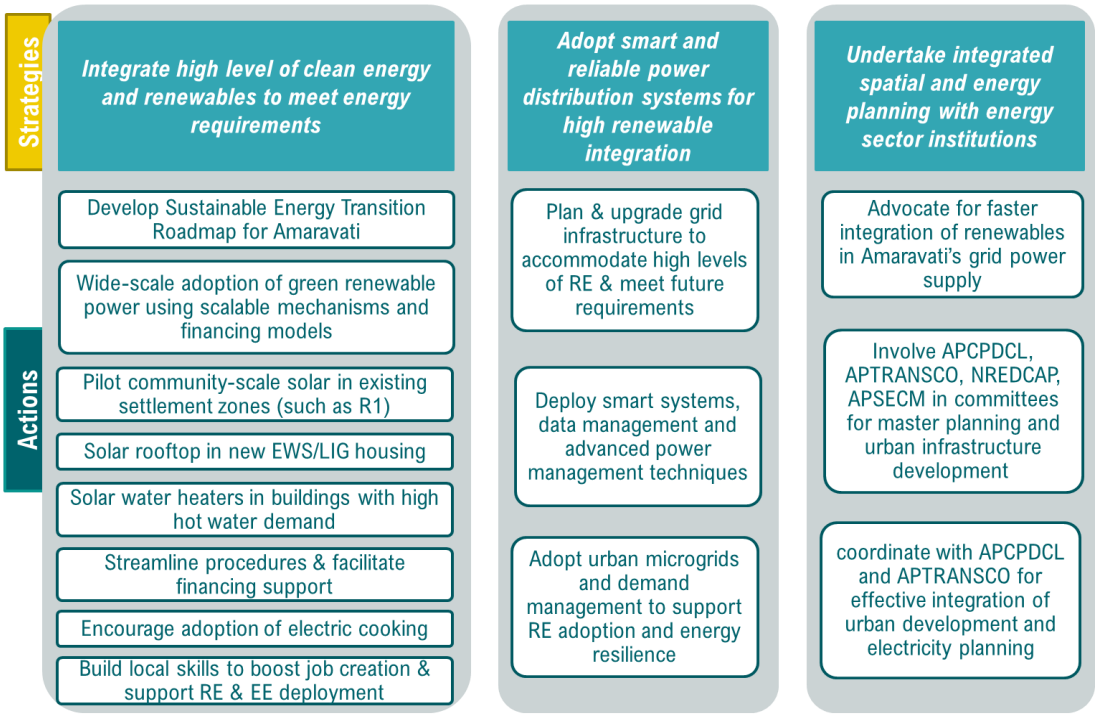


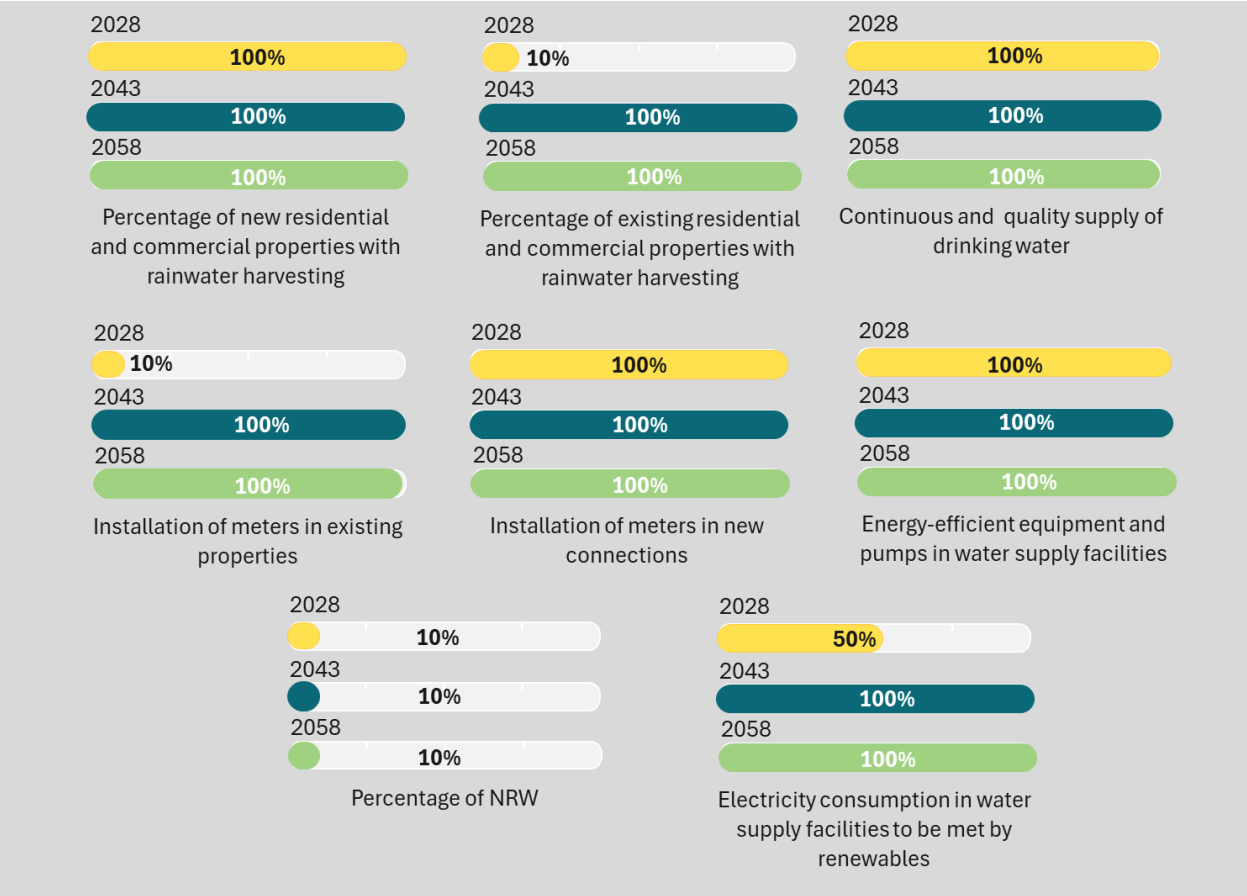
Figure 1-1: Climate Mitigation and Adaptation Strategies for Energy and Buildings

Strengthened resilience to climate hazards: Heat stress, urban flood

Good Practices	
Singapore - Large-scale adoption of green and energy efficient buildings through targeted policy schemes and incentives	Melbourne - Joint large-scale renewable procurement by large energy users from wind-farms. 100% renewable-based municipal operations
Vijayawada - Technical guidelines with passive and active measures for heat-resilient and sustainably cooled buildings, adoptable in Amaravati	Ahmedabad and Surat - Significant renewable energy adoption in municipal operations (city service utilities, municipal buildings)
London – Program to aggregate and implement energy efficiency and renewable energy projects in multiple public buildings through third-party ESCOs	Vancouver - 100% renewable energy use target by 2050 supported by Renewable City Strategy document
Palo Alto and London - Requirements to salvage and reuse building components and materials at end-of-life through planning/permits	New Delhi – Facilitation of rooftop solar adoption by consumers through single point web portal. Battery energy storage installed at substation for power quality, reliability, network decongestion

1.2.2 Water Supply

Key Climate Targets



Amaravati, as a pioneering greenfield capital city, possesses the unique advantage of establishing a circular and climate-resilient water infrastructure from the outset. The city's strategy approach centers on developing a diversified water portfolio that integrates multiple sustainable sources, including tertiary treated wastewater recycling, systematic rainwater harvesting across all buildings, and managed groundwater recharge systems. This multi-source strategy significantly reduces dependence on conventional freshwater supplies while building redundancy against climate-induced supply disruptions.

The implementation of mandatory water-efficient fixtures throughout residential, commercial, and institutional buildings, coupled with dual plumbing systems that separate potable and non-potable water distribution, will substantially reduce overall freshwater consumption. A state-of-the-art smart metering and monitoring network will ensure a continuous, 24/7 water supply while detecting and minimizing distribution losses through real-time leak detection and pressure management systems.

Net zero is central to this vision, with the entire water supply infrastructure powered by renewable energy sources, including solar and wind installations, creating an operationally carbon-neutral and financially self-sustaining system. Concurrently, robust environmental protection measures safeguard the Krishna River

ecosystem, preserve urban water bodies, and maintain aquifer integrity through strict wastewater discharge standards, comprehensive wetland conservation programs, and strategic groundwater recharge initiatives, ensuring long-term water security during the city expansion. The water supply sectoral strategies and actions will make Amaravati a water-secure, climate-resilient, and inclusive capital, ensuring equitable access to safe drinking water while protecting the Krishna River ecosystem and its underlying aquifers.

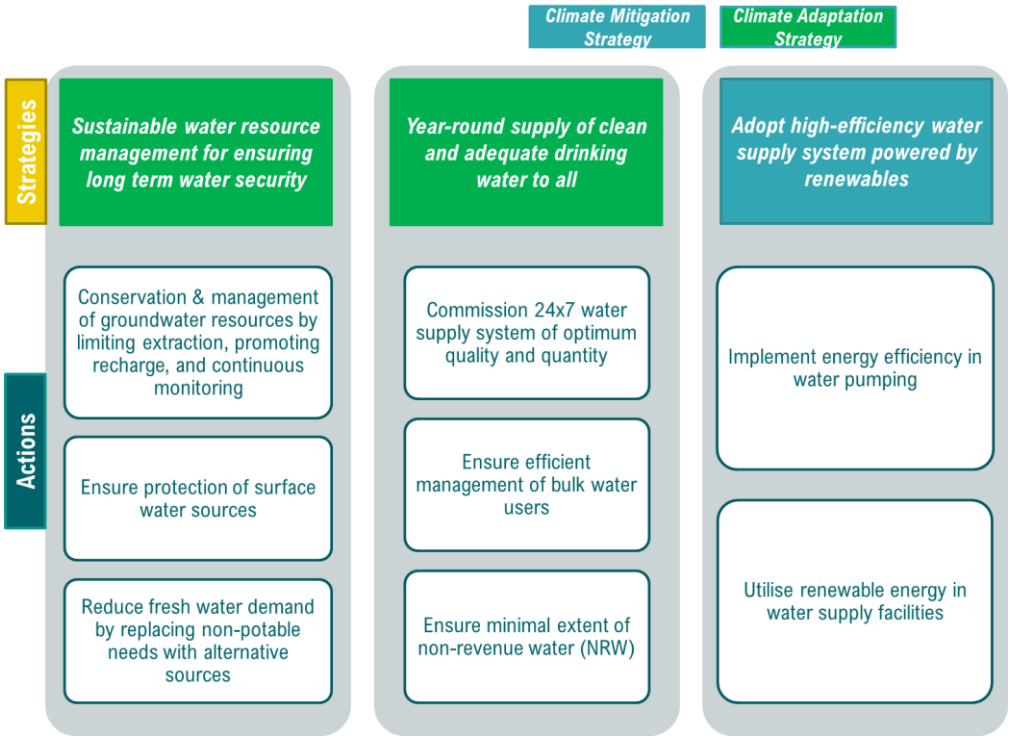


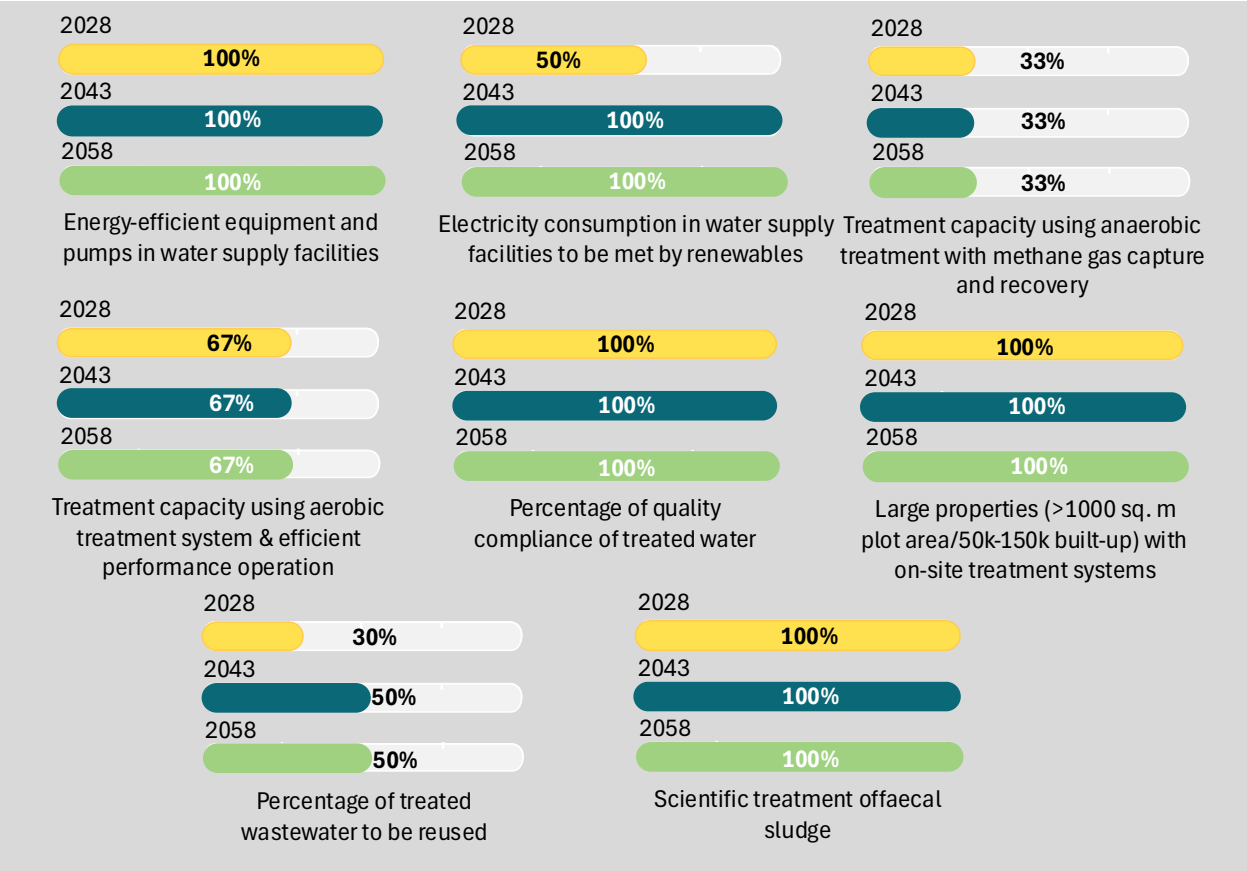
Figure 1-2: Climate Mitigation and Adaptation Strategies for Water Supply

Strengthened resilience to climate hazards: Heat stress, urban flood

Good Practices	
Shimla – Multiple water sources to meet growing water demand from rapid urbanisation and achieve resilience and flexibility.	Jerusalem - Installation of rooftop rainwater collection in schools for non-potable uses.
Austin – Mandate large-scale commercial and residential buildings to incorporate dual plumbing systems for non-potable reuse water.	Seosan – Establishment of District Metered Areas (DMAs) equipped with advanced smart water meters to monitor consumption and minimize non-revenue water losses
Brazil – Enhancing Energy Efficiency in Water Distribution through Automation and High-Efficiency Equipment	Adelaide – Installation of moveable solar PV to reduce energy savings and emissions in water supply systems

1.2.3 Wastewater Management

Key Climate Targets



Amaravati is advancing towards a climate-resilient and circular wastewater management system that emphasizes efficiency, safety and sustainability across collection, treatment and reuse. A city-wide sewer network will prevent contamination during flooding, guided by geo-hydrological planning, SCADA enables monitoring and an automated cleaning system to ensure reliability and timely maintenance.

Treatment plants will incorporate low-carbon and innovative solutions such as anaerobic digestion, methane recovery, and renewable energy integration to reduce emissions and enhance energy efficiency. In parallel, decentralized wastewater systems will serve large developments. The mandated reuse of treated wastewater for construction, landscaping, and district cooling, while faecal sludge will be processed scientifically through FSTPs or co-treatment facilities. Together, these interventions will make Amaravati a zero-discharge, low-emission and water secure city, resilient to future climate challenges.

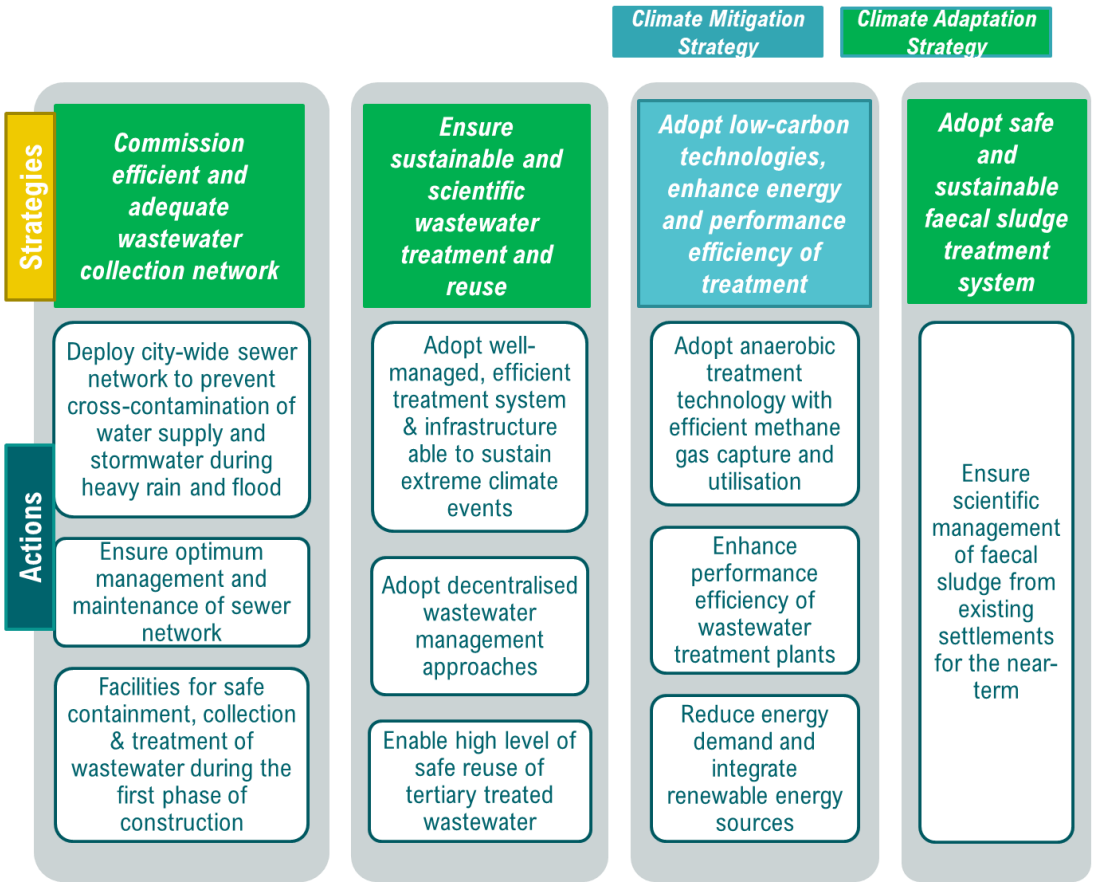


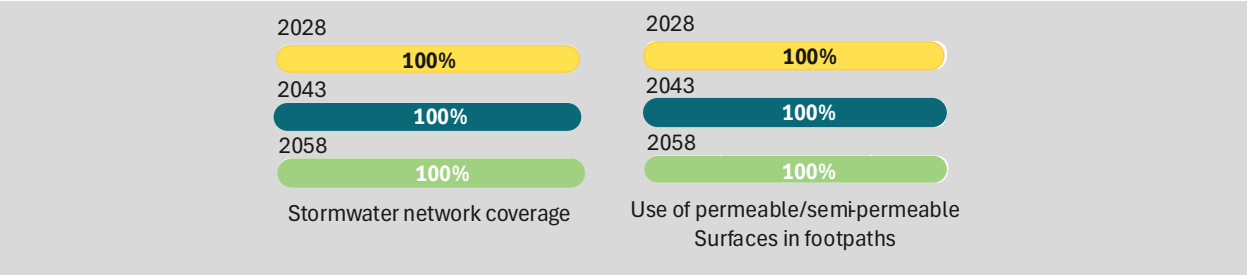
Figure 1-3: Climate Mitigation and Adaptation Strategies for Wastewater Management

Strengthened resilience to climate hazards: Urban flood

Good Practices	
Madurai – HomoSEP robotic cleaning system mechanized manhole maintenance, eliminating manual entry and improving efficiency.	Banka (Bihar) – BioLoo bio-digester toilets treat waste onsite, producing pathogen-free water and biogas for reuse.
Pune – Double-storey 20 MLD SBR STP optimized land use and ensured flood-resilient wastewater treatment.	Singapore – NEWater initiative treats wastewater via microfiltration, RO, UV to supply 40% national demand.
Surat – Treated wastewater from four tertiary treatment plants reused for industry, lakes, and greening.	California (Riverbank) – SCADA-integrated wastewater plant achieved 75% energy savings through automation and fine-bubble diffusers.
hennai – Anaerobic sludge digestion across seven STPs generates biogas for power, reducing operational emissions.	Maharashtra – Co-treatment of faecal sludge in existing STPs improved efficiency, reduced costs, and ensured sustainability.

1.2.4 Stormwater Management

Key Climate Targets



Amaravati is situated on the banks of the River Krishna, upstream of the Prakasam Barrage, and within the catchment areas of the Kondaveeti Vagu and Pala Vagu. The Pala Vagu joins with the Kondaveeti Vagu at Krishnayapalem, which ultimately flows into the Krishna River at Undavalli. With planned urbanisation of Amaravati, it is expected that rainfall runoff will increase, potentially surpassing the existing capacity of these vagus and compromising the city's resilience. Measures are planned to manage a rare, one-in-a-hundred-year rainfall event. These include increasing the capacity of both the Kondaveeti Vagu and Pala Vagu, constructing five reservoirs in the Kondaveeti Vagu catchment (three of which will be within Amaravati), upgrading the pumping capacity at Undavalli, and constructing a new pumping station at Vykuntapuram. Moreover, a gravity diversion channel from the Lam Reservoir is proposed to redirect runoff from upstream areas to the Vykuntapuram pumping station. An underground stormwater drainage network is also planned across the city to channel runoff into the Kondaveeti vagu and Pala vagu at various locations vagus.

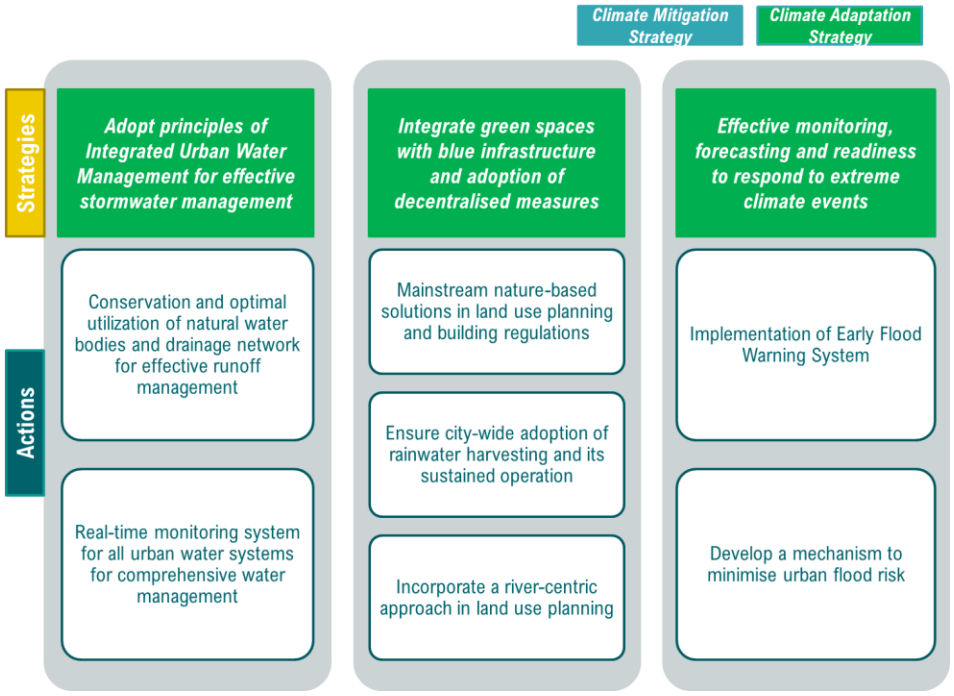


Figure 1-4: Climate Mitigation and Adaptation Strategies for Stormwater Management

Strengthened resilience to climate hazards: Urban flood, Cyclone, Heat stress

Good Practices	
Chennai, India – Sponge parks capture rainwater runoff, enabling infiltration and groundwater recharge in urban areas.	Johannesburg, South Africa – Canal rehabilitation using eco-engineering for 100-year flood protection and erosion control
Kochi, India – Canal rejuvenation through desilting, widening, and culvert reconstruction to enhance flood resilience.	Vancouver, Canada – Raincity Strategy manages rainwater via green infrastructure to capture 90% annual rainfall.
Amsterdam, Netherlands – Waternet integrates the entire urban water cycle for sustainable and efficient management	Canada (RainGrid) – Smartgrid stormwater system harvests rooftop runoff, reducing discharge and providing reuse opportunities.
Kanpur, India – Urban River Plan protects Ganga and Pandu riverfronts through no-development buffer zones.	Semarang, Indonesia – Community-based flood warning system builds local preparedness and early-response capacity.

1.2.5 Solid Waste Management

Key Climate Targets

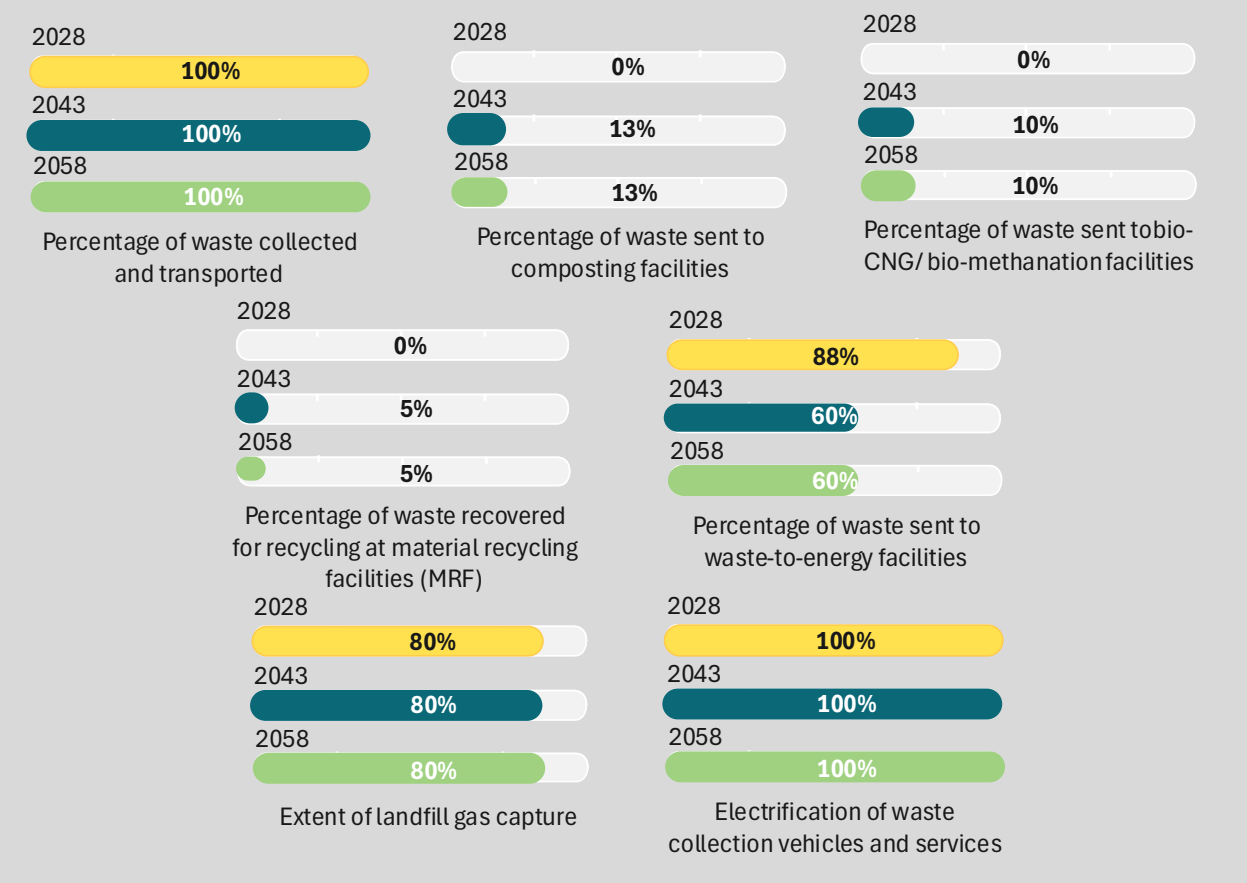


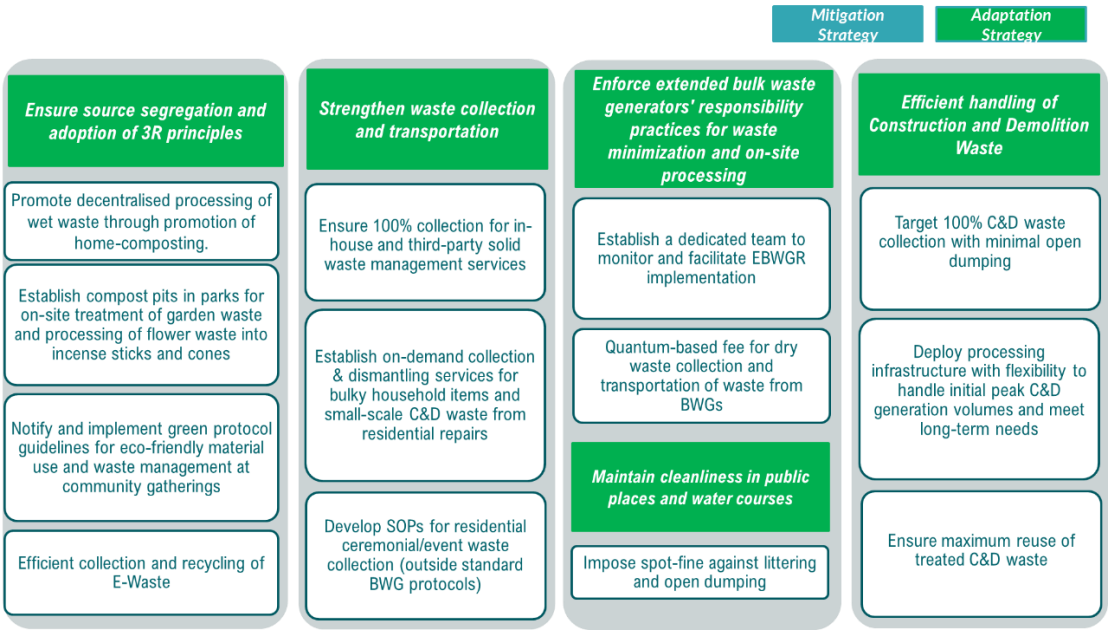
Table 1-1: Waste Processing Targets

Waste Type	Processing or disposal solution	2028		2043		2058	
		TPD	Share	TPD	Share	TPD	Share
Dry Waste	Waste to Energy	462	88%	998	60%	2,354	60%
	Waste to Recycling	-	-	89	5%	210	5%
Wet Waste	Composting	-	-	212	13%	500	13%
	Biomethanation / Bio-CNG	-	-	170	10%	400	10%
Inerts	Sanitary Landfill	66	12%	208	12%	491	12%

**TPD – tonnes per day*

Amaravati, as a new greenfield capital city, aims to build a climate-friendly and circular solid waste management system from the outset. City's approach prioritises waste prevention and source reduction through extensive household and community-level composting programs, localized processing of garden and horticultural waste via neighborhood composting treatment units, and IEC campaigns promoting zero-waste behaviours, proper segregation practices, and community ownership.

The city will achieve 100% door-to-door segregated waste collection by capturing all waste streams through optimized routing systems and dedicated collection schedules for different waste categories. Additionally, transport to various treatment methods will be employed for other types of waste. Robust compliance and monitoring mechanisms will include quantum-based user fees that incentivize waste reduction, real-time digital tracking systems for collection vehicles and waste flows, and immediate spot fines for violations. The entire waste management value chain will be decarbonized through electric collection fleets, renewable energy integration across all treatment facilities, GPS-enabled route optimization, and data-driven operational efficiency improvements that minimize fuel consumption and GHG emissions. Advanced recycling, Bio-CNG production, and scientific landfills with methane capture will help reduce emissions, positioning Amaravati as a national exemplar of circular economy principles in waste management.



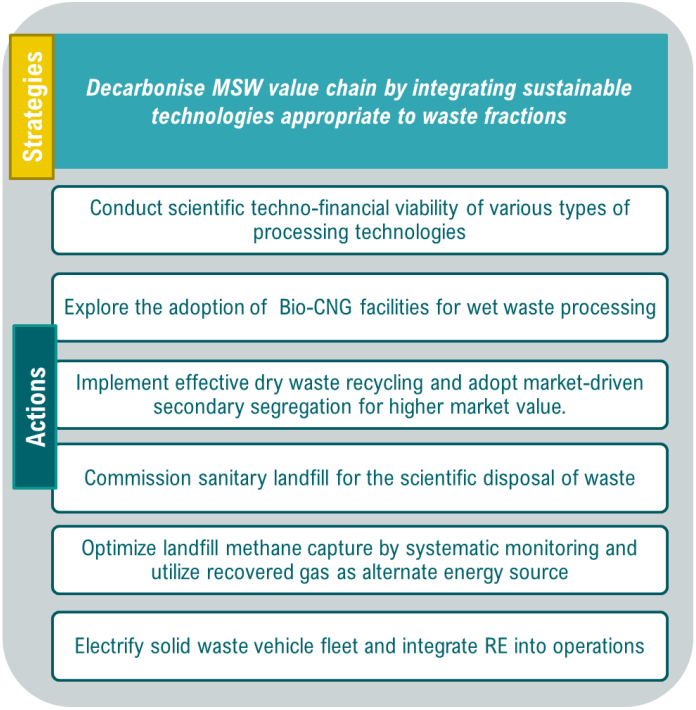


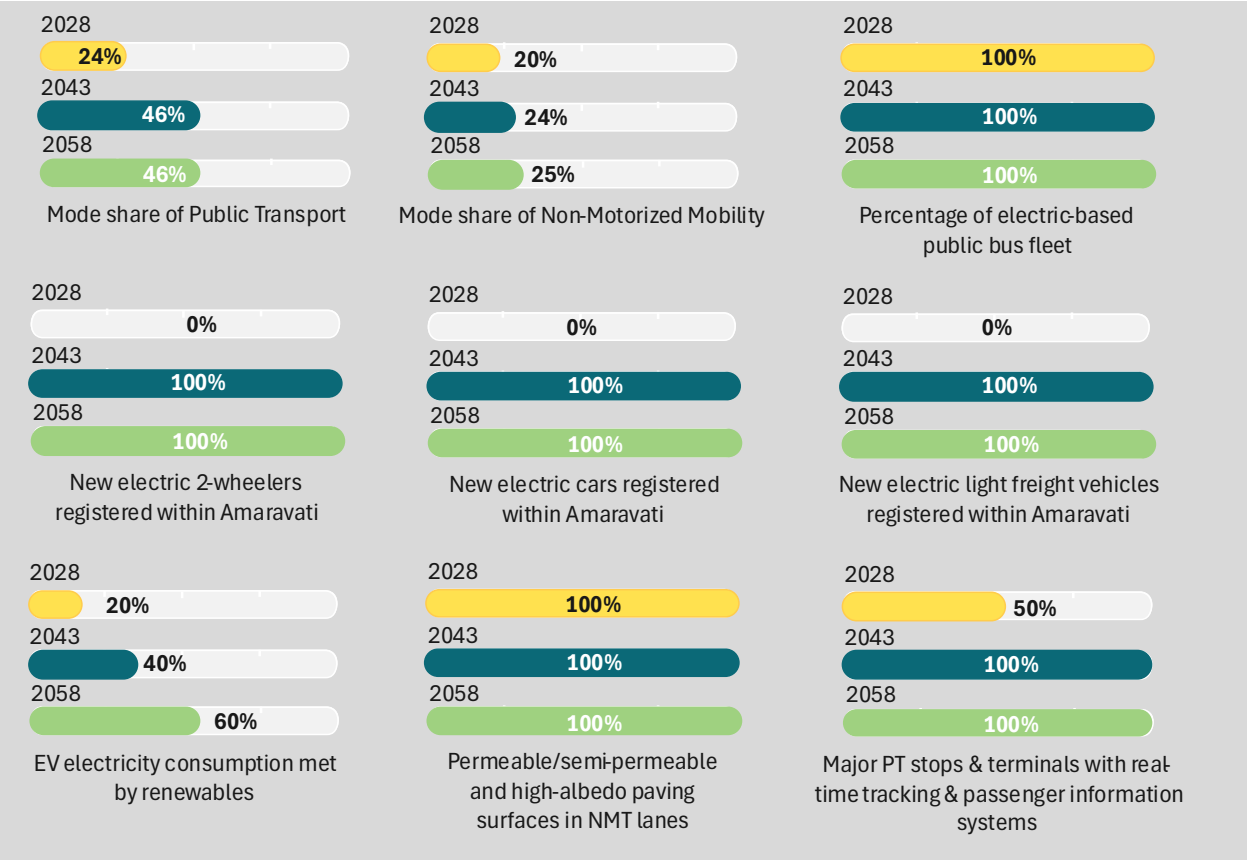
Figure 1-5: Climate Mitigation and Adaptation Strategies for Solid Waste Management

Strengthened resilience to climate hazards: Urban flood and cyclone

Good Practices	
San Francisco –Mandated the residents and businesses to collect waste using three bins through the Recycling & Composting Ordinance enacted in 2009.	Tirupati - Processes 6 TPD of floral waste into agarbattis with plantable packaging and employs 150 SHG Women.
Trichy – Promote source segregation by launching the Students@Clean contest in schools. School-led IEC drives increased segregation from 70% to 100% and reduced waste sent to landfill.	Switzerland – Introduction of a robust national e-waste system under EPR, funded by an upfront recycling fee on electronic purchases, with SWICO and SENS coordinating collection and recycling.
Vijayawada – Deployment of QR-coded RFID tags to track waste pickup, smart bins for monitoring, and GPS-equipped vehicles for optimized routes, ensuring effective door-to-door collection.	Texas – Installation of methane gas detectors at landfill linked to a central data system for continuous emissions tracking, improving methane capture efficiency and ensuring regulatory compliance.

1.2.6 Transportation

Key Climate Targets



Amaravati envisions developing a climate-smart, low-emission, and integrated urban transport system that promotes clean mobility, accessibility, and resilience. The transport strategy focuses on building an efficient public transit network, expanding non-motorized mobility, accelerating the transition to electric vehicles, and ensuring climate-resilient infrastructure and governance to support sustainable urban growth.

The city will prioritize the deployment of a city-wide electric public bus system, supported by multimodal integration across BTT, metro, and feeder networks. Infrastructure will be designed with universal accessibility, real-time monitoring, and energy-efficient technologies. Continuous cycle tracks, shaded walkways, and public bicycle sharing systems will promote active, safe and inclusive mobility.

Amaravati will lead the transition towards electric and low-carbon transport by mandating EV adoption for government fleets, developing renewable-powered charging infrastructure, and piloting low-emission freight and logistics corridors. Roads, depots and terminals will incorporate climate-resilient, nature-based designs to withstand heat and flooding. Together, these strategies will reduce GHG emissions, enhance connectivity, and create a seamless, inclusive and resilient transport ecosystem.

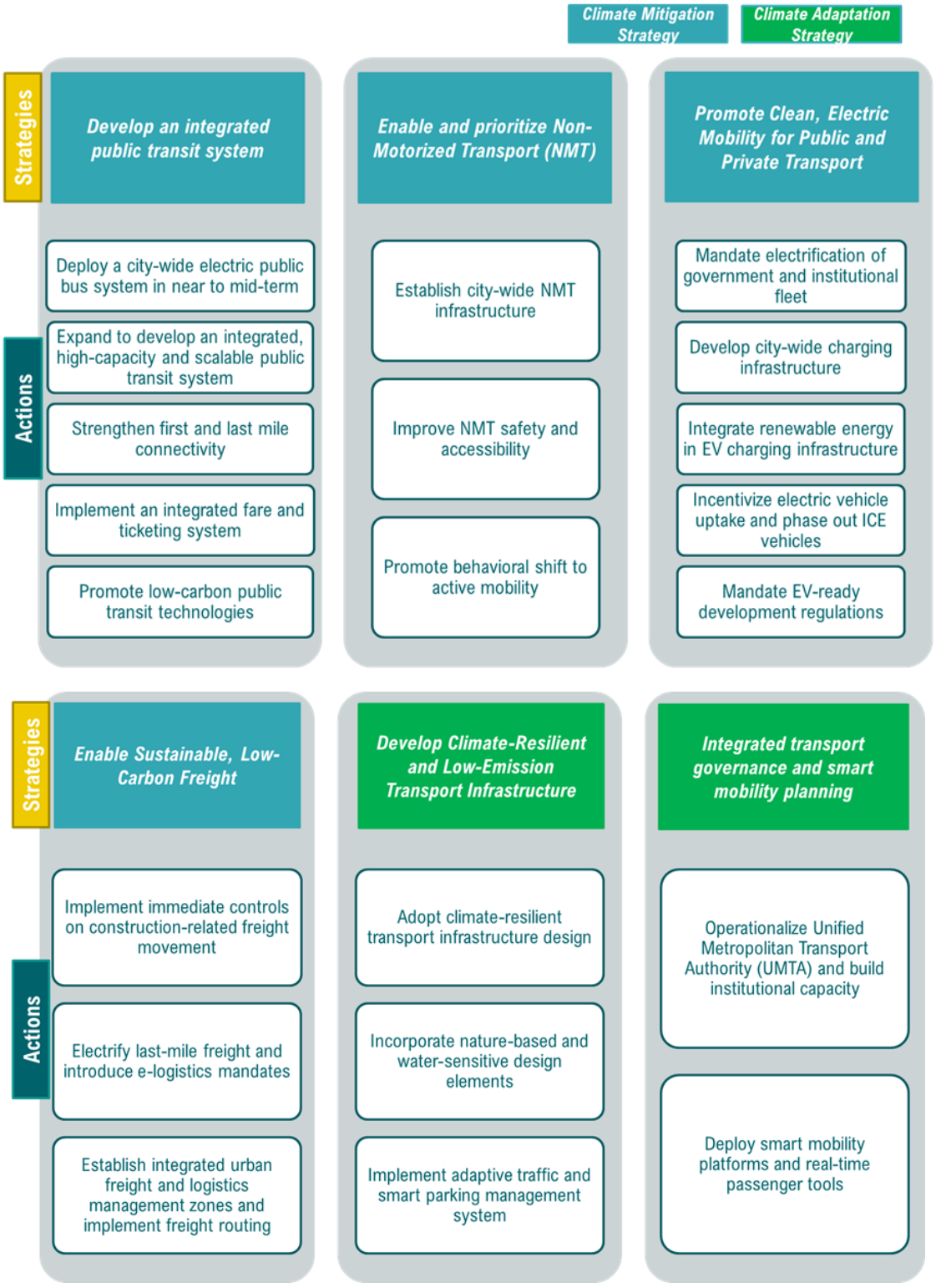


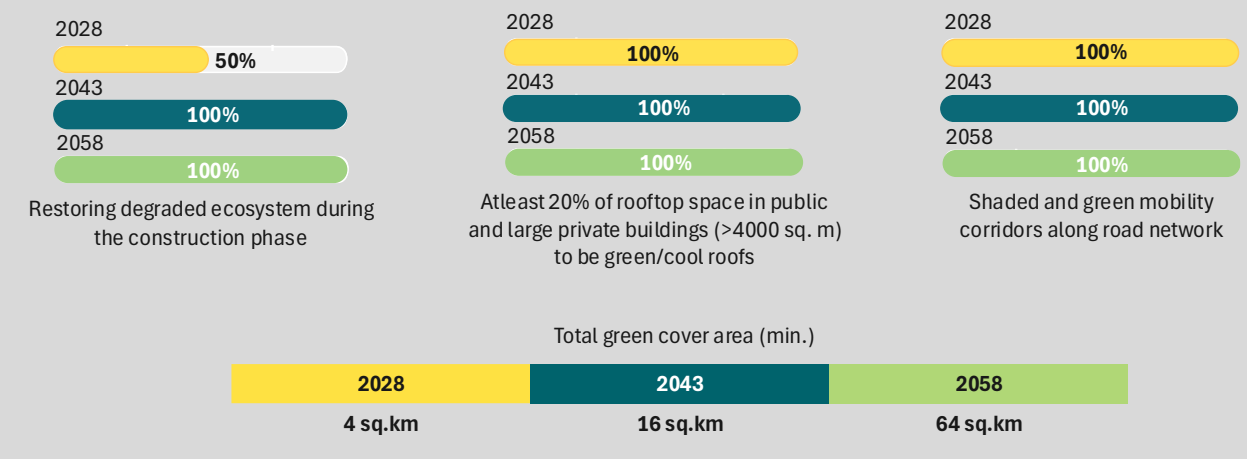
Figure 1-6: Climate Mitigation and Adaptation Strategies for Transportation

Strengthened resilience to climate hazards: Heat stress, urban flood

Good Practices	
Pune – Scaled e-buses with dedicated depots, solar shelters, centralized operations improved reliability. Adopted data-driven Comprehensive Mobility Plan using modelling and GIS for BRT, Metro expansion	Singapore – Implemented Walk-Cycle-Ride strategy integrating cycling paths, pedestrian zones, and shared mobility apps.
Ahmedabad – On-route solar-powered charging pilot reduced dead-kilometres, saved costs and GHG emissions.	Amsterdam – Deployed 3,000 smart chargers powered by renewables with real-time demand management system.
Bhopal – Automated PBS integrated with BRT smart card; seamless first- and last-mile connectivity.	Beijing – Low-Emission Zone restricted high-polluting freight vehicles, improving air quality and health outcomes.
Kochi – Introduced Kochi1 smart card integrating metro, buses, and ferries under a PPP model.	Delhi - Charging/Swapping Infrastructure Action Plan 2022-25 mandates installing EV charging and battery-swapping stations citywide, with 20% of parking in new buildings and 5% of existing parking spaces across agencies required to be EV-ready.
Nagpur – Piloted AI-based adaptive traffic signals, ANPR detection and smart traffic command centre.	Seoul – Operates centralized real-time platform integrating transit cards and sensors for live route management.

1.2.7 Biodiversity and Urban Greening

Key Climate Targets



Amaravati's comprehensive Urban greening and biodiversity strategies and actions will play a vital role in mitigating urban heat and flood risks by enhancing the city's ecological resilience while simultaneously addressing climate vulnerabilities through nature-based solutions. The strategic preservation and restoration of natural water bodies, combined with the systematic integration of blue-green infrastructure throughout the urban fabric, will significantly enhance the city's capacity for rainwater infiltration, groundwater

recharge, and surface runoff management, thereby reducing downstream flood pressures during intense precipitation events.

Large-scale afforestation programs that encourage indigenous species selection, establish native forest clusters to maintain ecological connectivity, and develop extensive green mobility corridors will substantially expand urban tree canopy coverage across residential, commercial, and institutional areas. These interventions will directly counteract urban heat island effects through evapotranspiration, provide essential shade cover for pedestrians and public spaces, improve ambient air quality through carbon sequestration and pollutant filtration, and create wildlife habitats that support urban biodiversity conservation goals. Green roofs, facades and urban agriculture will integrate nature into the built environment, enhancing cooling and stormwater retention.

These climate actions will help Amaravati city tackle heat stress through an extensive tree canopy that provides cooling through evapotranspiration and shade while reducing ambient temperatures, and address flooding by creating natural retention systems, permeable surfaces, and enhanced infiltration capacity that absorbs and slowly releases stormwater, preventing overwhelmed drainage systems during extreme rainfall events.

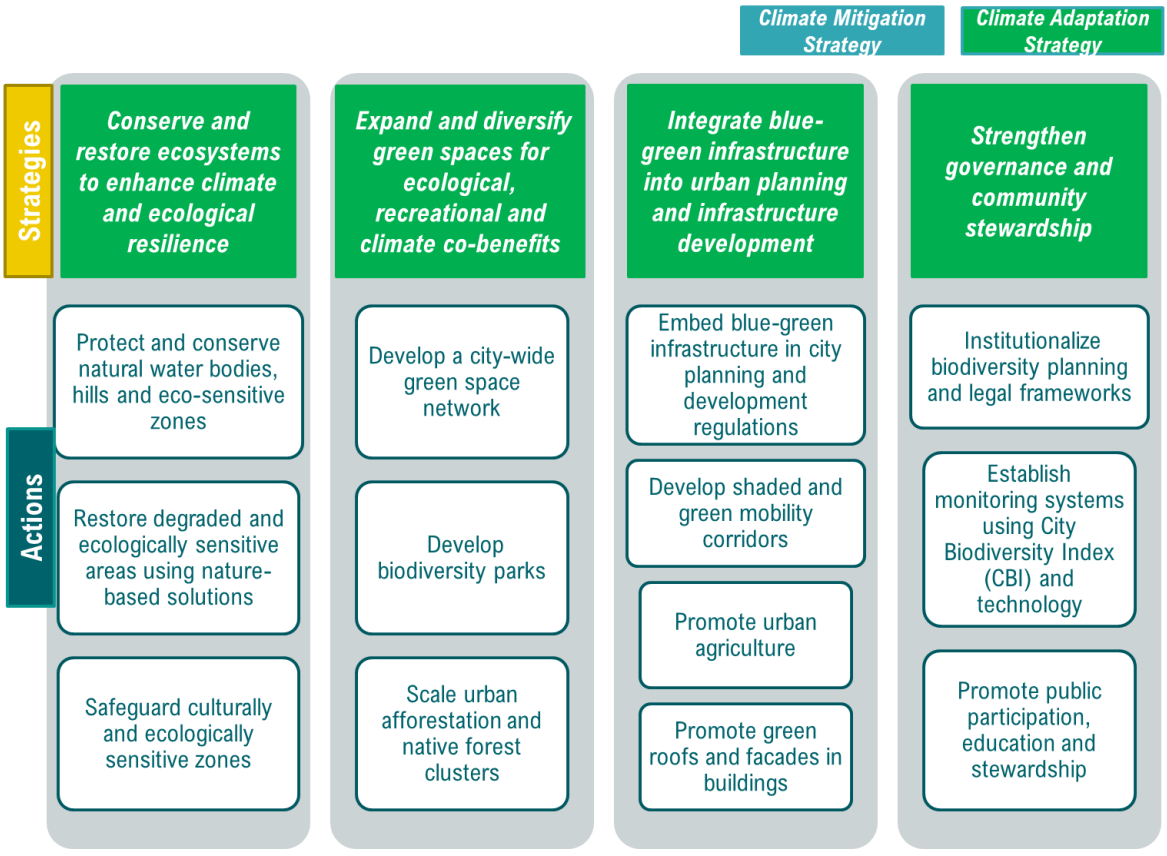


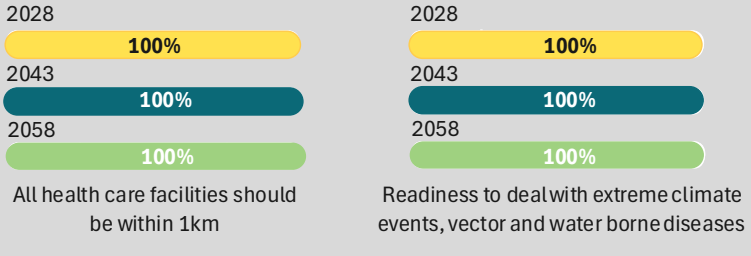
Figure 1-7: Climate Mitigation and Adaptation Strategies for Biodiversity and Urban Greening

Strengthened resilience to climate hazards: Heat stress, urban flood

Good Practices	
Hyderabad – Neknampur Lake was revived by Dhruvansh organisation through biodiversity restoration, water retention measures, and community recreation, using phytoremediation, floating treatment wetlands, desilting, and garbage removal.	Tennessee - A stretch of the French Broad River suffered severe flood-induced bank erosion during bridge construction, threatening the bridge and nearby railroad. To stabilize the slope, a vegetative riprap system is installed to reinforce the stream bank
Baltimore – Uses GIS and satellite imagery to manage its urban forest, inventorying over 1.2 lakh trees, stumps, and sites into TreeKeeper and updating canopy maps to target planting and maintenance; with i-Tree Streets, the city estimates $9.3 million in annual benefits from energy savings, stormwater control, and cleaner air, guiding canopy expansion and long-term forest health.	Chennai – Adyar Eco Park is a 358-acre restored wetland along the Adyar estuary, which reintroduces mangroves, mudflats, marshes, and tropical dry evergreen forest with 172 native species to store carbon and keep places cooler through shade and evapotranspiration.
Prayagraj – Prayagraj Municipal Corporation created dense Miyawaki forests across 55,800 sq m for Mahakumbh 2025, planting 1.2 lakh trees with 63 species in Naini and 27,000 trees with 27 species at Baswar after clearing a dump. These fast-growing groves can lower temperatures by 4–7°C, enhance biodiversity, and accelerate environmental restoration.	Toronto – LEAF organisation runs an Adopt-A-Street-Tree program that engages residents and businesses in post-planting care, improving street-tree survival through community monitoring and maintenance. LEAF handles planting and education, while community adopters handle tasks such as watering, weeding, removing litter, and tracking tree health.
Kochi – The city has developed a baseline City Biodiversity Index (CBI) in 2020, scoring 45/72 across 18 indicators. The index has highlighted the need to protect biodiversity, expand green cover, and strengthen governance, with projects and budgets aligned to LBSAP via the CBI monitoring tool.	Tokyo - Mandates green roofs on private buildings over 1,000 m² and public buildings over 250 m², with at least 20% of the rooftop area greened. This helps the city to lower ambient temperatures, reduce building energy demand, retain stormwater to reduce flooding, improve air quality and biodiversity.

1.2.8 Health

Key Climate Targets



Amaravati aims to strengthen its health systems to withstand climate hazards such as heatwaves, floods and disease outbreaks while building long-term resilience and institutional capacity. The strategy focuses on improving accessibility, preparedness and adaptive capacity of healthcare services for all communities, particularly the urban poor, elderly, women and children. Key actions include ensuring universal access to health centres, implementing a citywide Heat Action Plan, and integrating climate risk and disease surveillance into health sector planning. Public health infrastructure will be upgraded with cool roofs, renewable power, flood-resilient designs, and mobile health units to ensure service continuity during emergencies. Amaravati also prioritizes capacity building for health professionals, community awareness and real-time monitoring through a climate health dashboard and early warning systems. Together, these measures will safeguard public health and ensure a climate-resilient, inclusive and responsive healthcare system.

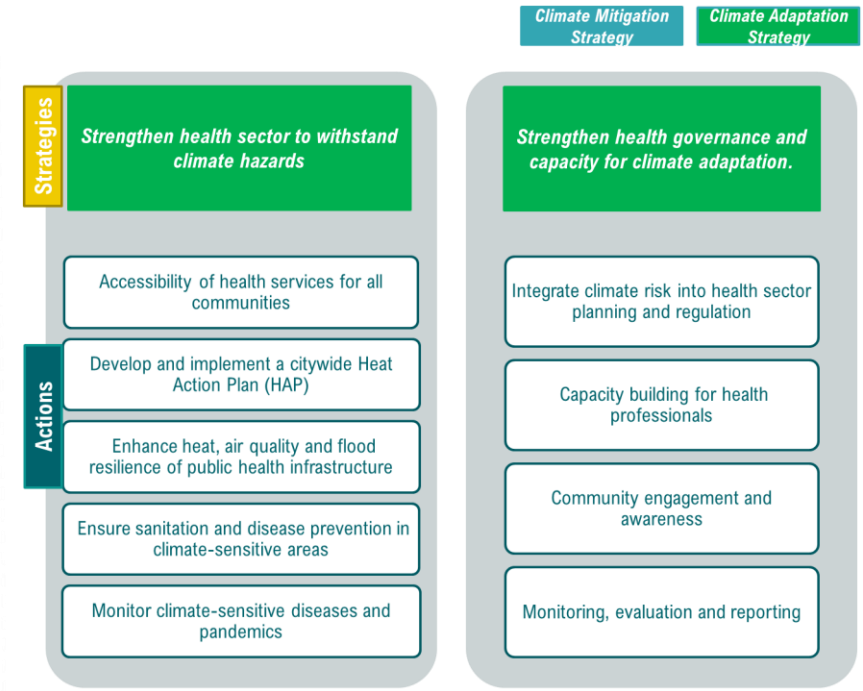


Figure 1-8: Climate Mitigation and Adaptation Strategies for Health

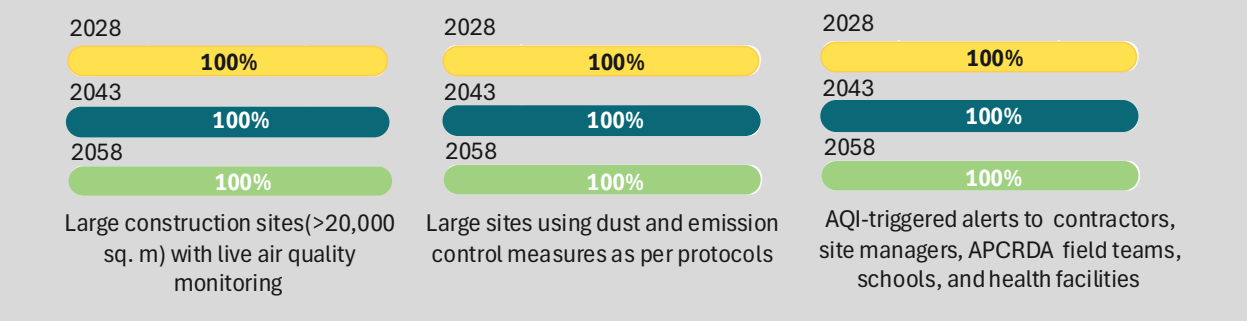
Strengthened resilience to climate hazards: Heat stress, urban flood

Good Practices	
Bhubaneswar – GIS-based urban health centres within 1 km ensure equitable access for vulnerable communities.	Singapore – Integrated cooling, shaded walkways, and heat-health campaigns enhance urban climate resilience.
Ahmedabad – Pioneered Heat Action Plan with early warnings, awareness drives, and reduced heat-related deaths	Melbourne – Citywide heat alert system links communities with hospitals for quick emergency response.

Tamil Nadu – One Health Centre integrates real-time disease and climate data for adaptive policy	Tokyo – Mobile clinics and telemedicine ensure continuous healthcare during heatwaves and typhoons.
Kerala – Elevated, solar-backed PHCs ensured uninterrupted medical services during floods and heavy rainfall	Odisha – CLTS model empowered SHGs for sanitation, reducing disease outbreaks in flood-prone areas.

1.2.9 Air Quality Management

Key Climate Targets



Amaravati aims to ensure clean air throughout its urban development process, aligning with its broader vision of becoming a climate-resilient and sustainable capital city. The city's air quality strategy focuses on minimizing dust and emissions from construction, integrating pollution resilient urban design, and establishing strong governance and adaptive management systems.

The approach begins with enforcing stringent dust and emissions control at all construction and infrastructure sites through comprehensive construction environment management plans, real time monitoring, and anti-smog measures. Low-emission equipment, reuse of treated wastewater for dust suppression, and material handling regulations will further reduce particulate pollution.

To build long-term resilience, the city will integrate air quality considerations into urban and building design such as air filtration in buildings, vegetative buffers and green corridors to reduce dust re-suspension. Strong institutional mechanisms will support these actions through management cell, AQI-linked alerts and compliance monitoring. Together, these measures will enable Amaravati to evolve as a clean and low-emission city, ensuring that rapid growth does not compromise environmental and public well-being.

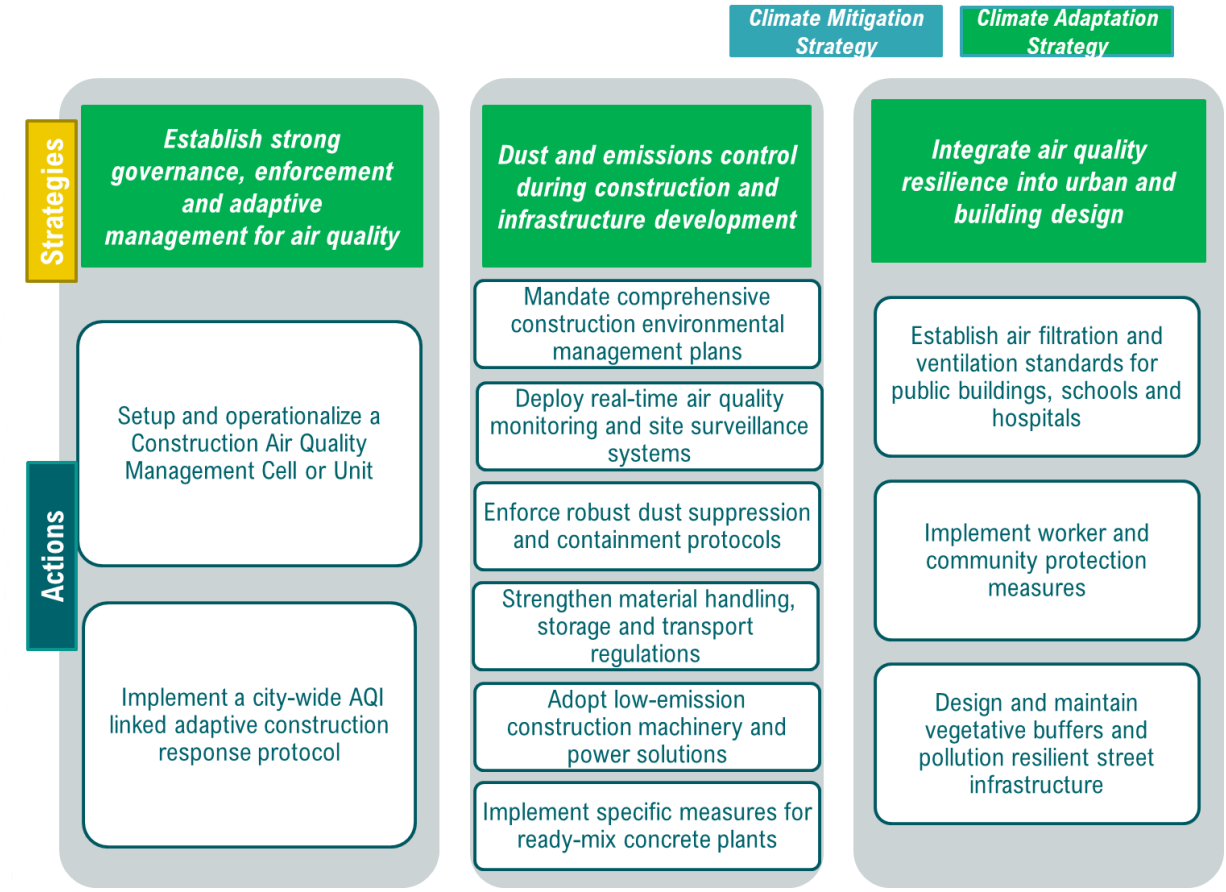


Figure 1-9: Climate Mitigation and Adaptation Strategies for Air Quality Management

Strengthened resilience to climate hazards: Heat stress, urban flood

Good Practices	
NCR Delhi: Graded, AQI-based curbs—from extra misting to halting earthworks—plus automated alerts	Ahmedabad – Municipal 'Good Construction Practices' policy mandated dust control, air monitoring, and compliance audits for large sites
London – Green construction framework enforces low-emission equipment, on-site air sensors, and strict contractor compliance.	Pune – Nyati Group's RMC plant used bag filters, paved roads, and real-time air monitoring to cut fugitive dust

1.3 Integrating Interventions to Build Resilience to Climate Risks

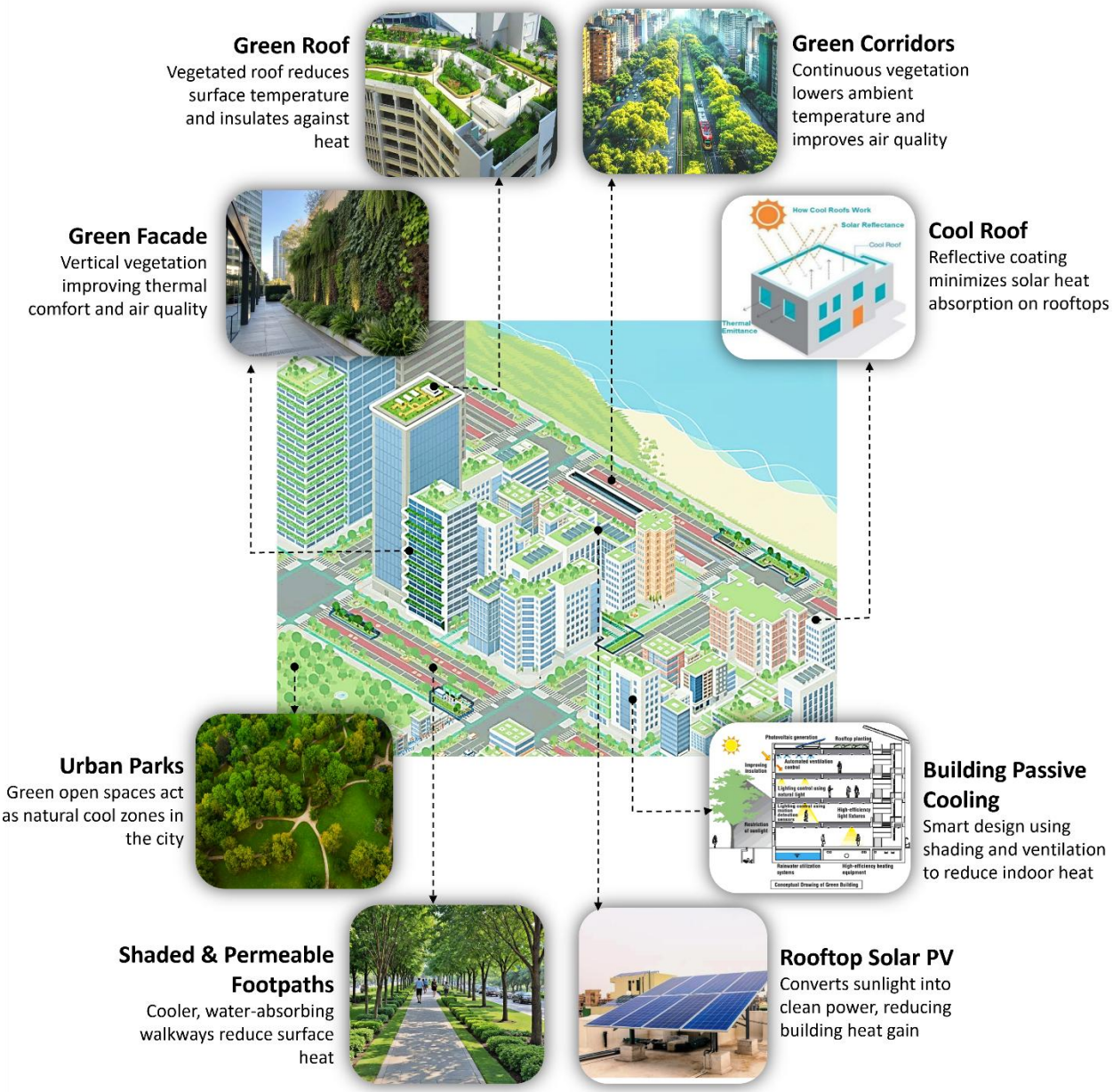


Figure 1-10: Interventions to mitigate Urban Heat Stress

Interventions for Thermal Comfort and Reduced Heat Stress

Amaravati's rapid development as a greenfield capital presents both opportunities and challenges in addressing urban heat, water scarcity, and livability concerns. As construction activity expands, increasing impervious surfaces, limited vegetation, and reduced airflow heighten urban heat island effects, aggravating heat stress and energy demand. These issues are further compounded by climate projections indicating a rise of 1 to 2.4°C in maximum temperatures by 2078 and more frequent heatwaves[1]. To mitigate these risks, it is important that Amaravati's urban design adopts an integrated, multi-layered cooling approach that links built form, landscape, and renewable energy systems.

City and Neighbourhood Scale Interventions

At the city level, Amaravati promotes a blue-green network that integrates green corridors, urban parks, and shaded, permeable footpaths to regulate microclimate and manage stormwater. These interconnected systems form ecological spines that link open spaces, water channels, and vegetation belts across the city.

- Green corridors—tree-lined streets and vegetated links—facilitate air circulation, lower surface and ambient temperatures, and act as wind channels that disperse trapped heat and pollutants.
- Urban parks and open spaces serve as thermal sinks that absorb carbon dioxide and provide shade, while also functioning as community recreation zones that improve well-being.
- Permeable and shaded footpaths use high albedo materials and vegetation to reduce heat storage, allow groundwater recharge, and offer pedestrian comfort even during peak heat hours.

Building-Level Interventions

At the building scale, Amaravati's planning and design guidelines promote energy-efficient and climate-responsive buildings through a mix of green infrastructure and passive cooling techniques:

- Green roofs add a vegetative layer that insulates buildings, reduces rooftop temperature, and minimizes heat absorption while providing stormwater retention benefits.
- Cool roofs coated with reflective, high-SRI materials deflect solar radiation, lowering indoor temperatures and air-conditioning loads.
- Green facades improve air quality, reduce wall heat gain, and enhance aesthetics while acting as noise and dust barriers.
- Passive design measures - optimized orientation, cross-ventilation, shading devices, and insulated envelopes - reduce reliance on mechanical cooling systems and create thermally comfortable indoor environments.
- Rooftop solar PV systems generate renewable energy while shading roofs, further reducing heat absorption and emissions from grid-based power use.

These measures not only improve building energy performance but also contribute to urban-scale heat mitigation, demonstrating how design decisions at the micro level influence macro-level climate resilience.

By embedding these measures into master planning, development control regulations, and building codes, Amaravati can ensure that every layer of its urban fabric—streets, buildings, and open spaces—contributes to climate adaptation and mitigation. This approach not only reduces urban heat and enhances livability.

[1] Climate projections as per Hydrological and Climate Modelling of Solapur and Vijayawada cities by IIT Madras, 2019 under RCP 4.5 and RCP 8.5. Representative Concentration Pathway (RCP) scenarios describe different trajectories for greenhouse gas concentrations and the resulting radiative forcing (energy added to the climate system) by 2100.

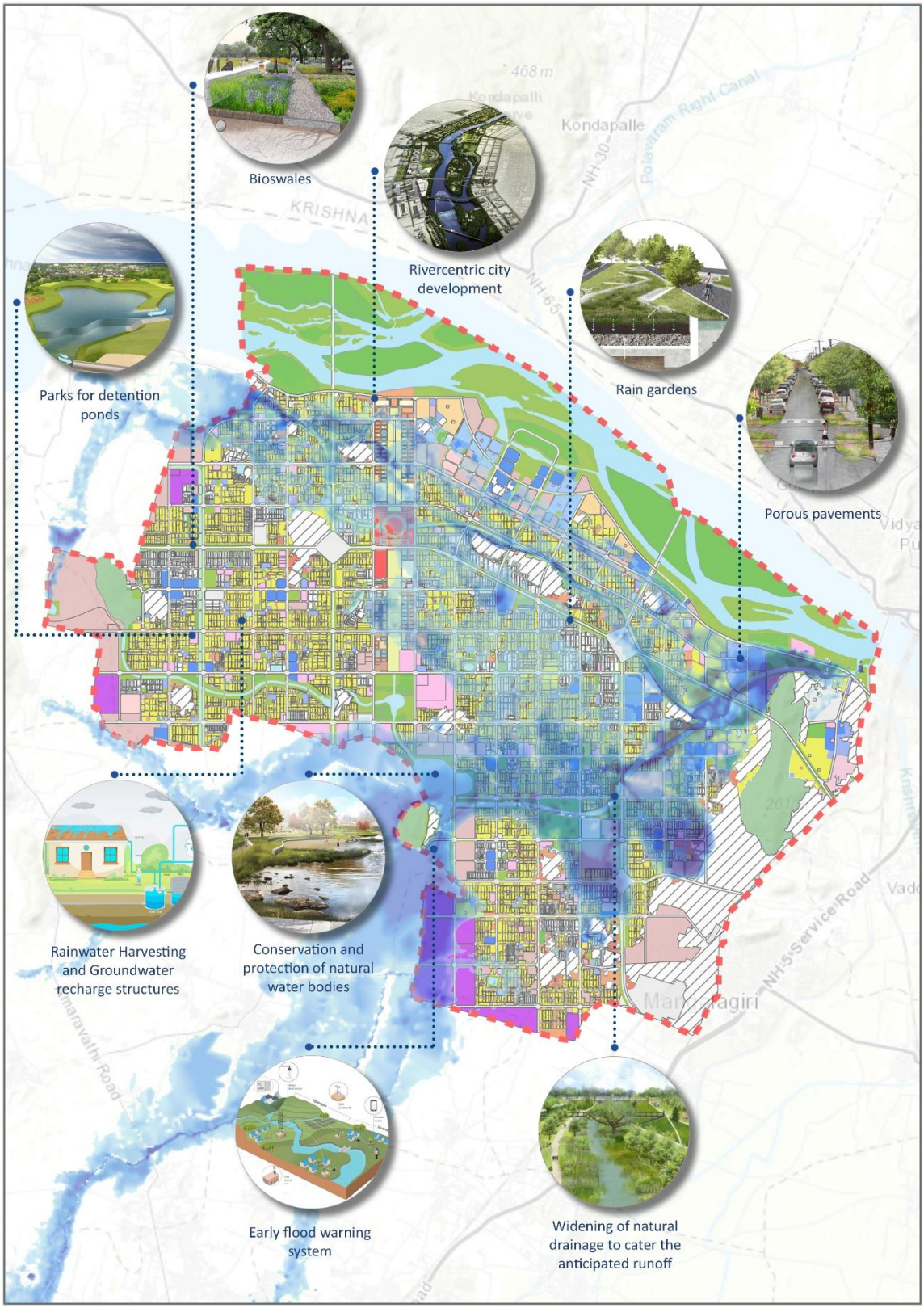


Figure 1-11: Interventions for Urban Flooding

Interventions to Improve Resilience to Urban Flooding in Amaravati

Addressing rainwater runoff surcharging the Vagu network is essential to reducing flood risk vulnerability. It is important to implement actions that focus on minimizing runoff generation and effectively managing runoff through engineering and nature-based solutions. Stormwater management planning starts with conserving and protecting natural water bodies and drainage systems.

Amaravati is situated on the banks of the River Krishna and upstream of the Prakasam barrage. A river-centric design that protects the river's ecology and encourages interaction between citizens and nature needs to be planned, with the capacity of its existing bund road running along the River Krishna to be enhanced to accommodate higher traffic movement and enhance protection of surrounding areas against backwater of the Prakasam barrage. Identifying and notifying the boundaries of lakes and vagus in the city is crucial for protection and legal enforcement against encroachments over time. Since Amaravati lies in the lower reaches of the Kondaveeti Vagu catchment, most runoff passes through the city before reaching the River Krishna. The design measures for widening of Kondaveeti Vagu should accommodate upstream runoff and the anticipated runoff from developed spaces and infrastructure in Amaravati. Additionally, the existing irrigation canals that previously served the irrigation needs should be preserved, even though the irrigation demand is expected to significantly reduce once urbanization increases. However, the canals will still assist in channeling rainwater runoff out of the city.

Reducing runoff generation is fundamental to effective stormwater management. Using nature-based solutions is both effective and cost-efficient. Incorporating bio-swales and rain gardens in green buffer zones along the roads E5, E10, N6, N7, N9, and N13 can help. Maintaining land cover porosity through porous pavements and parking areas aids in groundwater recharge and aquifer replenishment, which will be crucial during events of erratic and low rainfall. Decentralized solutions such as rainwater harvesting structures and recharge pits should be mandated across properties through building guidelines and codes. Additionally, strict enforcement through monitoring cells once properties are occupied is essential to ensure compliance and continued utility of such solutions.

Detention ponds in parks can serve as temporary storage basins that capture and slowly release stormwater, reducing peak runoff and mitigating urban flood risks. Planning a detention pond network that spans across parks in different zones and neighbourhoods is important. This intervention requires a detailed study, identification of relevant priority parks, and designing runoff diversion systems. An early flood warning system provides additional preparation time and enables communication with vulnerable groups to increase proofing measures and coordination with authorities. Automatic rain gauges and sensors should be installed throughout the Kondaveeti Vagu catchment to monitor rainfall, water levels, velocity, and rainfall on a real-time basis, especially as high-intensity rainfall events are anticipated to become more common. The data specific to each rainfall event, including information on the spatial extent of waterlogging, depth, and duration, must be collated and made available for effective mitigation measures in the future. This meticulously recorded long-term historical data helps validate models and in turn supports flood protection.

1.4 Advancing towards Net-Zero Greenhouse Gas Emissions through Climate Actions

Amaravati is envisioned as a world-class capital city for the State and a model planned, future-ready urban centre in India. The city envisions integrating the best features of urban planning, sustainability, and effective governance to create an inclusive, highly liveable, and world-class urban ecosystem. Amaravati's infrastructure aims to meet global standards with efficient, eco-friendly utilities and technology-driven development. Current plans include green spaces, the preservation of water bodies, mixed-use areas to reduce travel and energy use, and a focus on non-motorized and public transportation. The city emphasises adoption of energy-efficient infrastructure, renewable energy, flood protection, wastewater reuse, and urban cooling for resilience.

This vision aligns with Andhra Pradesh's Swarn Andhra Policy, 2024 and the Integrated Clean Energy Policy, 2024, both of which focus on low-carbon urban development, renewable energy integration, and state-wide long-term carbon-neutral growth.

Amaravati's Baseline GHG emissions in 2024

Baseline GHG emissions for the capital city area are estimated to be 2.42 lakh 332 tonnes of carbon dioxide equivalent (CO_2e). Per capita emissions in the current scenario in 2024 stand at 1.31 tonnes of CO_2e.

Primary contributor to emissions is the Stationary Energy sector, which includes consumption of electricity and fuels in existing buildings and accounts for 80.4% of total emissions. The Transport sector accounts for about 13% of emissions, and the remaining 6.6% emissions result from the Waste sector in 2024.

Amaravati's Climate Pathway from 2028 to 2058

Amaravati's GHG emission reduction target (noted in section 1.1) emphasizes its ambition to advance towards net-zero GHG emissions. Through its overarching climate targets and sectoral climate strategies and actions, the city is committed to adopt a pathway that supports deep-cuts in its GHG emissions during its planning horizon of 2028 to 2058. Amaravati aims to progressively reduce GHG emissions through decarbonisation of energy, sustainable mobility, and improved waste management.

In the climate action planning process, Amaravati's climate strategies and targets were identified as part of its **Climate Action Scenario**. The city's future GHG emissions were modelled based on this Climate Action Scenario, assuming implementation of all its sectoral climate strategies and actions outlined in the CCAP (see Volume 1, section 6 for further details). Implementing its Climate Action Scenario will help Amaravati to achieve deep GHG emissions reduction at the city-scale, as much as 80.2% as compared to the BAU by 2058.

The Climate Action Scenario, that envisions implementation of Amaravati's climate strategies and actions in the CCAP, helps to reduce the city's GHG emissions across its planning horizon of 2028 to 2058.

By 2058, total GHG emissions are expected to decline from 62.79 lakh tCO_2e in the BAU scenario to 12.45 lakh tCO_2e, reflecting an 80.2% reduction (50.33 lakh tCO_2e).

The Climate Action Scenario results in the following levels of emission reduction compared to BAU:

- **GHG emissions in 2028:** *17.5% lower* than BAU
- **GHG emissions in 2043:** *58.8% lower* than BAU
- **GHG emissions in 2058:** *80.2% lower* than BAU

With implementation of its climate actions, Amaravati's **per capita emissions** are estimated to be **0.31 tCO_2e by 2058**. This is much lower than the existing baseline situation, with per capita emissions of 1.31 tonnes of CO_2e in 2024 and represents a significant decline (about 76%), especially considering the infrastructure improvement and transformation that the capital city will bring to the region.

Through the low-carbon and climate-oriented planning approach under its CCAP, Amaravati's per capita emissions on completion of its development in 2058 are estimated to be much lower as compared to that of brownfield Indian and global cities.

Amaravati's Projected Per Capita GHG Emissions Compared to Indian and Global Cities

City	Per Capita GHG Emissions (tCO_2e)	Year
Amaravati	0.31	2058
Ahmedabad	2.1	2021-22
Chennai	1.9	2018-19
Coimbatore	1.75	2021-22
Hyderabad	2.48	2022-23
Mumbai	1.8	2019
Vijayawada	1.85	2021-22
Bangkok	7.39	2024
London	3.2	2022
Los Angeles	5.4	2020
Montreal	13	2019
New York	11	2019
Singapore	12.3	2021

If Amaravati's development took place as per the BAU scenario following conventional patterns in the absence of climate and sustainable planning interventions, emissions are projected to reach 62.79 lakh

tCO_2e by 2058 (see Table 1-1 and Figure 1-1). Adoption of climate actions across sectors would help limit GHG emissions to 12.45 lakh tCO_2e by 2058 in the Climate Action scenario. A comparison of the two scenarios highlights Amaravati's clear shift toward a low-carbon growth pathway.

Table 1-2: Sector-wise GHG emissions under the Climate Action Scenario, 2028 - 2058

Sector and Sub-sector	Climate Action Scenario				BAU emissions	Reduction from BAU levels
	GHG Emissions (tonnes of CO_2e)			Share of emissions		
	2028	2043	2058	2058	2058	2058
Stationary Energy	**6,92,862**	**10,36,106**	**8,53,140**	**68.5%**	**50,86,174**	**83.2%**
Residential Buildings	2,71,054	3,93,737	2,47,639	19.9%	18,16,512	**86.4%**
Commercial and Institutional Buildings/Facilities	3,23,495	4,74,380	3,50,822	28.2%	23,24,190	**84.9%**
Industries	97,679	1,65,216	2,49,058	20.0%	9,39,850	**73.5%**
Fugitive Emissions (from piped gas supply)	634	2,772	5,622	0.4%	5,622	**0.0%**
Transportation	**77,821**	**1,62,665**	**2,33,094**	**18.6%**	**7,10,347**	**67.2%**
On-road Transportation	77,821	91,504	1,11,959	9.0%	5,48,635	**79.6%**
Rail/Metro	-	71,161	1,21,136	9.7%	1,61,712	**25.1%**
Waste	**41,153**	**69,222**	**1,59,031**	**12.8%**	**4,82,237**	**67.0%**
Solid Waste	36,042	52,904	1,23,245	9.9%	1,52,996	**19.4%**
Wastewater	5,111	16,318	35,786	2.9%	3,29,241	**89.1%**
Total	**8,11,837**	**12,67,992**	**12,45,265**	**100%**	**62,78,757**	**80.2%**

In the Climate Action scenario, about 68.5% of emissions would result from stationary energy sector, while transportation and waste are estimated to contribute 18.7% and 12.8%, respectively. The main emission sources are anticipated to be PNG (68.6%), electricity used for transport (18%), and waste management (12.8%), while transport fuels will contribute minimally at 0.6%, reflecting a strong transition toward cleaner and electrified systems.

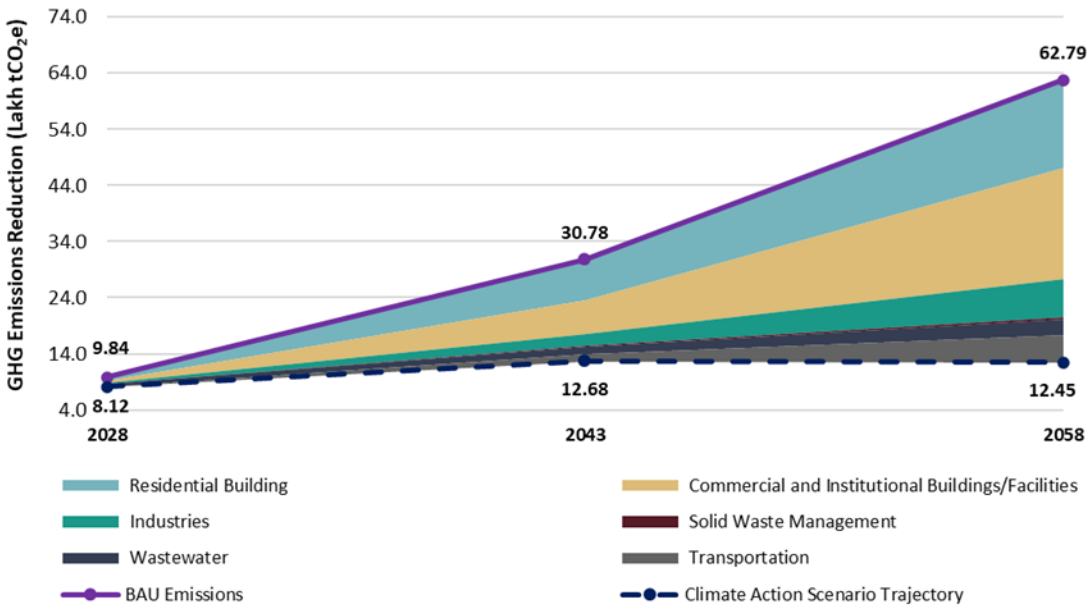


Figure 1-12: GHG Emissions reduction potential of actions in the Climate Action Scenario compared to the BAU Scenario, 2028 - 2058

Emission Reductions by Sector

The emission reductions in Amaravati's Climate Action Scenario can be analysed across three key sectors: **stationary energy, transportation, and waste**.

The stationary energy sector is expected to be the primary driver of emission reductions, mainly from large-scale integration of renewable energy, improved building energy performance, the adoption of energy-efficient technologies, and the switch to cleaner energy sources to meet the energy demand. The sector is estimated to contribute over 84.1% of the total reduction potential in 2058. Of this, proposed climate actions in commercial and institutional buildings and facilities are estimated to contribute 39.2% of the total emissions reductions, followed by residential buildings with a share of 31.2%, and industries accounting for 13.7%.

The transport sector is projected to account for 9.5% of the total emissions reduction from BAU levels, primarily through the shift to public and electric mobility, supported by renewable-powered charging infrastructure. In the waste sector, adopting scientific processing technologies for solid waste, such as composting, bio-methanation, and material recovery, will significantly reduce methane emissions and promote a circular economy. In addition, the target for methane recovery from wastewater treatment for energy generation will also help reduce emissions in the city. The overall contribution of the waste sector to emissions reduction is estimated to be 6.4% (see **Error! Reference source not found.**).

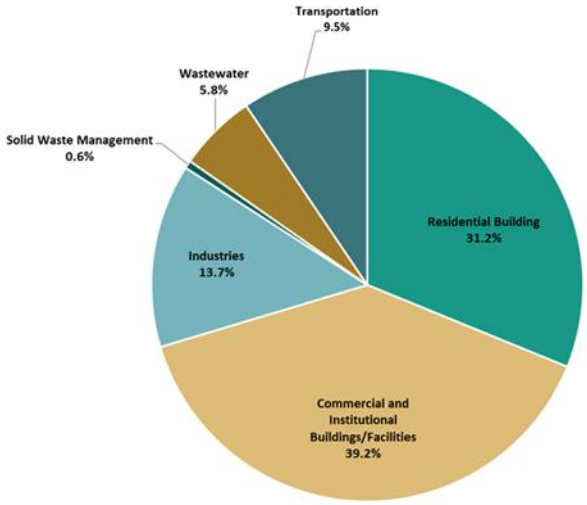


Figure 1-13: Sector contribution to GHG emissions reduction from the BAU levels, 2058

2 Sector-wise Climate Actions and Implementation Details

The Amaravati CCAP outlines 37 strategies across 9 sectors to guide the city towards strengthening it climate resilience and achieving net-zero GHG emissions. Each sectoral strategy is accompanied by defined targets, with actions detailed to reduce emissions and enhance resilience to climate change. Wherever possible, these strategies and actions have been aligned with existing state and national policies, master plan and infrastructure development plans to ensure convergence and effective implementation of climate actions.

Actions for implementation in the CCAP are identified and prioritised based on their benefits for climate resilience, feasibility (including technical, political, and financial aspects), and the time required for these actions to yield results (short, medium, and long term).

The feasibility of each intervention is evaluated based on technical, financial, and political aspects, as well as the timeframe needed to achieve the intended impact in the city. Overall feasibility is determined by the availability of accessible and affordable technology, the presence of allocated or easily obtainable funding, and the ability to secure political and social support. The timeframe for impact considers whether an intervention can enhance the resilience of an urban system in the short term (by 2028), medium term (by 2043), or long term (by 2058).

Further, to establish the priority of the proposed actions, their potential to generate climate resilience benefits was evaluated. This assessment of the climate actions focused on several factors: their capacity to contribute to the redundancy and flexibility of urban systems, their role in informing future planning of these systems, their responsiveness to sudden shocks or stresses, and their potential for reducing GHG emissions. Details of this analysis can be found in Annexures A & B. This approach helped determine the priority of various actions. For instance, actions with significant climate resilience benefits, high feasibility, and a quick impact timeframe should be prioritised for implementation, especially those supported by readily available technology and financing options.

The subsequent sections present the identified climate resilience actions across sectors in the following structure:

- Sectoral snapshot of information reflecting its baseline status including its share of GHG emissions and opportunities, challenges, and gaps; guiding policies and initiatives that align with proposed actions, BAU GHG emissions scenario and the identified climate risks; vulnerable areas and actors and their adaptive capacity; overall GHG emissions mitigation potential and climate resilience impact and co-benefits; and the SDGs that will be met through the proposed actions.
- The sector specific adaptation and mitigation strategies and targets: The adaptation strategies are to help build resilience towards climate risks and urban system vulnerabilities while the mitigation strategies are to address the targeted GHG emission reductions from the sectors. The strategies have a set of targets outlined for the timelines of 2028, 2043 and 2058. Details of implementation for the proposed actions are presented with implementation entities, financing mode and prioritisation and feasibility parameters.

2.1 Energy and Buildings

Baseline Status (2024-25)	**Electricity consumption:** 220.4 million kWh **Share in total energy consumption**: 74% **GHG emissions:** 1,94,944 tCO_2e (80% of total GHG emissions) **Share in GHG emissions from buildings:** Residential buildings (53%), Commercial and institutional buildings/facilities (41%), Industries (5%), Agriculture (2%)
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • India's NDC: Aims for 50% electric power installed capacity from RE sources by 2030 • UJALA Scheme, EESL's Super-Efficient AC Program (ESEAP) Scheme, BEE star labelling program and awareness supporting penetration for EE appliances. • Ministry of Power's target: all DISCOMs to achieve 43.3% Renewable Purchase Obligation[2] by 2030 • Energy Conservation and Sustainable Building Code (ECSBC), 2024: energy efficiency standards for commercial and office buildings (connected load>100 kW) • Eco-Niwas Samhita, 2024: standards for energy efficiency, renewable energy use, and other green building requirements for residential buildings • India Cooling Action Plan[3]: aim to reduce cooling demand by 20% to 25% (focusing on building envelope design) and cooling energy demand by 25% to 40% by 2038 • PM Surya Ghar Muft Bijli Yojana: supports solar PV installations[4] • Mission LiFe: promotes environmental conscious lifestyle[5] • Pradhan Mantri UJJWALA scheme: supports cleaner fuel adoption • Scheme for Development of Solar Parks and Ultra-Mega Solar Power Projects to support setting up of solar power parks until 2026, enabling grid-scale RE expansion. **State Policy/Programme/Targets:** • Andhra Pradesh Integrated Clean Energy Policy 2024: aims to achieve net-zero by 2047 for the state and promotes RE, including green hydrogen[6] • AP Energy Efficiency and Energy Conservation policy 2023-28: aims to save around 20% of total energy demand by 2028[7] • State target to achieve a renewable purchase obligation (RPO) of 22% by 2026-27 in its electricity supply, comprising 9.5% solar and 12.5% non-solar power[8] • AP Building Rules, 2017 require ECBC compliance for all commercial/non-residential buildings with plot area ≥ 1000 sq. m or built-up area > 2000 sq. m. All multiplexes, hospitals, hotels, and convention centers must be AP ECBC-compliant. • In Andhra Pradesh, Energy Conservation cells have been institutionalised in all government head of department offices, district offices, and corporation/society

[2] Ministry of Power Notification F.No. 09/13/2021-RCM, July 22
[3] India Cooling Action Plan, March 2019, MoEFCC
[4] PM Surya Ghar Bijli Yojana. Accessed August 2025.
[5] Mission LiFE, Accessed August 2025
[6] Andhra Pradesh Integrated Clean Energy Policy 2024, Energy Department, Andhra Pradesh State Energy Conservation Mission, Accessed August 2025.
[7] Andhra Pradesh Energy Efficiency and Energy Conservation Policy, Energy Department, Andhra Pradesh State Energy Conservation Mission, Government of Andhra Pradesh, Accessed August 2025.
[8] APERC Renewable Power Purchase Obligation (Compliance by purchase of Renewable Energy/Renewable Energy Certificates) Regulations, 2022. Accessed August 2025.

	offices. These cells act as a nodal agency to coordinate with the State Designated Agency on energy efficiency and conservation measures.[9] • AP Green Hydrogen & Green Ammonia Policy 2023 aims to promote green hydrogen production within five years using solar and wind energy [10] **City Policy and Initiatives** • Zoning Regulations and Urban Design Guidelines, 2024 notified for Amaravati Government Complex (AGC) include building sustainability measures and requirements for building developments located within the AGC area • Urban Design and Architectural guidelines (UDAG) (draft), 2025 include specific green building features and minimum green building rating certification requirements for public, institutional and private buildings. The measures and norms are aligned with the ECBC, GRIHA, LEED, IGBC • UDAG includes requirements for rooftop solar installations on at least one-third of rooftop area across the city (excluding AGC area) • Upcoming public buildings being constructed in compliance with green building norms (including EDGE standards) • Procurement of high-efficiency rated pumps planned in city utility infrastructure. • Integration of district cooling systems is planned for the AGC area, to enable reduction in cooling-related energy demand.
Opportunities and Gaps	• Significant opportunity to integrate energy efficiency and high level of renewables at the outset in public and private buildings and infrastructure for city utilities. • Projected climate trends necessitate integration of climate-responsive measures such as passive cooling, heat-resilient materials in buildings and community spaces to ensure thermal comfort with anticipated rising temperatures. • Amaravati's policy regulations and guidelines to support low-carbon and green buildings are in place, with robust enforcement and supporting measures required to help ensure widespread adoption. • Energy Conservation and Sustainable Building Code (ECSBC), 2024 (i.e. updated version of ECBC, 2017) and Eco-Niwas Samhita, 2024 can be integrated into Amaravati's guidelines for adoption in commercial, office and residential buildings. • Amaravati is envisioned to be fully renewable-powered capital city. A significant portion of green power will need to be integrated from offsite RE sources to complement on-site/rooftop RE deployment. • Establishing strong institutional frameworks and coordination mechanisms among different urban planning and energy sector institutions such as APCRDA, ADCL, APCPDCL, APTRANSCO, APGENCO, APSECM, NREDCAP, AP DTCP is critical to streamline urban and power infrastructure planning, building code enforcement and energy management. • Significant enabling actions on early-stage planning, policy measures, business models, private sector participation, financing and incentives, local power grid readiness, and monitoring required to achieve ambitious EE and RE adoption.

[9] State Energy Efficiency Index 2023, Bureau of Energy Efficiency, Alliance for an Energy Efficient Economy, 2024, Accessed August 2025.
[10] AP Green Hydrogen & Green Ammonia Policy 2023, Accessed August 2025.

Climate Risk and GHG Emissions Scenario

GHG Emissions:

Sector	GHG Emissions in BAU (tCO_2e)			
	2024	2028	2043	2058
Residential Buildings	102,863	332,877	1,120,122	1,816,512
Commercial and Institutional Buildings/Facilities	79,742	373,323	1,082,687	2,324,190
Industries	9,399	115,687	375,035	939,850
Agriculture, Forestry, and Fishing Activities	2,941	-	-	-
Total emissions from Buildings	**194,944**	**822,521**	**2,580,616**	**5,086,174**

Climate Risk Status: Medium

- Increase in building energy demand, especially for cooling, with growing population and rising temperatures
- High surface and air temperature and related impacts on health due to inadequate heat resilience
- Urban flooding and waterlogging risks due to impermeable surface areas in the built environment

Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions

GHG Mitigation Potential and Indicative Cost of Interventions:

Parameters	Climate Action Scenario		
	2028	2043	2058
GHG Emissions in Climate Action Scenario (tCO2e)	692,862	1,036,106	853,140
GHG emissions reduction from BAU	16%	60%	83%
Total cost of mitigation actions by 2058 (Million INR)	266,566		

Strengthened Resilience to Climate Hazards:

Heat stress, urban flood

Climate Resilience Impact and Co-benefits:

- Reduced dependency on grid for energy; high green power integration
- Improved indoor thermal comfort in buildings and enhanced heat resilience, especially for vulnerable groups in low-income homes
- Improved permeability of surfaces in the built environment and lower flood risk due to protected buildings
- Lower risk to public health from extreme heat

SDGs	GOAL 3: Good Health and Well-being, GOAL 7: Affordable and Clean Energy, GOAL 8: Decent Work and Economic Growth, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 15: Life on Land

Climate Strategies, Actions and Targets

Strategy 1: Prioritise energy efficiency and renewable energy adoption in public buildings and city utilities

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Green and Energy-Efficient Public Buildings	Public buildings that are certified green buildings and/or AP ECBC/ECSBC-compliant	100%	100%	100%
Renewable Energy in Public Buildings	Electricity consumption in public buildings to be met by renewables	50%	100%	100%
Energy efficiency adoption in public utilities and facilities	Adoption of energy-efficient equipment and pumps in public utility service facilities	100%	100%	100%
Renewable energy in public utilities and facilities	Electricity consumption in public utility service facilities to be met by renewables	50%	100%	100%
LED street lights with control & management systems (voltage controller and timer)	Street-lights with LED lamps and energy efficiency controls	100%	100%	100%

Proposed Actions

Action 1: Build and operate certified green, energy-efficient public buildings

Action details

Amaravati's public buildings should take the lead to implement green building and energy efficiency measures to first reduce their energy demand and then utilise green power to meet energy requirements. This action should be prioritised in all government-owned and managed buildings, including public offices, hospitals, schools, social housing, residential quarters, community facilities (auditoriums, sports complexes, libraries, convention centres). These measures will further emphasise passive design elements such as optimised window placement, reflective roofing materials, natural ventilation, and green landscaping to enhance thermal comfort and reduce reliance on mechanical cooling. These measures are particularly important given Amaravati's exposure to extreme heat, with max. daily temperatures reaching up to 48.8°C.

Existing initiatives

Key public buildings, including APCRDA office, are being designed and constructed as per green building standards (including IFC-EDGE standard)

Sub Actions:

- New public buildings to achieve green building certification (such as GRIHA/EDGE/IGBC/LEED) and comply with AP ECBC/ECSBC, where applicable (plot area ≥ 1000 sq. m or built-up area > 2000 sq. m) **(ongoing/planned)**
- Social/affordable housing and residential quarters built by APCRDA/AP Housing Board should follow guidelines as per Eco-Niwas Samhita, 2024.
- Tender documents for construction of new buildings include clear green building and energy efficiency requirements. Specify targeted certification level (e.g. GRIHA 3-star, EDGE certified/advanced, IGBC/LEED gold or platinum) and link compliance by concessionaire to contractual conditions (e.g. BoQ terms, payment, and approvals). **(ongoing/planned partly)**
- Update zoning and development control regulations to enable ECSBC, 2024 and green building standard compliance and adoption of green building features in different building types as per Amaravati's Urban Design and Architectural Guidelines (UDAG), 2025 (refer Strategy 2, Action 1). **(ongoing/planned)**
- Integrate high levels of on-site renewables such as rooftop solar PV and solar water heaters along with off-site solar and wind energy. Key public buildings to go beyond ECSBC norms and target Net-zero buildings, ECSBC+, super ECSBC adoption to serve as demonstration models. (eg. Super-ECBC compliant APEPDCL training centre at Visakhapatnam).
- Ensure that current contractual provisions remain aligned with the IGBC Platinum rating standard awarded to Amaravati's Master Plan in 2018.
- Identify existing public buildings targeted for energy audits in order to implement renewable energy and energy efficiency improvement projects.

Potential locations: Public-owned and managed buildings within the Amaravati Government Complex and across zones

Implementing entities

Lead: APCRDA

Supporting: ADCL, AP DTCP, AP Housing Board, APSECM, APCPDCL, NREDCAP, Green building certification agencies, contractors, architects

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Short term (2028 for AGC phase), Medium term (2043 for city expansion)

Monitoring Indicators:

- Percentage of new public buildings and social housing with green building certification
- Percentage of existing and new public buildings and social housing complying with AP ECBC/ECSBC/Eco-Niwas Samhita
- Rooftop solar PV capacity installed on public buildings
- Percentage of public building energy consumption met by renewable energy sources
- No. of existing public buildings with energy audits followed by actionable energy-saving implementation
- No. of public buildings that are net-zero, ECSBC+ or Super ECSBC compliant

Good Practice:

Indira Paryavaran Bhawan in New Delhi stands as India's pioneering net-zero government building with notable RE integration and green building features**.** Powered by a 930 kWp solar rooftop and features passive design features such as strategic orientation, shaded facades, and high-performance insulation to optimise thermal comfort without mechanical cooling. It deploys innovative systems like chilled beams and geothermal exchange along with green landscaping and rainwater harvesting, earning a GRIHA 5-star rating and serving as a model for climate-responsive institutional building design.

APEPDCL's training centre at Visakhapatnam is Andhra Pradesh's first super ECBC-compliant building. Supported by a significant grant from the Bureau of Energy Efficiency, the facility hosts the state's new Centre of Excellence for Energy Transition and serves as a demonstration model integrating green technologies, energy management solutions, and advanced testing labs.

Action 2: Establish enabling policies for low-carbon government buildings and public procurement

Action details

Introduce zoning regulations and green public procurement policy interventions that address all new public buildings across the city, promoting the adoption of renewable energy and energy efficiency measures. These interventions will enable government buildings to be designed and operated in a climate-sensitive and sustainable manner, shifting towards procurement that prioritises energy efficiency and low carbon footprint in buildings and operations.

Existing initiatives

Zoning Regulations and Urban Design Guidelines, 2024 notified for the Amaravati Government Complex (AGC) outline sustainability measures and requirements for buildings and sites located within the AGC area. Further, for the city area beyond the AGC, the Urban Design and Architectural guidelines (UDAG) have been prepared recently in 2025, which include specific recommendations on green building features and minimum green building rating requirements for different building types, including public and semi-public buildings.

Sub Actions:

- Enforce green building measures and requirements outlined in UDAG, 2025 for all public buildings.
- Develop a green public procurement policy to integrate energy efficiency, renewable energy, and low-carbon materials within Amaravati's government buildings and facilities:
    - Require use of high-efficiency and BEE star-rated electrical equipment and appliances, LED lights, occupancy and daylight sensors, renewable energy, green building materials and components, and building energy management systems.
    - Maintain a list of vendors and reference costs for energy-efficient appliances and fixtures for heating, air conditioning, lighting and ventilation, plumbing, and certified green materials.
    - Use procurement platforms and channels such as EESL's UJALA, GeM (Government e-Marketplace) portal, EESL Mart portal. Prioritise local and regional vendors.

Implementing entities:

Lead: APCRDA (Policy and Regulation)

Supporting: DTCP, APSECM, ADCL, procurement departments

Type of action: Climate Mitigation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Notification or publication of Green Public Procurement Policy • Percentage of new public buildings complying with green building requirements in zoning regulations • No. of government buildings adopting renewable energy systems • Percentage of high-efficiency electrical equipment, appliances and lighting fixtures procured • Percentage of public building using certified green materials and low-carbon components
Good Practice: **Vienna's** has successfully implemented an internationally recognized model for sustainable municipal procurement for over two decades through the EcoBuy Vienna Program. It has developed over 100 ecological criteria across 23 categories including energy efficiency, recycled content, organic production, and low-carbon standards – applicable to vehicles, construction materials, office supplies and institutional food services. These sustainability indicators guide the city's €5 billion annual procurement procedures, with the program estimated to reduce 15,000 tonnes of CO_2 and save €1.5 million annually through environmentally sound construction, water-saving devices, efficient lighting, and organic food procurement. **Seoul** has implemented a green procurement policy for all public institutions since 2007, with mandates to prioritize eco-labeled and recycled products in all purchases. By 2017, 42% of Seoul's public procurement spend—KRW 122 billion—was on green products. The city has also advanced integration of EE and RE into public infrastructure, setting ambitious energy performance requirements for public buildings, including mandatory best-in-class green building certification and retrofits, large-scale PV installation, and full transition to LED lighting.

Action 3: Integrate energy efficiency and renewables into utility service infrastructure
Action details Amaravati, envisioned as India's first fully renewable-powered capital city, is integrating energy efficiency and renewable energy into its core utility service infrastructure to meet the projected power demand. Procure high energy efficiency equipment (pumps, VFDs, APFC panels, transformers) and target 100% RE supply for energy-intensive infrastructure. **Sub Actions:** • Procure and operate high energy efficiency equipment in utility services such as water pumping, wastewater treatment plants, street lighting, and flood prevention pumping systems **(ongoing/planned partly)** o Include deployment of high-efficiency pumps, variable frequency drives, automatic power factor correction panels and advanced transformers in public tenders for facilities. o Include energy efficient operation and performance requirements in contracts of third-party operators for relevant facilities (e.g. sewage treatment plants).

• Target 100% RE supply for energy-intensive infrastructure such as water supply and wastewater facilities, streetlights, bus depots, and MRT stations. o Adopt a mix of on-site and off-site RE resources including solar, wind, waste-to-energy to meet diverse energy demand. A solar and wind energy portfolio along with battery energy storage solutions can help provide round-the-clock RE power for continuous operations of water supply and wastewater facilities and cater to night-time street lighting load. o Design facilities to be ready for RE integration (on-site and off-site) from an early-stage including infrastructure (electrical, metering, sanctioned load) and space considerations and reflect requirements in tender documents for their construction.
Potential locations: City-wide in all utility infrastructure and facilities
Implementing entities **Lead:** APCRDA, ADCL **Supporting:** APCPDCL, NREDCAP, utility operators, technology and service providers
Type of action: Climate Mitigation
Climate resilience benefits: Very High
Timeline: Short to Medium term
Monitoring Indicators: • Percentage of utility facilities using high-efficiency equipment (such as pumps, VFDs, APFC panels, transformers) • Electricity consumption per unit service/output indicator (e.g MLD of water or wastewater treated) • Share of renewable energy in total power consumption from city utilities • Installed capacity of on-site and off-site renewable energy catering to utilities • Frequency and no. of energy performance audits for utility facilities • Energy savings, renewable energy based consumption and related GHG emissions avoided in facilities
Good Practice: Adelaide city has implemented high-efficiency equipment in utility services across water pumping stations, wastewater treatment plants, and street lighting. The city's wastewater facilities utilize variable frequency drives and advanced automation to reduce energy consumption, while LED retrofits in street lighting have cut electricity use by over 60%. **Singapore's** MRT system and bus depots are transitioning toward 100% renewable energy through solar installations and off-site RE procurement, supported by RE-ready infrastructure and battery storage. These cities demonstrate how integrating smart technologies and renewable energy portfolios can decarbonize core urban infrastructure while enhancing operational resilience. **Ahmedabad** and **Surat** have pioneered renewable adoption in municipal operations in India. Ahmedabad sourced about 16% of its municipal electricity through a combination of 10 MWp solar PV and 21 MW wind power in 2023–24. Surat achieved a remarkable 25% green power share for municipal operations, powered by 38.7 MW of wind and 19 MWp of solar PV, totaling to 57.7 MW[11]. Both cities intend to scale-up their renewable energy capacity over the next five years.

Action 4: Test innovative solutions and implementation models for further scale-up

[11] Information gathered from Ahmedabad Municipal Corporation and Surat Municipal Corporation

Action details

Explore and pilot scalable innovations in energy and building technologies such as integrated solar PV and wind, battery energy storage, building-integrated PV (BIPV), net-zero buildings, and diverse renewable energy (RE) procurement/business models. Aggregate pilot projects across city assets and sites to enhance cost-effectiveness and demonstrate stronger impact.

Sub Actions:

- Identify sites to implement proof-of-concept pilot projects on technological solutions (solar PV, wind, renewables with battery energy storage, BIPV, net-zero buildings and implementation models to support scalable deployment, potentially attracting technical assistance and concessional finance.
- Identify and develop on-site captive as well as off-site/open access RE projects, including rooftop and ground-mounted solar, wind power plants, to meet daytime energy consumption (mainly through solar energy) and night-time consumption (through wind energy).
- Aggregate projects across multiple sites to reduce costs and enable bulk procurement
    - Partner with technology providers and project developers for aggregated, low-cost deployment of on-site solar PV or green power purchase, where space is limited.
    - Identify a list of regional energy service companies (ESCOs) (such as from BEE's empanelled list) to support aggregated energy efficiency deployment at no/low capital cost, with payment models based on achieved energy savings.
- Test various implementation models such as ESCO/RESCO, CAPEX, OPEX, lease, open access, group captive (multiple connections/consumers source power from one shared RE project) for rooftop solar PV and off-site RE use to determine best-fit for different use-cases.

Potential locations: Existing and imminently planned public buildings and infrastructure facilities within the AGC and in other locations

Implementing entities

Lead: APCRDA

Supporting: ADCL, APSECM, APCPDCL, empanelled ESCOs, technology and service providers, research & academic institutions (e.g., IITs, NITs, SPA Vijayawada)

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Medium term

Monitoring Indicators:

- No. of proof-of-concept pilot projects identified and operationalised
- No. or scale of sustainable energy solutions tested/implemented (e.g. solar PV, wind, battery storage, BIPV, net-zero buildings) along with savings and impacts
- Installed renewable energy capacity (rooftop solar + wind) across pilot and aggregated sites
- No. of implementation models tested (CAPEX/OPEX/ESCO/RESCO/open access/group captive) and third-party contracts executed to support energy efficiency and renewable adoption
- Reduction in per-unit procurement cost through aggregation
- No. of partnerships with technology providers, project developers, research institutions and ESCOs to evaluate, pilot and deploy market-ready sustainable building and energy solutions

Good Practice:

London's RE:FIT program uses an Energy Performance Contracting (EPC**)** model, which supports public sector organizations to engage pre-qualified ESCOs to undertake projects on energy efficiency and renewable adoption. The Greater London Authority coordinates the program and aggregates multiple buildings for retrofit, allowing economies of scale and streamlined procurement, with framework contracts with ESCOs that guarantee energy savings over an agreed payback period to building owners. RE:FIT has supported retrofits in over 660 public buildings, with 32,000 tonnes of carbon emissions savings annually from a £100 million investment.

Building-integrated photovoltaics (BIPV) have been successfully deployed in the CtrlS Datacenter in **Navi Mumbai**, with solar PV modules of 863 kWp capacity covering over 50,000 square feet of façade area and generation about 590 MWh per year. Using BIPV technology, this project is able to use an active facade area that is about 7-8 times of that available on the roof. The **Indira Paryavaran Bhawan in New Delhi** also incorporates BIPV in its design.

Action 5: Establish a central energy management system to track energy performance

Action details

A centralised Energy Management System (EMS) can be designed to systematically collect, monitor, and analyse energy consumption data from all public buildings and service facilities in Amaravati. The EMS will track key energy performance metrics and help identify opportunities for energy saving and better renewable energy integration, thereby supporting energy management across public assets and infrastructure. It can be integrated, wher possible, with the city's proposed SCADA systems.

Sub Actions:

- Establish a process to record and report energy consumption data from all public buildings and service facilities, linking with proposed SCADA systems where possible.
- Develop a centralised EMS to support APCRDA in real-time monitoring and analysis of energy performance through metrics such as energy performance index (EPI in kWh per sq. m), energy intensity of water supply, seasonal consumption patterns, and peak power demand, along with energy generation and utilisation.
- The central EMS can track and benchmark energy performance (e.g. EPI < 150 kWh/sq. m per year or kWh per MLD) and help implement targeted interventions for improvement.
- Energy performance report and achievements can be disseminated to private buildings, residents and stakeholders to raise awareness and encourage adoption of solutions.

Potential locations: Centralised data command center hosted within APCRDA to monitor energy performance in all public buildings (schools, hospitals, offices, libraries) and city utility facilities (water pumping stations, STPs, street lights); linked with utility-level SCADA system

Implementing entities

Lead: APCRDA

Supporting: ADCL, utility operators, technology/service providers, IT system integrators and consultants, APSECM (for guidance and standards), SCADA system vendors/partners

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Medium term

Monitoring Indicators:

- No. or percentage of public buildings and service facilities integrated into and reporting energy data to an energy management system
- Availability and frequency of real-time energy performance reports
- Reporting and reduction in Energy Performance indicators such as EPI
- Reporting and reduction in energy intensity of urban services and facilities (e.g. kWh/MLD of water supply)
- Public disclosure of renewable energy consumption and energy savings in public buildings & utilities

Action 6: Training of public officials to support the adoption of solutions

Action details

Partner with state agencies (APCPDCL, APSECM, NREDCAP) and other technical institutions to deliver targeted training programs for departmental officials on energy management and supporting implementation of energy efficiency and renewable energy measures.

Implementing entities

Lead: APCRDA

Supporting: APSECM, APCPDCL, NREDCAP, technical partners, training and academic institutions

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- No. of departmental officials trained through certified programs
- No. of training sessions conducted in collaboration with state agencies and other institutions
- Percentage of trained departments actively implementing energy efficiency and renewable energy initiatives/projects

Strategy 1 - Financing Modes/Sources

APCRDA budget, APSECM and NREDCAP funds, EESL BEEP Scheme, ESCO and RESCO models, demand aggregation of multiple projects, MNRE's grid connected rooftop solar programme, PM Surya Ghar Muft Bijli Yojana, multilateral grants/assistance

Strategy 2: Reduce energy use by developing green, climate-responsive, and energy-efficient buildings in all zones

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Energy-efficiency in private and institutional and buildings and industries	Residential, commercial, and institutional buildings and industries with energy efficient LED lights	100%	100%	100%
	Residential, commercial, and institutional buildings and industries with high efficiency brushless DC (BLDC) ceiling fans	100%	100%	100%
	Residential buildings with high efficiency cooling appliances (atleast 4-star rated refrigerators and air conditioners)	80%	100%	100%
	Commercial and institutional buildings and industries with high efficiency cooling appliances (atleast 4-star rated refrigerators, efficient HVAC systems and air conditioners)	80%	100%	100%
	Residential, commercial and institutional buildings with energy-efficient water pumps	100%	100%	100%
Buildings built with green building measures and high energy efficiency standards	New residential buildings that are green buildings/Eco Niwas Samhita compliant	100%	100%	100%
	New residential buildings with passive cooling measures	100%	100%	100%
	New commercial and institutional buildings that are compliant to AP ECBC/ECSBC (plot area ≥ 1000 sq. m or built up area > 2000 sq. m) / certified green buildings	100%	100%	100%
	New commercial and institutional buildings with passive cooling measures	100%	100%	100%

Proposed Actions

Action 1: Integrate green building norms into zoning regulations across residential, commercial, business, industrial, logistics and education zones

Action details

In accordance with Environmental Clearance requirements, all the residential buildings, commercial and institutional complexes in Amaravati should be constructed following green building concepts to ensure

energy efficiency, low carbon footprint, and resource conservation. Such adoption will be enabled and promoted through building and zoning policy and regulations.

Sub Actions:

- Enforce green building mandates proposed for all new buildings in the AGC as per the AGC Zoning Regulations and Urban Design Guidelines, 2024 **(ongoing/planned)**
- Include compliance to AP ECBC/ECSBC norms and green building certification systems (GRIHA, EDGE, IGBC, LEED) into Amaravati's zoning regulations - covering energy efficiency, RE use, sustainable building materials, thermal comfort and smart metering, taking guidance from the building sustainability checklist of AGC's Zoning Regulations and Urban Design Guidelines, 2025 **(ongoing/planned)**
  - As per AP Building Rules, 2017, all buildings with plot area ≥ 1000 sq. m or built-up area > 2000 sq. m, whichever is higher, must comply with AP ECBC norms.
  - Multiplexes, hospitals, hotels, and convention centers must be AP ECBC-compliant irrespective of their built-up area as per the AP Building Rules, 2017.
  - Submission of green building and AP ECBC/ECSBC compliance documents required for building permit and approvals.
- Develop a guideline/guidebook for green and energy-efficient design and construction in line with NBC, ECSBC and Eco-Niwas Samhita guidelines:
  - Contextualised to Amaravati's local conditions and including easy-to-follow practical measures across different building sizes and typologies.
  - Include actions across building lifecycle including design, construction, operations and end of life.
  - No-cost/low-cost measures should be highlighted for wide-spread adoption.
- Mandate use of LED lights and promote high-efficiency appliances such as BLDC fans, air conditioners, HVAC/chiller systems, refrigerators, and common utilities (water pumps, common area lighting, lifts) in all buildings **(ongoing/planned)**
- Restrict use of diesel backup generators.
- To promote circularity, include requirements for developers to provide building decommissioning/de-construction plans for end-of-life stage, linking these to building permissions.

Potential locations: City-wide across all residential, commercial, business, industrial, logistics, and educational zones, AGC, townships, and new developments

Implementing entities

Lead: APCRDA

Supporting: AP DTCP, APSECM, APCPDCL, architects and contractors, real estate developers, , Building Materials Technology Promotion Council (BMTPC), green building agencies, technical institutes (e.g. SRM University, Acharya Nagarjuna University, SPA Vijayawada)

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- No. and percentage of new buildings (by typology) meeting AP ECBC/ECSBC/Eco-Niwas Samhita and green certification requirements annually
- No./percentage of building permits processed with green building/EE compliance documentation
- No./percentage of building projects with high-efficiency appliances and equipment adopted

- No. of building projects with deconstruction/circularity plans submitted by developers
- Guideline/guidebook for green and energy-efficient buildings published

Good Practice:

Palo Alto's 2019 Deconstruction Ordinance requires all residential and commercial demolition projects to undergo salvage assessments and mandatory deconstruction with on-site source separation of materials. This policy prioritizes reuse of salvageable components, streamlines material recycling, and maximizes material recovery, serving as a replicable model to promote circularity in construction. In **London**, new large construction and development projects need to submit a Circular Economy Statement which includes how the building will enable disassembly or reuse of components at end-of-life, as part of their planning/permit requirement for approvals.

Action 2: Integrate passive cooling measures to maximize thermal comfort and use sustainable building materials across all zones

Action details

- Prioritize passive cooling strategies in all new building designs across the city zones to minimize heat gain and limit dependence on mechanical cooling due to the city's warm, humid climate and rising temperatures. Passive cooling measures can be incorporated through appropriate orientation, daylighting and ventilation, shading, sizing of windows, and wall and roof materials as follows:

  Walls:
  - Walls of all major buildings (mid to large size) should have a U-value of less than 3.3 W/m^{2}K to improve heat insulation and reduce energy for cooling
  - Buildings with 24-hour use (e.g., hospitals, hotels, call centres) to ensure that the thermal performance of external walls and roofs conforms to ECSBC norms
  - Add thermal insulation like rock wool, glass wool, EPS or XPS panels to the inner or outer surface of external walls
  - Adopt double layered walls with air gaps or insulation material
  - Use of insulated material like autoclaved aerated concrete blocks to reduce heat conductivity

  Roofs:
  - Buildings with 24-hour use to have U-value 0.261 W/m^{2}K (24-hour use) and buildings with day-use to have U-value of 0.409 W/m^{2}K
  - Install high solar reflective index (SRI) tiles or coatings to reflect sunlight
  - Pilot green roofs, ensuring adequate structural load capacity of the walls and waterproofing and drainage to avoid seepage. Native and drought resistance species can be used to minimize water consumption.

  Windows:
  - High performance glazing and glass with low U value < 3.3 W/m^{2}K in all major buildings
  - Provide shading such as overhangs, fins or vegetation
  - Enable cross ventilation by aligning windows and vents with prevalent wind direction

- Use sustainable, low-carbon construction materials, considering the significant building construction to be undertaken
    - Promote use of locally sourced (within a 50-60 km radius) and certified low-carbon building materials, recycled C&D waste and its products.
    - Establish mandates for procurement and use of C&D waste materials in public, commercial, residential and institutional buildings, subject to stringent quality control.
    - Develop protocols for deconstruction and disassembly of old buildings or structures instead of demolition to help salvage and reuse materials.

Potential locations: City-wide across all residential, commercial, institutional, business, industrial, logistics, and education zones, AGC

Implementing entities

Lead: APCRDA

Supporting: AP DTCP, BMTPC, architects, contractors, real estate developers and academic/research institutes (e.g. SPA Vijayawada), green building agencies

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- Percentage of new buildings by typology adopting passive cooling measures and meeting related standards for building components (from annual building permit records)
- No. and area of green roofs and cool roofs implemented
- Thermal comfort measurements (indoor temperatures) or simulated 'cooling degree days' improvement from cooling measures in completed buildings
- Percentage of new buildings using locally sourced/recycled or certified low-carbon materials
- Mandate for C&D waste utilization developed and published
- Notification or publication of SOP/guideline for demolition/decommissioning plans

Good Practice:

Technical Guidelines to achieve heat-resilient and sustainably cooled buildings in **Vijayawada**, that are suited to the city's warm and humid climate, can be readily applied to Amaravati given the close proximity to Vijayawada. The guidelines are based on field evaluations of diverse building types existing in Vijayawada - including schools, hospitals, auditoriums, and social housing. They have been prepared by ICLEI South Asia in collaboration with Vijayawada Municipal Corporation and support from C40.

The guidelines include passive and active cooling strategies like natural ventilation, shading, reflective materials, insulation, low-carbon and efficient HVAC systems, and renewable energy integration. They are aligned with national standards (ECBC, NBC) and include cost estimates across specific solutions, along with available financial incentives. Designed for application across all building typologies (residential, commercial, institutional, industrial buildings) and include solutions that can implemented at various building stages – design stage, selection of building materials and as retrofit measures.

Action 3: Partner with green building agencies and implement pilot projects

Action details

Partnering with green building agencies will help to understand opportunities, build awareness, demonstrate/pilot solutions, and implement at-scale measures and green building standards. This action will provide enabling support to have all new constructions as green and resource efficient buildings and align with the Amaravati vision of a sustainable city.

Sub Actions

- Partner with green building accreditation agencies (e.g. GRIHA, IFC-EDGE, IGBC or LEED) to support green building adoption through third-party verification, training for architects and city planners, and sharing of best practices **(ongoing/planned).**
- Implement pilot projects in housing, institutional/educational and private buildings projects to demonstrate passive design measures, sustainable building materials, energy efficient equipment, RE interventions, and energy monitoring solutions at the building-scale.
- Adopt sustainable building materials and construction techniques standardized by Building Materials Technology Promotion Council (BMTPC) and relevant organizations such as IGBC, GRIHA. Ensure integration by modifying appropriate clauses of 'Schedule of Rates' notified by Andhra Pradesh public works department as well as guidelines and regulations set by APCRDA for development in Amaravati.
- Develop and publish a list of empanelled green building vendors consisting of material suppliers and technology/service providers, including accredited vendors of IGBC, EDGE, GRIHA, BMTPC.

Potential locations: AGC, affordable/social housing projects, new institutional (schools, universities), public offices, hospitals, and commercial buildings coming up in the near-term

Implementing entities

Lead: APCRDA

Supporting: AP Roads and Buildings, AP DTCP, APSECM, AP Housing Board, IGBC, GRIHA, EDGE, BMTPC, architects/builders, academic/research institutions, contractors, Public Works Dept (for Schedule of Rates modification)

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short to Medium term

Monitoring Indicators:

- No. of pilot green buildings developed and certified by typology (residential, public, private, institutional) and their impacts/benefits (e.g. energy and water saving, GHG reduction)
- No. of architects/planners completing trainings from green building certification/third-party agencies
- Amendments/notification to Schedule of Rates and Amaravati's building regulations/guidelines to incorporate sustainable building materials and construction techniques
- Publication of list of accredited and empanelled green building vendors and materials suppliers

Good Practice:

The **city of Adeliade** has adopted a collective approach to achieve its targets under the Carbon Neutral Adeliade Plan. Low carbon services and solutions can be availed through a publicly accessible directory of 190+ organizations across 13 service categories including energy services, building design, printing, events/venues among others. The Carbon Neutral Adelaide Partner Program enables partners to participate in Adelaide carbon neutrality efforts, recognizing their contribution and commitments.

Singapore's Building and Construction Authority (BCA) publishes a directory of its accredited professionals/suppliers, enabling public agencies and private developers to match green building projects with pre-qualified consultants, materials and service providers.

Action 4: Incentivise green building certification for private buildings

Action details

Offering supporting incentives can help promote and accelerate the adoption of green building standards across different types of private buildings. Incentive options offered should motivate building developers and owners to adopt the highest levels of green building certification and energy efficiency standards.

Existing initiative

Incentives offered to AP ECBC-compliant and green certified buildings as per AP Building Rules, 2017 include i) 20% discount on building permit fees, staggered payment of development charges allowed in four installments, and a 20% reduction on stamp duty for property sold within three years.

Sub Actions

- Offer appropriate fiscal and non-fiscal incentives such as fast-tracked approval, building permit fee discounts, tax rebates, additional FSI, reimbursement of certification fees or consulting charges for new apartments, business parks, commercial, industrial, and logistics buildings.
- Review incentives periodically in consultation with stakeholders to ensure benefits offered adequately reflect incremental costs and evolving market conditions.
- Ensure compliance to green building norms during construction phase and post-occupancy.

Potential locations: New and ongoing private projects across Amaravati city including housing, apartment complexes, business and IT parks, commercial offices, warehousing, and logistics hubs; with initial focus on large-scale developments and projects in growth corridors.

Implementing entities

Lead: APCRDA

Supporting: Green building and financial experts, independent verification agency to conduct monitoring and evaluation

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short to Medium term

Monitoring Indicators:

- No. of building projects by typology that are provided with appropriate incentives
- Frequency of review of green building incentives
- No. of new private buildings by typology with green building certification (by rating type)
- Percentage of buildings with post-occupancy audits and complying to green building norms

Good Practice:

Singapore's Green Mark Incentive Schemes have helped achieve significant large-scale adoption of green and energy efficient buildings, with the Building and Construction Authority (BCA) offering grants for audits, retrofits, and new high-performance designs, along with regulatory support such as floor area bonuses and reduced development charges. As of end-2022, the Green Mark programs had helped to green about 55% of Singapore's buildings (by gross floor area). Singapore had nearly 2,600 Green Mark–certified buildings in 2025, which together save over 4.2 billion kWh annually. Key highlights of the schemes include incentives that promote higher-tier green rating, strong emphasis of energy efficiency to achieve incentives, and financial support extended for architects and engineers to enable design of sustainable buildings in addition to developers and home-owners.

Action 5: Promote enhanced building energy performance and reporting

Action details

Monitoring of energy performance can help to progressively optimize and reduce energy consumption across buildings in data-driven manner through targeted interventions. Energy performance can be tracked for larger buildings at first and expanded gradually to cover city-wide buildings.

Sub Actions:

- Outline clear requirements in the zoning regulations for all major mid to large-size buildings and complexes to achieve an EPI of less than 150 kWh/sq. m. per year.
  - Promote minimum EPI standards across commercial, institutional, and residential buildings in a phased manner, with mandates established in a time-bound manner.
  - Update EPI standards progressively over time for different building typologies.
  - Include conditions to undertake periodic energy performance improvement and implement actions to meet EPI requirements.
- Promote Building Energy Management Systems in mid to large size buildings and complexes.
- Link smart meters with mobile applications with the support of APCPDCL and APSECM to provide real-time energy use alerts and recommendations to consumers.
- Establish process for private and public buildings to report energy performance periodically (bi-annually/annually).
  - Can target mid to large size buildings in the near-term and extend to city-wide buildings in a phased manner.
  - Track energy use patterns, compare energy performance against local buildings and national benchmarks, and support targeted energy efficiency retrofits.
  - Provide a pool of certified energy auditors, service and solutions providers to support energy audits and identify energy improvement measures in high energy use buildings.
  - Building owners and occupiers can implement solutions to improve energy performance and meet minimum energy use benchmarks.

Potential locations: Central business districts, large public and institutional buildings, high density residential zones, industrial and logistics parks

Implementing entities

Lead: APCRDA

Supporting: APSECM, APCPDCL, BEE, certified energy auditors, building owners and developers

Type of action: Climate Mitigation
Climate resilience benefits: Medium
Timeline: Short to Medium term
Monitoring Indicators: • No. of buildings by typology reporting energy performance annually • No. and floor area of buildings by typology achieving EPI norms or benchmarks • No. or percentage of buildings equipped with smart meters and EMS/BEMS • Annual reduction in EPI and energy saving achieved by buildings • Percentage of non-compliant buildings receiving support for corrective action • No. of energy audits completed and followed by implementation of energy performance improvement measures
Good Practice: The **Frederiksberg Municipality in Copenhagen** had 40% of its energy consumption coming from public buildings. The municipality implemented a central energy management system to track its energy consumption and has achieved 8% electricity savings and 6% reduction in heating demand. This was achieved through installation of smart meters at building and facility level, by analyzing granular data with hourly time intervals, and consultations with public officials and citizens through capacity building and training programs to optimize the equipment use based on analysis provided by the EMS. **Hong Kong's** Energy Use Benchmarking Program provides an online tool that allows building owners to compare their electricity consumption performance with similar building types. This benchmarking initiative covers residential, commercial, and transport sectors, helping users identify energy-saving opportunities and improve efficiency.

Action 6: Expand and institutionalize the AGC Urban Design Committee (UDC) and team into a city-wide Green Building Promotion Department
Action details An Urban Design Committee (UDC) and Urban Design team is in place at present to support adoption of green building and sustainable urban design measures within the AGC area. The role of the AGC UDC and the Urban Design team can be expanded to review, approve and monitor city-wide public and private projects, beyond the AGC area. **Sub Actions:** • A 'City Urban Design or Green Building Promotion' department or team can be institutionalized to promote and ensure compliance with AP ECBC/ECSBC norms and green building standards. • Include subject experts such as green building accredited professionals, low-carbon construction and materials experts into the team to review building project proposals across the city and improve their environmental performance. • Establish a centralised approval and monitoring system for upcoming buildings in Amaravati, using standardized templates for developers/owners, outlining key building energy and sustainability performance criteria to be integrated into the building approval process.

• Conduct periodic performance reviews, identify challenges and implement corrective and enabling actions in consultation with stakeholders.
Implementing entities **Lead:** APCRDA **Supporting:** AP DTCP, APSECM, Green building agencies, external subject experts, BMTPC, academic institutions, architects/builders associations
Type of action: Climate Mitigation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Relevant department or team established with staff and experts to support green and sustainable building adoption • No./percentage of building permit applications reviewed and approved including AP ECBC/ECSBC/Eco-Niwas Samhita/green building certification compliance • No./percentage of public/private projects monitored post-occupancy for sustainability performance • Increase in certified green buildings and AP ECBC/ECSBC-compliant permits city-wide • Annual publication of city building sustainability performance on dashboards, websites or other media

Strategy 2 - Financing Modes/Sources

APCRDA budget, APSECM funds, BEE's Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE,) Partial Risk Sharing Facility for Energy Efficiency (PRSFEE) Scheme, EESL's Building Energy Efficiency Programme (BEEP), PPP/building developer and owner/occupant contributions, ESCO model, affordable/green home loans from banks, UJALA Scheme and Energy Efficient Fans Programme, bulk procurement for lower costs, multilateral grants/assistance, CSR for pilots

Strategy 3: Integrate Climate-Resilient Design and Thermal Comfort

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Mandate passive cooling and thermal comfort standards in all new buildings	New buildings complying with applicable passive cooling and thermal comfort standards	100%	100%	100%
Cool roofs in new and existing buildings	New public and residential buildings with high-SRI/ cool roofs	100%	100%	100%

Action Area	Target Parameter	2028	2043	2058
	Existing buildings retrofitted with cool roofs	50%	100%	100%
Green cover and façade greening	At least 20% rooftop area in public buildings and large private developments with plot area > 4000 sq. m to be green roofs	100%	100%	100%
	Buildings with rooftop gardens and façade greening	30%	50%	70%
Integrate flood-resilient design in building constructions	New plots with recharge pits, permeable paving and RWH system	100%	100%	100%

Proposed Actions

Action 1: Deploy localized cooling interventions for vulnerable zones and public spaces

Action details

Deploy localised cooling interventions such as cool roof retrofits, enhanced insulation, improved natural ventilation, and increased green cover in heat-vulnerable spaces, including schools, anganwadis (child-care centres), healthcare facilities and street markets. It can help reduce UHI effect, improve thermal comfort and reduce health risks, especially in zones and spaces with high footfall populations and vulnerable groups of population.

Sub Actions

- Identify existing vulnerable buildings such as schools, anganwadi's, health care centres and other buildings for insulation and natural ventilation upgrades, cool roof retrofits.
- Undertake periodic monitoring of green space provision in properties/buildings as per Urban Design and Architectural guidelines, Zoning Regulations and other regulations prior to issuing occupancy certificate.
- Identify locations of street vendors, public markets and public transit stations to implement facilities (shelters, drinking water, green cover, cool roofs) to reduce heat vulnerability.

Potential locations: All government and private schools, especially in zones with high density and higher land surface temperature; primary health care, hospitals, urban clinics across commercial, institutional and residential zones; major transport terminals and stations; vending zones in mixed-use (C1–C3), town center (C4), and regional center (C5) zones.

Implementing entities

Lead: APCRDA

Supporting: ADCL, Health, Education, and Women & Child Welfare Departments, NGOs, RWAs, green building agencies, architects and contractors, solution providers,

Indicative cost:

Cool roof tiles can cost between Rs. 120-150 including product, labour and installation. Cool roof paint can cost around Rs. 1300 for 4 liters.
Type of action: Climate Adaptation
Climate resilience benefits: High
Timeline: Short to Medium term
Monitoring Indicators: • No. of schools, anganwadi's and health facilities with cooling interventions implemented • No. of public markets, vendor sites, and public transport stations with cooling interventions (shelters, shade, drinking water, cool roofs) implemented • No. and percentage of buildings/properties complying to green area provision norms and total sq. m. of green area/spaces provided • Reduction in average and peak temperatures (indoor/outdoor), sampled in targeted locations, buildings, and public spaces
Good Practice: A study in **Ahmedabad's** informal settlements demonstrates that easily implementable cooling interventions such as reflective paint, thermocol insulation or mud roof significantly lower temperatures in informal housing compared to metal or cement roofs, improving heat resilience and offering scalable, cost-effective solutions for low-income settlements.[12]

Action 2: Mandate passive cooling and thermal comfort standards in all new buildings
Action details Mandating passive cooling and thermal comfort standards ensures buildings inherently remain cool and comfortable with significantly reduced dependence on air conditioning or mechanical ventilation. This intervention helps to deliver thermally comfortable environments to citizens with lower energy demand, and supports emissions reduction and mitigation of the urban heat island effect. **Sub actions:** • Enforce compliance with AP ECBC/ECSBC and Eco-Niwas Samhita for thermal comfort requirements • Enforce mandatory use of passive design elements such as building orientation, cross ventilation, external shading, ventilated roof and insulated envelopes in all buildings **(ongoing/planned)** • Include passive cooling requirements in building permit applications, design briefs, and development control regulations.
Potential locations: Applicable to all new residential, commercial, institutional, and industrial buildings across all zones. Could be demonstrated in government complexes and newly developed residential layouts.
Implementing entities

[12] Combating Climate Change-induced Heat Stress: Assessing Cool Roofs and Its Impact on the Indoor Ambient Temperature of the Households in the Urban Slums of Ahmedabad. Accessed 17th August 2025.

Lead: APCRDA
Supporting: DTCP, APSECM, ADCL, architects, contractors, real estate developers, BMTPC

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- Percentage of new buildings complying with thermal comfort requirements as per AP ECBC/ECSBC/Eco-Niwas Samhita at permit application and completion
- Percentage of new buildings with specified passive design features (orientation, shading, insulation, ventilated roofs) implemented
- Reduction in average cooling energy intensity (kWh/sq.m) in new buildings

Good Practice:

Surat's IGBC Platinum-certified office building of the Diamond Bourse incorporates several measures including building orientation, stack ventilation, shaded courtyards, vertical fins, and radiant cooling to reduce energy demand by 50% compared to benchmark consumption in similar buildings as per ECBC.

Action 3: Promote cool roofs in new and existing buildings

Action details

Promoting cool roofs across Amaravati involves developing a comprehensive, city-wide implementation plan focused on phased adoption in areas prone to higher heat intensity such as dense urban clusters and vulnerable settlements. Cool roofs can help lower surface and indoor temperatures, reduce energy demand for cooling, improving health and comfort for residents, and reduce urban heat island effect.

Sub Actions:

- Develop a city-wide cool roof implementation plan targeting phased coverage in high-heat intensity zones.
- Provide incentives and guidelines for both builders and homeowners to install cool roof solutions in new and existing buildings.
- Use low-cost cooling solutions in existing village settlements to quickly reduce heat stress among the most exposed populations.
- Promote high solar reflective index (SRI) roofing and ventilated attic spaces in public and private buildings to reduce indoor heat gain and cooling loads.

Potential locations: Public buildings, schools, hospitals, existing residential areas and village settlements, new residential apartments, commercial and industrial roofs

Implementing entities
Lead: APCRDA
Supporting: AP DTCP, architects, contractors, real estate developers, NGOs, community organisations

Indicative cost:
Cool roof tiles can cost between Rs. 120-150 including product, labour and installation. Cool roof paint can cost around Rs. 1300 for 4 liters.

Type of action: Climate Adaptation; Climate Mitigation
Climate resilience benefits: Medium
Timeline: Short to Medium term
Monitoring Indicators: • Publication of city-wide cool roof implementation plan • Area (sq. m) of cool roofs installed annually (new and retrofitted) • Percentage of new buildings with high SRI/cool roofs • No./percentage of existing homes with cooling solutions implemented • Reduction in average indoor and surface temperatures at cool roof implementation sites • No. of policy and incentive beneficiaries
Good Practice: In **Hyderabad**, cool roofs in households were able to reduce cooling energy demand by 10-19% in the top floor of buildings, lowering indoor air temperature by 2^0C. High-density polyethylene (HDPE) cool roof membranes were piloted in a low-income neighborhood in the city. Similarly cool roof coating demonstrated in two office buildings in Hyderabad reduced roof surface temperatures by 5°C and cooling energy use by 15-20% during summer.

Action 4: Enhance green cover and vertical greening
Action details Expanding urban greenery on roofs and façades directly lowers surface and ambient temperatures, reduces cooling loads and improves thermal comfort. This intervention delivers multiple benefits for a hot-humid greenfield city like Amaravati. Amaravati's Master Plan emphasizes extensive green–blue networks and pollution prevention. The EC/NGT conditions call for plantations using native, multi-use species to protect ecological diversity. Embedding rooftop/vertical greening into zoning approvals and tying compliance to building occupancy permission process helps to operationalize these requirements and supports city-wide green cover. **Sub Actions** • Mandate at least 20% of rooftop area in public buildings and large private developments with plot area > 4000 sq. m. plot area to be green roofs **(ongoing/planned)** • Promote rooftop gardens and façade greening for all buildings with adequate structural load bearing capacity **(ongoing/planned)** • Implement vertical gardening through the use of native species to keep structures cooler • Undertake periodic monitoring of green space provision in properties/buildings as per zoning/byelaws before issue of occupancy certificate.
Potential locations: AGC- office buildings, public buildings; large private developments across C1–C6 commercial, I1–I3 non-polluting industry, and R3–R4 higher-density residential zones; priority corridors and areas susceptible to heat
Implementing entities **Lead:** APCRDA

Supporting: AP DTCP, architects, contractors, real estate developers, NGOs, community organisations
Indicative cost: Rooftop garden installation costs approximately Rs. 800 per sq.ft.[13] including the cost of the rooftop garden layer and installation.
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short to Medium term
Monitoring Indicators: • Percentage of new public buildings with rooftop/vertical greening installed and maintained • Percentage of large private developments (by built-up area threshold per zoning/building rules) implementing mandated rooftop/façade greening • Total green roof/façade area implemented (sq. m.) and annual native species survival rate (%) • Estimated impact (such as annual cooling energy reduction or indoor/surface temperatures) from green roofs/façades • No. and percentage of buildings/properties complying to green area provision norms and total sq. m. of green area/spaces provided

Action 5: Integrate flood-resilient design in building constructions
Action details Given Amaravati's location along the banks of the River Krishna and anticipated flooding risks due to its low-lying topography and climate impacts, integrating flood proof designs and measures into buildings constructed is important. **Sub Actions** • Mandate elevated plinth height and floor level elevation standards in all buildings located in low-lying or flood-prone areas as identified in flood mapping by APCRDA **(ongoing/planned)** • Elevate the critical electrical and power infrastructure above expected flood levels to prevent water damage and service disruption. • Mandate on-site stormwater management measures such as recharge pits, rainwater harvesting systems and permeable paving to minimize runoff and waterlogging at the plot level. • Ensure flood resilient features are included in building approvals and tender documents, and link occupancy certificates to verified compliance.
Potential locations: All buildings in low-lying/urban flooding-prone zones within Amaravati as identified by flood mitigation and hydrological studies. New development areas in expansion zones adjacent to riverbanks, drainage channels, and stormwater catchments
Implementing entities **Lead:** APCRDA **Supporting:** Planning department, Engineering and Public Works Department, Geotechnical consultants
Type of action: Climate Adaptation

[13] R Dhivya Barathi and R Vidjeapriya, 2022, IOP Conf. Ser.: Earth Environ. Sci. 1086 012006

Climate resilience benefits: Medium
Timeline: Short term
Monitoring Indicators: • Percentage of new buildings in flood-prone areas complying with minimum plinth height and floor elevation standards • Percentage of building proposals including on-site stormwater management measures • Percentage of occupancy certificates issued only after verified compliance with flood resiliency features • No. of awareness/training workshops held for developers and residents on flood resilient construction
Good Practice: Rebuild Kerala Development Programme mandated elevated plinths, stilt construction in flood zones, corrosion-resistant materials, onsite rainwater management in reconstruction projects after the 2018 floods, reducing vulnerability in low-lying areas.

Strategy 3 - Financing Modes/Sources
APCRDA budget, AMRUT scheme, APSECM funds, EESL's Building Energy Efficiency Programme (BEEP), PPP/building developer and owner/occupant contributions, bulk procurement for lower costs, affordable/green home loans from banks, multilateral grants/assistance, climate adaptation funds, CSR contributions

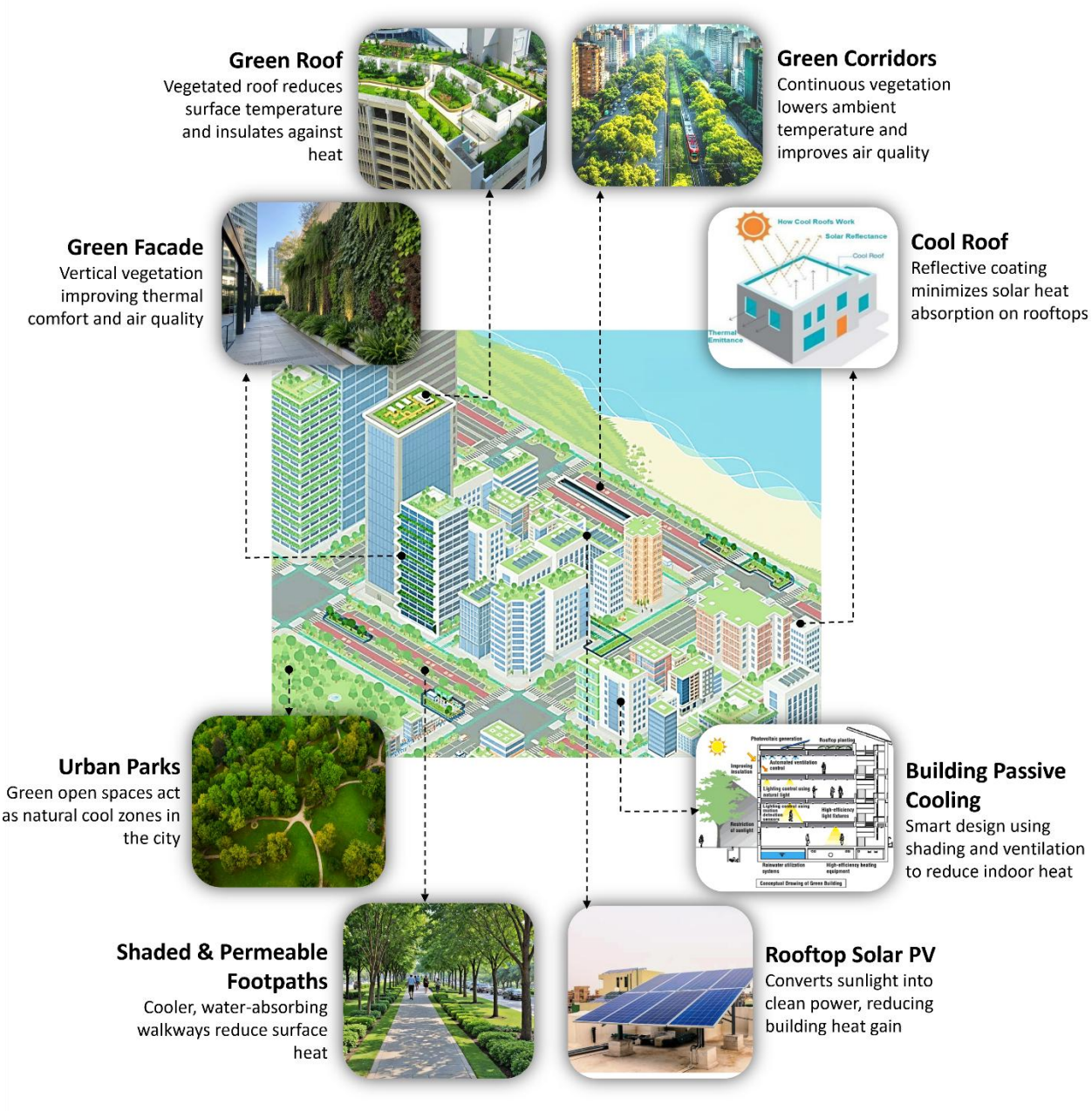


Figure 2-1: Interventions to mitigate Urban Heat Stress

Integrating Interventions for Thermal Comfort and Reduced Heat Stress

Amaravati's rapid development as a greenfield capital presents both opportunities and challenges in addressing urban heat, water scarcity, and livability concerns. As construction activity expands, increasing impervious surfaces, limited vegetation, and reduced airflow heighten urban heat island effects, aggravating heat stress and energy demand. These issues are further compounded by climate projections indicating a rise of 1 to 2.4°C in maximum temperatures by 2078 and more frequent heatwaves[14]. To mitigate these risks, it is important that Amaravati's urban design adopts an integrated, multi-layered cooling approach that links built form, landscape, and renewable energy systems.

City and Neighbourhood Scale Interventions

At the city level, Amaravati promotes a blue-green network that integrates green corridors, urban parks, and shaded, permeable footpaths to regulate microclimate and manage stormwater. These interconnected systems form ecological spines that link open spaces, water channels, and vegetation belts across the city.

- Green corridors—tree-lined streets and vegetated links—facilitate air circulation, lower surface and ambient temperatures, and act as wind channels that disperse trapped heat and pollutants.
- Urban parks and open spaces serve as thermal sinks that absorb carbon dioxide and provide shade, while also functioning as community recreation zones that improve well-being.
- Permeable and shaded footpaths use high albedo materials and vegetation to reduce heat storage, allow groundwater recharge, and offer pedestrian comfort even during peak heat hours.

Building-Level Interventions

At the building scale, Amaravati's planning and design guidelines promote energy-efficient and climate-responsive buildings through a mix of green infrastructure and passive cooling techniques:

- Green roofs add a vegetative layer that insulates buildings, reduces rooftop temperature, and minimizes heat absorption while providing stormwater retention benefits.
- Cool roofs coated with reflective, high-SRI materials deflect solar radiation, lowering indoor temperatures and air-conditioning loads.
- Green facades improve air quality, reduce wall heat gain, and enhance aesthetics while acting as noise and dust barriers.
- Passive design measures - optimized orientation, cross-ventilation, shading devices, and insulated envelopes - reduce reliance on mechanical cooling systems and create thermally comfortable indoor environments.
- Rooftop solar PV systems generate renewable energy while shading roofs, further reducing heat absorption and emissions from grid-based power use.

These measures not only improve building energy performance but also contribute to urban-scale heat mitigation, demonstrating how design decisions at the micro level influence macro-level climate resilience. By embedding these measures into master planning, development control regulations, and building codes, Amaravati can ensure that every layer of its urban fabric—streets, buildings, and open spaces—contributes to climate adaptation and mitigation. This approach not only reduces urban heat and enhances livability.

[14] Climate projections as per Hydrological and Climate Modelling of Solapur and Vijayawada cities by IIT Madras, 2019 under RCP 4.5 and RCP 8.5. Representative Concentration Pathway (RCP) scenarios describe different trajectories for greenhouse gas concentrations and the resulting radiative forcing (energy added to the climate system) by 2100.

Strategy 4: Integrate clean energy and renewables to meet energy requirements

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Renewable energy adoption in buildings	Electricity consumption in residential buildings to be met by renewables	40%	75%	100%
	Electricity consumption in commercial and institutional buildings and industries to be met by renewables	40%	75%	100%
	Solar Water Heaters to meet at least 20% of hot water requirements in multi-story residential apartments and complexes, hospitals, government buildings, residential schools, educational institutions, hostels and industries (with plot area > 500 sq. m)	100%	100%	100%
Adoption of electric cooking	Residential buildings using electric cooking (powered by renewables)	0%	5%	10%
	Commercial and institutional buildings using electric cooking (powered by renewables)	0%	10%	15%

Proposed Actions

Action 1: Develop Sustainable Energy Transition (SET) Roadmap for Amaravati

Action details

A SET Roadmap will provide a city-wide blueprint to decision-makers, planners, and utilities to phased adoption of high level of renewables. It will target round-the-clock RE supply through both on-site decentralised sources (within the city) and off-site large megawatt scale RE sources (from outside of Amaravati and the capital region). The roadmap will a unified strategy and specific actions to support large-scale RE procurement and integration and identify innovative business models to significantly reduce costs, create local employment, and ensure that power demand for buildings, infrastructure and electric vehicles is powered by green energy.

Sub Actions

- Assess technologies including solar, wind, waste to energy, bio-CNG, bio-methanation, combined heat and power systems, battery energy storage, pumped hydro storage.
- Identify phase-wise targets for renewables including solar PV, solar water heating, wind, waste to energy and biomass until 2058.
- Allocate buildings across residential, commercial, industrial, education and healthcare zones demarcated for solar rooftop and solar water heater installation.
- Solar PV targets for new warehouses, IT parks, and non-polluting industries

• Identify targets and sites for solar and wind-powered public infrastructure such as water supply facilities, sewage treatment plants, streetlights, waste facilities, bus stops and depots, and for EV charging infrastructure in line with EV targets. • Business models for end-use related to bio-CNG. Identify locations if decentralized bio-methanation plants (e.g. near proposed vegetable markets) • Develop a dashboard to monitor RE installation, electricity generation and emissions savings • Identify financing options including private investment, public funds, low-interest or concessional loans, climate finance along with mechanisms to support small and large-scale RE projects.
Implementing entities **Lead:** APCRDA **Supporting:** ADCL, NREDCAP, APCPDCL, APIIC, technical consultants and renewable energy developers.
Estimated targeted scale Renewable energy in residential buildings: 2028 – 58 million kWh 2043 – 1,151 million kWh 2058 – 3,426 million kWh Renewable energy in commercial buildings: 2028 – 47 million kWh 2043 – 928 million kWh 2058 – 4,249 million kWh Renewable energy in industrial buildings: 2028 – 17 million kWh 2043 – 335 million kWh 2058 – 1,535 million kWh
Indicative cost: Renewable energy in residential buildings: 2028 – 16,734 lakh INR 2043 – 333,194 lakh INR 2058 – 991,584 lakh INR Renewable energy in commercial buildings: 2028 – 13,487 lakh INR 2043 – 268,547 lakh INR 2058 – 1,229,677 lakh INR Renewable energy in industrial buildings: 2028 – 4,874 lakh INR 2043 – 97,051 lakh INR 2058 – 444,399 lakh INR
Type of action: Climate Mitigation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Phase wise renewable capacity installed (MW)

- Percentage of total city electricity consumption met by renewables
- No. of buildings/zones with rooftop solar and solar water heating
- Renewable energy generation and GHG emission savings tracked via dashboard
- Capacity of decentralized renewable installations

Good Practice:

Vancouver has committed to a target of 100% renewable energy use by 2050. Its Renewable City Strategy sets out interventions focusing energy demand reduction, zero-emission new buildings, deep retrofits, increasing renewable energy use, and expanding renewable energy supply – primarily in buildings, transport and city infrastructure**.** It integrates detailed land use planning, energy-efficient building standards, renewable neighborhood energy systems, and electrification of transport. Vancouver's approach includes partnerships, public engagement, and innovation support, aligning with regional, provincial, and federal policies.

Action 2: Promote at-scale adoption of green renewable power

Action details

To meet Amaravati's goal of becoming fully renewable powered, enabling interventions on policy, regulation, facilitated and aggregated deployment, business models, investments and awareness will be crucial. These actions will result in wide-scale adoption of on-site and off-site renewable energy solutions across commercial, institutional, industrial, public, residential buildings and complexes, helping significantly reduce the city's carbon emissions and energy costs.

Sub Actions

- Ensure solar-ready rooftops though requirements in zoning regulations and guidance on rooftop structural design, strength, utility placement, and shadow avoidance. In line with AGC Regulations, city-wide buildings can have 50-70% of roof area dedicated to solar PV or solar water heating depending on building needs. **(ongoing/planned partly)**
- Enforce requirements to adopt RE in:
    - Commercial and institutional properties (plot area> 1,000 sq. m or built-up area> 2,000 sq. m.), multiplexes, hospitals, hotels, convention centres as per AP ECBC, 2019/ECSBC 2024.
    - Group apartments of 100+ units, nursing homes, hospitals and hotels to deploy solar water heating and solar lighting systems, with 15% of external lighting in residential complexes and 5% in commercial/institutional buildings to be powered by RE.
- Encourage major private sector, commercial, institutional and industrial consumers with high consumption to integrate high level of RE-based electricity from an early-stage, through both on-site RE and off-site green power purchase.
- Facilitate aggregated procurement and deployment of solar PV for a group of commercial, institutional, residential and industrial consumers, through group captive models and community pooling of small-scale RE projects.
- Implement awareness campaigns to promote RE adoption among consumers and community.
- Publish a regional list of empaneled solar PV and solar water heating vendors aligned with lists of APCPDCL and NREDCAP. Facilitate partnerships with local/regional solar companies for discounted bulk procurement and coordinated group-scale installations.

- Support innovative space-efficient solar PV deployment through elevated structures (e.g. 'Ojas') and solar carports.
- Expand the district cooling network beyond the AGC area to serve high cooling demand of large commercial and institutional buildings, shopping malls, hotels and hospitals in the CBD and high-density commercial zones in the mid-term.
- Pilot emerging solutions in the short to mid-term including:
    - building integrated PV solutions (solar roof tiles, solar facades, BIPV skylights, curtain walls, shading devices, solar windows in glass facades of CBD and commercial zones)
    - battery energy storage systems (for applications such as maximising RE utilisation, energy management, maintaining grid operations, optimizing power distribution at substation)
    - floating solar deployment (while evaluating ecosystem, biodiversity and environmental impacts) reuse of EV batteries as second life battery energy solutions for stationary applications (EV charging, renewable energy storage, energy management)
    - hydrogen fuel cells for buildings
    - use of EV-charging facility to provide grid support

Potential locations: AGC, commercial & institutional buildings, large residential townships, group apartments, hotels, hospitals, multiplexes, IT parks, warehouses.

Implementing entities

Lead: APCRDA

Supporting: APCPDCL, NREDCAP, APSECM, RESCO companies, renewable technology and service providers, academic & research institutions involved in clean energy and building innovations.

Indicative cost:

Rooftop solar PVs approximately cost INR 75,000 for a 1 kW system

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- Total installed RE capacity (on-site/off-site) and increase in RE adoption year-on-year
- Percentage of total city-wide electricity consumption met through renewables and sector/consumer-category-wise breakup (residential, commercial, industrial)
- Installed rooftop solar PV capacity (MWp) annually
- Percentage of new buildings/properties complying to RE adoption requirements, including solar-ready rooftops
- No. and installed capacity of large-scale aggregated RE adoption projects completed
- Capacity of district cooling network and floor area (sq. m.) served
- No. of RE vendors and solution providers empaneled and actively participating in RE deployment
- No. and outreach of awareness and promotional campaigns completed
- No. of pilot installations and operational status of advanced and innovative renewable and grid support technologies.
- Cumulative GHG emissions avoided from RE adoption annually

Good Practice:

The **City of Melbourne** led the creation of the Melbourne Renewable Energy Project in 2017 - a collective effort by 14 public and private institutions, including universities, banks and local councils to purchase large-scale renewable energy – which supported development of a new wind farm of 80 MW. The buying group committed to purchase 88 GWh annually (over 1/3rd of the wind farm's capacity) under a long-term power purchase agreement. This pioneering initiative subsequently led to Melbourne switching to 100% renewable-based municipal operations from the same wind farm in 2019. It also brought additional RE into the market with long-term price certainty. Building on this success, the city of Melbourne facilitated a second round of aggregated RE procurement in 2020 – with seven large energy users including universities, property companies and manufacturers to procure 110 GWh annually from a wind farm.

The DISCOM, **BSES Rajdhani Power,** facilitates rooftop solar adoption by consumers in **Delhi** through a one-stop-shop portal. The portal serves as a single point source of information, with detailed guidance and step-by-step facilitation for submission of applications and installation of rooftop solar PV by empanelled installers.

Action 3: Use scalable implementation mechanisms and financing models

Action details

Testing and adopting innovative mechanisms and financing models is pivotal to help realize ambitious RE adoption across Amaravati city. By leveraging a mix of on-site, off-site, physical, and virtual RE solutions with the best-fit financing and implementation models, Amaravati can maximize integration of green energy across diverse consumer categories from households and apartments to commercial and institutional establishment, while optimizing financial returns for consumers.

Sub Actions

- Utilise on-site, off-site, physical, and virtual renewable energy mechanisms (e.g., net metering, open access, renewable energy certificates, feed-in tariffs, carbon offsetting) to optimize financial returns and enhance integration of renewables.
- Test and adopt innovative investment and business models such as CAPEX, RESCO, captive, group captive, rent-a-roof, subscription, demand aggregation (DISCOM-led/city-led) for different consumers to tap into private investments as per the building typology, size and energy demand. Such models ensure consumers obtain quality products at competitive prices.
- Encourage innovative service solutions such as the integrated utility services model for mid to large-size commercial and institutional consumers, wherein an energy service provider delivers a bundled package of energy services to consumers — including electricity supply, rooftop solar installation, energy efficiency upgrades, and maintenance.

Potential locations: City-wide across residential (including affordable housing), commercial, institutional, and government zones targeting public buildings, hospitals, hotels, large residential and commercial complexes, business and industrial parks, universities, schools and institutional buildings.

Implementing entities

Lead: APCRDA

Supporting: ADCL, NREDCAP, APCPDCL, private RESCOs, technology and service providers, EPC contractors, RWAs, building owners/operators

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- No. of buildings/consumers adopting innovative and market-based RE implementation models
- Installed RE capacity and generation by implementation/business models deployed

Good Practice:

The Boston Community Choice Electricity (BCCE) is a municipal aggregation program facilitated by the City of **Boston**, that allows community members to opt for using renewable powered electricity. Consumers, including residents and businesses, can choose to enroll in the Optional Green 100 rate, with 100% of electricity coming from RE sources, thereby supporting Boston in reducing carbon emissions.

In **Hyderabad,** the Telangana State Renewable Development Corporation (TSREDCO) undertook aggregated rooftop solar installations across government and residential buildings. Over 27 MW of rooftop solar PV capacity was deployed between 2017-2019, with an investment of USD 24 million through RESCO and CAPEX modes.

Action 4: Pilot community-scale solar in existing settlement zones (such as R1)

Action details

By piloting community-scale shared solar solutions in existing settlement zones, Amaravati can leverage its greenfield status to effectively introduce renewable energy access and resilience in its community. A decentralised approach empowers communities with locally managed clean energy, reducing dependence on the grid while promoting social inclusion through livelihood opportunities for community groups, including women and youth.

Identify areas within existing settlement-based zones such as the R1 zone, having clustered housing and shared infrastructure such as schools, community centers or Anganwadis to pilot shared solar PV solutions such as:

- Rooftop solar PV on community buildings or schools, with power supplied to nearby households by net-metering. Employment opportunities can be created for cleaning and maintenance of solar panels.
- Solar streetlights in neighborhood streets and community spaces.
- Solar-powered livelihood units such as solar food dryers, sewing units, cold press oil units or food processing units, where women from self-help groups can be trained on O&M.

Potential locations: Existing settlement zones such as R1 (Village Planning Zone), community infrastructure sites including schools, community centers, and anganwadi's, public spaces within clustered housing areas

Implementing entities

Lead: APCRDA

Supporting: ADCL, APSECM, NGOs, self-help groups, residential welfare associations (RWAs), technical partners for O&M training

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- No. of rooftop solar PV systems installed across community buildings, schools, anganwadis along with installed capacity and RE generation
- Installed capacity and functionality of solar-powered livelihood units
- No. and capacity of solar streetlights installed and operational in neighborhood areas
- No. of persons from community trained, particularly women and youth, in solar O&M

Good Practice:

SELCO foundation installed a solar food dryer in Udupi, Karnataka where women were trained to process jackfruit, chillies, and kokum to enable preservation and off-season sales. These hybrid solar dryers generated an income of Rs. 5,000-10,000 per month for each SHG member. Similar community-based solutions powered by sustainable energy solutions can also be explored for community in existing settlement zones.

Action 5: Integrate solar rooftop in new EWS/LIG housing

Action details

Integrate rooftop solar PV systems into the building plans of EWS/LIG housing (reserved in residential projects with a site area > 4000 sq. m as per Zoning Regulations) to power common loads such as common area lighting, shared amenities, and water pumps. Solar electricity can also partly power household loads such as lighting and fans.

Potential locations: New EWS and LIG housing developments in Amaravati as per zoning regulations

Implementing entities

Lead: APCRDA

Supporting: ADCL, AP Housing Board, NREDCAP, APCPDCL, APTIDCO, NGOs involved in affordable housing.

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- No., capacity and RE generation of solar rooftop systems installed in affordable/EWS/LIG housing
- Percentage of common area and utility loads met by solar
- Estimated energy savings and emissions reduction

Good Practice:

A 31.5 kWp **rooftop** solar PV installed at the Krantiveer Khudiram Bose affordable housing complex at **Rajkot** generates around 2,500 kWh of electricity per month and reduces 25 tCO_2e GHG emissions per year.

Action 6: Implement solar water heaters (SWHs) in targeted buildings

Action details

Installation of solar water heaters (SWHs) in Amaravati's large residential, commercial, institutional, and government buildings is a crucial sustainability measure that directly aligns with environmental mandates and NGT directives for the greenfield capital. Mandating SWHs in buildings with significant hot water demand will promote renewable energy adoption and mitigate GHG emissions.

Sub Actions:

- Establish and enforce mandates to install SWHs in multi-storey apartments/complexes (>100 units or with plot area > 500 sq. m), hotels, banquet halls, hospitals, educational institutions, and government buildings, depending on hot water demand **(ongoing/planned)**
- Select SWH or solar PV with heat pump/solar thermal based on site-specific analysis and hot water demand.
- Include SWH installation confirmation (layout and equipment specs) at building permission and occupancy certificate stages.
- Provide incentives such as increased FSI/FAR, property tax rebates, capital cost discounts to developers and owners for installing SWHs.
- Conduct periodic compliance audits and use digital records for monitoring.

Potential locations: New developments across Amaravati (e.g., zones designated for mid to large institutional, hospital buildings, hotels), government offices (existing and new constructions), major educational institutions and universities, planned affordable housing and large residential housing and townships with hot water requirements

Implementing entities

Lead: APCRDA

Supporting: ADCL, NREDCAP, AP DTCP, building developers and architects associations

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- No. and total capacity (liters/day) of SWHs installed in buildings (apartments, hotels, hospitals) and year-on-year increase
- Percentage of new buildings granted occupancy certificate with SWH installation
- No./percentage of buildings availing incentives for SWH installations

Action 7: Streamline procedures and facilitate financing support for renewable adoption

Action details

A streamlined approval system and a dedicated digital platform will support RE adoption and speed up Amaravati's transition to clean energy while reducing approval process related delays.

Sub Actions

- Streamline solar PV installations through a single-window clearance and digital platform supported by APCPDCL, APCRDA and other relevant departments

- Establish a single-window clearance system for the provision of approvals/permits to RE project developers from different regulatory entities.
- Offer a single 'one-stop shop' digital platform for end-to-end management of RE project applications including application submission, feasibility assessments, technical approvals, subsidy facilitation and on-ground implementation, monitoring and tracking.

- Offer incentives such as faster building approvals, tax rebates, FAR/FSI incentives to promote RE adoption. Collaborate with financing institutions to facilitate access to low-interest loans.

Implementing entities

Lead: APCRDA

Supporting: APCPDCL, NREDCAP

Type of action: Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- No. of RE applications processed via the digital platform
- Installed solar PV capacity (MW) annually
- Amount of incentives and financing disbursement supported/facilitated
- Average turnaround time for RE project approvals

Action 8: Encourage adoption of electric cooking

Action details

Supply of PNG through a city-wide network is planned in Amaravati to adopt a relatively cleaner energy source from LPG. Electrification of cooking can be promoted, particularly for a portion of domestic, commercial and institutional consumers as PNG is not a completely zero emission source.

Sub Actions

- Develop awareness campaigns on the health and environmental benefits of electric cooking, targeting women and primary cooks in households, hotels, canteens and cafeterias.
- Encourage mid to large-scale government and institutional canteens and cafeterias to shift to electric cooking (powered by renewables) through incentives and financial support
- Incentivize electric cookstoves (through discounts) and undertake distribution supported by NREDCAP, EESL and private CSR funding. Offer electric cook-stoves at low-cost, especially to low-income households as an alternative to PNG.
- Incorporate infrastructure to support electric cooking in new residential buildings including provision of electrical connections and ventilation

Potential locations: Government offices, institutions, mid to large-sized hotels, restaurants, and commercial kitchens, large residential apartments and select lower-income housing

Implementing entities

Lead: APCRDA

Supporting: NREDCAP, EESL, private sector, RWAs

Type of action: Mitigation

Climate resilience benefits: Medium

Timeline: Medium term

Monitoring Indicators:

- No. and percentage of households, commercial and government canteens adopting electric cooking
- Percentage reduction in LPG/PNG consumption in households and commercial units
- No. and outreach of awareness events/campaigns conducted

Action 9: Build local skills to boost job creation and support RE and EE integration

Action details

Training local community members including youth as installers, technicians, and maintenance personnel for RE and EE solutions directly supports Amaravati's climate vision and employment opportunities.

Sub Actions

- Provide technical training to youth in existing settlements to serve as installers and O&M technicians for solar PV, solar water heaters, LED lighting, energy efficient equipment and as energy maintenance personnel in Amaravati's upcoming properties and facilities. Collaborate with technical universities and skill-development training institutes.
- Link the training to existing programs such as Suryamitra technician, Andhra Pradesh State Skill Development Corporation, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) to enable formal certification and further job opportunities.

Potential locations: Technical and vocational training centers within Amaravati and existing settlements. Collaborating technical universities, colleges, and ITIs.

Implementing entities

Lead: Andhra Pradesh State Skill Development Corporation (APSSDC)

Supporting: APCRDA, technical universities and skill-development training institutes, national programs such as Suryamitra and MGNREGS, private sector partners engaged in RE for internships/apprenticeships, NGOs focused on youth employment, green jobs, and technical training.

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- No. of community members and youth trained and certified in RE and energy efficiency skills.
- No. of new jobs created locally in renewable energy and energy-efficiency sectors
- Percentage of RE and EE projects staffed with locally trained technicians
- No. of installations (solar PV, LED, efficient equipment) supported by local technicians.
- Contribution to overall city RE/EE targets

Good Practice:

Capetown partnered with a local NGO and industry association to develop a training programme for solar PV installers. The programme offers subsidies for male electricians (75% subsidy) and female electricians (100% subsidy). Over 100 candidates have received the solar PV training and it has helped to address the challenge of limited capacity of trained installation technicians.

Strategy 4- Financing Modes/Sources

APCRDA budget, PM Surya Ghar Muft Bijli Yojana, NREDCAP funds, RESCO models, bulk procurement/demand aggregation of multiple projects, group captive, rent-a-roof models, power purchase agreements, MNRE's grid connected rooftop solar programme, multilateral grants/assistance, CSR funds for pilots, National Efficient Cooking Programme; PM Awas Yojana, Suryamitra, MGNREGS and Skill India for vocational training and skill development

Enabling financing and implementation models for renewable energy deployment:

- On-site and off-site CAPEX (Capital Expenditure) models: Direct investment by building or property owners, supported by applicable government incentives.
- RESCO model: Third-party investors/RESCOs bear capital cost of deployment and own, operate, and maintain the system; users or building owners can forego upfront capital investment and pay for green power generated via power purchase agreements (PPAs).
- Group Captive and Open Access: Pooled investments from multiple consumers for jointly owned renewable generation assets
- Demand aggregation: DISCOMs or relevant nodal institutions facilitate aggregation of demand/procurement to negotiate better rates and attract private investments.
- Subscription based or rent-a-roof models: Residents/owners receive rental income or discounted energy by allowing third parties to install and operate solar PV on their rooftops.
- Renewable Energy Certificates or carbon offsetting: Sale of green credits for additional revenues.

Strategy 5: Undertake integrated spatial and energy planning at the city-scale with energy sector institutions

Proposed Actions

Action 1: Advocate for faster integration of renewables in Amaravati's grid power supply

Action details

Achieving Amaravati's vision of being fully renewable powered capital city will require significant support and coordination from state-level agencies and power sector institutions:

- Need to engage with state-level power sector entities, decision-makers, and electricity suppliers (e.g., APTRANSCO, APCPDCL, Andhra Pradesh Energy Department, State Load Dispatch Centre) in order to help increase ambition and accelerate the integration of renewables into Amaravati's electricity supply.
- Promote the adoption of aggressive renewable energy deployment for Amaravati's demand in addition to state-level RPO (Renewable Purchase Obligation) targets, support utility-scale, off-site, and distributed on-site renewables, and ensure grid readiness for 100% RE integration.

- Regularly participate in state-level policy dialogues, working groups, and sector planning to align city and state objectives, and to enable necessary technical and regulatory support to meet Amaravati's ambitious RE targets

Implementing entities

Lead: APCRDA

Supporting: APTRANSCO, APCPDCL, NREDCAP, APSECM

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- Percentage increase in RE share in Amaravati's grid mix and electricity consumption
- No. of formal engagements with power sector and electricity supply institutions
- No. of grid-connected on-site and off-site renewable projects commissioned
- Availability of RE integration roadmap aligned with Amaravati's climate change action plan targets

Action 2: Involve officials from APCPDCL, APTRANSCO, NREDCAP and APSECM in committees for master planning and urban infrastructure development.

Action details

Involve key officials from APCPDCL, APTRANSCO, NREDCAP and APSECM in Amaravati's master planning and urban infrastructure committees. This will systematically help to coordinate and integrate renewable energy and energy efficiency into spatial planning and infrastructure design at an early stage and on regular basis.

Participation can be sought in relevant committees such as city-level master planning, infrastructure, zoning, and project review committees, sub-committees tasked with energy, utilities, building codes, and sustainability integration. Such involvement will help better embed RE and energy efficiency solutions into Amaravati's urban infrastructure and spatial development while also helping inform and synchronize planning of power infrastructure to meet city-wide targets.

Implementing entities

Lead: APCRDA

Supporting: APCPDCL, APTRANSCO, NREDCAP, APSECM

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- No. of official committee meetings/working groups involving APCPDCL, APTRANSCO, APGENCO, NREDCAP, APSECM annually
- No. of cross-agency policy and infrastructure alignment meetings
- Evidence of renewable and energy efficiency integration of renewable into city development and infrastructure planning, projects and regulations

Action 3: Coordinate with APCPDCL and APTRANSCO for effective integration of urban development and electricity planning

Action details

Establish a coordination mechanism between the APCRDA, ADCL, APCPDCL and APTRANSCO to synchronise urban development with electricity planning. Such an integration will enable sustainable energy management at the city-scale and support the integration of renewables, energy efficiency solutions, and E-mobility at an early stage in Amaravati's built infrastructure and electricity networks.

Sub Actions:

- Undertake periodic consultations, information-sharing, and joint reviews to align planning, decision making, and facilitate policy and regulatory implementation.
- Promote renewable solutions through policy measures to avoid future network congestion, transformer overloading, and meet future demands from EV infrastructure and increased cooling requirements due to rising heat.
- Conduct periodic demand and load assessment over Amaravati's development timeline to understand patterns, power requirements, and identify opportunities for RE solutions, energy management, and grid infrastructure upgrades or expansion requirements.
- APCPDCL and APTRANSCO will be informed at an early-stage of upcoming developments, densification, high energy consumers, and plans for RE adoption. This will help estimate power demand against existing grid capacity, manage peak loads, and undertake distribution grid planning measures.
- APCPDCL and APTRANSCO can suggest suitable energy management options at the planning stage for large commercial complexes, institutional buildings, industries to support high RE integration and ensure stable grid operation.
- Given Amaravati's ambitious RE targets, ensuring smooth integration of intermittent renewable electricity generation into the city's local power system. APCPDCL and APTRANSCO can advise at an early-stage on spatial distribution of large-scale RE projects considering their grid capacity, while providing suggestions on rooftop solar PV and large-scale RE deployment across different consumers.
- APCPDCL and APTRANSCO can coordinate and provide inputs to locate EV charging infrastructure, considering existing electricity grid infrastructure and future load expansion.
- Coordinate with state-level institutions and private sector to facilitate participation and partnerships with RE generators and EPC players to support large-scale RE deployment for Amaravati's power demand.

Potential locations: High-density/commercial zones, infrastructure corridors in Amaravati, all public and large private buildings, utility facilities and major mobility nodes (EV charging, transit hubs)

Implementing entities

Lead: APCRDA

Supporting: APCPDCL, APTRANSCO, ADCL, NREDCAP, APSECM

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- No. and frequency of formal coordination meetings and joint planning sessions per year

- Annual increase/adoption of renewable and energy efficiency solutions in city through joint planning
- No. of joint studies/load demand assessments completed and followed by local power grid and distribution system deployment/improvement measures
- No. of new developments at zonal/neighbourhood/project-scale integrating RE and EE measures based on committee/coordination input
- No. of RE and EV infrastructure locations sited through joint coordination

Strategy 6: Adopt smart and reliable power distribution systems for high renewable integration

Proposed Actions

Action 1: Plan and upgrade grid infrastructure to accommodate high levels of renewables and meet future requirements

Action details

As a greenfield capital city, Amaravati has a unique opportunity to design its power system to accommodate advanced technologies and significant levels of green power from the ground up. Proactively installing and upgrading grid infrastructure, including substations, smart distribution lines, and grid-scale energy storage, will enable Amaravati to absorb high shares of renewable energy, reliably support EV adoption, and handle rapidly growing energy demand.

Sub Actions

- Install or upgrade substations, transformers, and distribution lines to handle high RE penetration and ensure reliable supply.
- Ensure grid stability and power quality by managing the inherent variable generation from RE by using energy storage solutions, especially in distribution infrastructure including substations.
- Conduct regular performance and safety audits of the power infrastructure and distribution network. Undertake resource adequacy assessments to identify improvement areas.
- Plan and implement measures to meet high energy demand from end-uses such as fast charging EV infrastructure expected to be deployed across Amaravati.

Potential locations: All urban and peri-urban zones under APCRDA jurisdiction, new and existing substations throughout Amaravati catering to business zones, commercial centers, and residential townships, EV charging clusters, public transport terminals/depots and AGC

Implementing entities

Lead: APCPDCL, APTRANSCO, APCRDA

Supporting: ADCL, NREDCAP, private EPCs, technology vendors, service providers and expert consultants

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Short term

Monitoring Indicators:

- Total additional substation/transformer capacity installed/upgraded (MVA)

- Percentage of grid-connected renewable energy share (annual reporting)
- Annual grid resource adequacy/stability assessments completed
- Annual no. of grid safety and performance audits completed
- No. and capacity (MW/MWh) of battery energy storage solutions deployed and operational
- No. of EV fast-charging hubs/grid nodes supported by new upgrades
- User/customer satisfaction rates for power quality/reliability in growth zones

Good Practice:

In **New Delhi**, BSES Rajdhani Power Limited (BRPL) with partners has commissioned a 20 MW/40 MWh battery energy storage system (BESS) project located at the Kilokari substation. The battery energy storage deployed will help improve power quality and reliable power supply in the area for over 12,000 low-income consumers. It is designed to deliver up to four hours of reliable daily power everyday, two hours each during the day and night. The BESS can provide multiple benefits such as improved power supply, enhanced grid stability, peak demand shaving, reduced overloading of network and renewable power integration.

Action 2: Deploy smart systems, data management and advanced power management techniques

Action details

Amaravati can incorporate digital intelligence, SCADA/ICT integration, and advanced analytics into its power infrastructure from an early-stage. This will help to ensure the power grid operates with real-time precision and future-ready flexibility. By incorporating AI-based demand-supply modelling, real-time monitoring and analytics-driven maintenance, the city could proactively manage outages, grid congestion and integration of distributed energy resources.

Sub Actions

- Integrate SCADA and ICT to enhance operational planning, real-time grid management, efficient data acquisition and processing, peak power demand management, complaint handling, electricity outage response, and proactive maintenance **(ongoing/planned partly)**
- Manage diverse energy resources and storage technologies to ensure a reliable power supply management, enhance grid resilience, and maintain high distribution network uptime.
- Leverage artificial intelligence and machine learning for power demand-supply modeling based on city development trend, tracking RE integration at zonal-level, and identifying new investment and maintenance requirements.

Potential locations: City-wide at major city substations and feeders, growth corridors, business districts, large public buildings (government, institutional, hospitals) and commercial centers, EV charging infrastructure, RE generation sites, and major transmission/distribution nodes. Solutions can be deployed for AGC area and imminent mid-to-large size upcoming developments in the near-term.

Implementing entities

Lead: APCPDCL, APCRDA

Supporting: APTRANSCO, ADCL, NREDCAP, grid technology vendors (SCADA/ICT/AI), service providers and expert consultants

Type of action: Climate Mitigation

Climate resilience benefits: Medium
Timeline: Medium term
Monitoring Indicators: • Extent of local power distribution network and infrastructure integrated with SCADA/ICT • Extent of city power grid network with real-time monitoring, management, analytics-enabled outage/complaint response • Performance metrics for distribution network uptime and reduction in average outage duration • No. of grid anomalies, outages, or distribution asset failures resolved proactively with smart system alerts

Action 3: Adopt urban microgrids and demand management to enable renewable adoption and energy resilience

Action details
By adopting urban microgrids and advanced demand management, Amaravati can efficiently incorporate high levels of renewables, maximise local RE use and maintain reliable power supply to critical services during outages or climate extremes. Microgrids and innovative demand-side solutions will help Amaravati create distributed, flexible, and adaptive energy system .
 	
Sub Actions
• Deploy modular local microgrids in office complexes, hospitals, schools, educational campuses and neighbourhoods to help locally manage RE generation, storage and consumption.
  ○ Modular urban microgrids, equipped with smart controls and battery storage, help to utilise higher amounts of RE, optimise energy demand, maintain power quality and reduce grid dependency.
  ○ Microgrids can ensure energy resilience by isolating from the power grid during outages and climate hazards, while powering critical infrastructure and essential services.
• Use smart meters, time-of-day pricing, and demand-response programs to shift power consumption to off-peak hours, when RE generation is abundant and ensure its higher use.

Potential locations: Initial deployment and pilots can target AGC area (offices, control centers, hospitals), institutional/educational and public campuses, large residential townships, commercial hubs and business parks, planned new neighborhoods, large EV charging sites
Implementing entities **Lead:** APCPDCL, APCRDA **Supporting:** APTRANSCO, NREDCAP, ADCL, technology vendors, service providers and expert consultants, technical and research institutes
Type of action: Climate Mitigation and Adaptation
Climate resilience benefits: Very High
Timeline: Medium term
Monitoring Indicators: • No. and capacity of urban microgrids deployed (by type/use, MW/MWh) • Percentage of critical infrastructure connected to microgrids

- Percentage of energy consumption in pilot zones met by locally generated RE
- Percentage of city covered with smart meters and Time of day tariff/demand response programs
- Relative reduction in grid peak load and improved power quality metrics
- Instances and no. of hours of critical services powered during grid outages/climate events

Good Practice:

New York launched RISE : NYC program in response to vulnerabilities exposed by hurricanes such as Sandy. Under the program, NYC Economic Development Corporation, HUD and private partners deployed eight neighbourhood microgrids in flood-prone zones. The microgrids combine rooftop solar, battery storage, and backup generators to allow these communities to island from the main grid outages and maintain power for critical loads.

Strategy 6 - Financing Modes/Sources

State funding for power grid expansion and upgradation, support/incentives under AP Integrated Clean Energy Policy, MNRE's Revamped Distribution Sector scheme and Green Energy Corridor scheme, National Smart Grid Mission, NREDCAP support, 15th Finance Commission, PPP and private sector investment (EPC, ESCO, RESCO modes), FAME (for storage/EV grid integration), multilateral grants/assistance for grid upgradation, smart grid technology and storage pilots.

2.2 Water Supply

Baseline Status (2024-25)	**Key Statistics:** • The Krishna River serves as the primary source of surface water for Amaravati, supplying the significant share of piped water. • As of 2024, the Rural Water Supply and Sanitation (RWSS) department supplies about 13 million liters per day (MLD) of treated water to 25 villages and the Mangalagiri-Tadepalli Municipal Corporation (MTMC) areas within Amaravati. • The NTR Sujala initiative provides access to safe drinking water to over 50,000 people across 100 villages in Andhra Pradesh, including the Amaravati city. • Village settlements rely on groundwater extraction through borewells, to supplement domestic and non-potable water needs.
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • GoI's AMRUT 2.0 and 15th FC supporting water infrastructure • CPHEEO Guidelines for planning, design and implementation of 24x7 water supply systems • Guidelines to Regulate and Control Groundwater Extraction in India, MOJS lists down extraction charges for various categories and volume of usage • National Framework on Safe Reuse of Treated Water has set year wise targets for reuse of treated wastewater. **StateLevel Policy/Programme/Targets:** • Andhra Pradesh Building Rules, 2017. • Action Plan for Rejuvenation of River Krishna of Krishna District • APWALTA Act 2002 **City Policy/Programme/Targets:** • Planned to meet a projected water demand of 925 MLD by 2058 • Setting up advanced water treatment plants in modular basis and expanding network coverage in phased manner • Implementation of smart meters, SCADA and 24/7 water supply system throughout the city • Long-term plans aim to use water from the River Godavari through the Polavaram project to help meet water demand during peak season or during other conditions of exigency • Zoning regulations mandate the construction of rain water harvesting structures for all the properties and promote the use of rainwater storage and water-saving plumbing fixtures • Urban design and architectural guidelines promote a blue-green network that connects canals, green corridors, flood control systems, and bio-retention features to improve water quality and enhance resilience
Opportunities and Gaps	• High dependence on ground water and partially on single surface water sources • Untreated ground water in several village settlements is not fit for direct drinking purposes[15] due to high concentration of total dissolved solids, nitrates and fluorides. • Flood events may pose risks to disrupt the functioning of headworks and transmission network[16]

[15] Dynamic Ground Water Resources of Andhra Pradesh State, 2024.
[16] World Bank, Amaravati Flood Mitigation Works: Environmental Impact Assessment–Environmental Management Plan Report, 2018.

	• Future water demand can be met by strengthening infrastructure, recharging ground water, implement rain water harvest structures, and adopting sustainable water use practices.
Climate Risk	**Climate Risk Status**: High Increased flooding during periods of high intensity rainfall increases chances for disruption in water supply. Groundwater is at higher risk of pollution in places with shallow water tables, as sewer leaks during floods can worsen contamination and increase health risks for people dependent on groundwater. • Increase in temperature will increase demand of water, particularly in summers and and heatwave periods. Projected drought event and increased evapotranspiration rate may adversely impact available water quantity and quality. This may lead to people shifting to bore wells for water supply from surface supply, lowering groundwater table, or in the worst-case, low-income groups might have to use untreated groundwater, raising public health concerns.
Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions	**Strengthened Resilience to Climate Hazards:** Heat stress, urban flood, cyclones **Climate Resilience Impact and Co-benefits**: • Address future water demand sustainably, mitigate heat stress, drought, and urban flooding impact and improve groundwater table by integrating blue-green networks, conserving water resources, and protecting related ecosystems. • Equitable and safe access to 24/7 water supply for all residents • Strengthen water security by mandating rainwater harvesting in all properties and promoting reservoir based storage for groundwater recharge. • Reduce public health risk due to contamination of groundwater • Lower operational and maintenance costs through the adoption of clean energy in water supply infrastructure. • Develop standard operating procedures for NRW management and implementing SCADA systems with data-driven decision-making will help reduce NRW.
SDGs	GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 7: Affordable and Clean Energy, GOAL 9: Industry, Innovation and Infrastructure, GOAL 10: Reduced Inequality, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 14: Life under Water, GOAL 15: Life on Land

Climate Strategies, Actions and Targets

Strategy 1: Sustainable water resource management for ensuring long term water security

Proposed Targets

Action area	Target Parameter	2028	2043	2058
Installation of RWH system in the properties.	Percentage of existing residential properties with rainwater harvesting	10%	100%	100%
	Percentage of new residential properties with rainwater harvesting	100%	100%	100%
	Percentage of existing commercial properties with rainwater harvesting	10%	100%	100%
	Percentage of new commercial properties with rainwater harvesting	100%	100%	100%

Proposed Actions

Action 1: Ensure protection of surface water sources

Action details

To protect surface water sources, Amaravati city should explore the potential use of multiple water sources to increase resilience and flexibility in meeting rising water demand. Enforcing strict regulations on the discharge of treated wastewater and conducting regular water quality monitoring will help maintain healthy aquatic ecosystems and prevent contamination.

Currently, the Krishna River is the primary source of water for meeting the water demand in Amaravati. The city is also planning to construct five reservoirs, which will act as multiple water sources.

Sub Actions

- Identify multiple water sources to support flexibility in meeting water demand **(Ongoing/Planned)**
- Maintain natural river bank ecology through the creation of a riparian buffer and embankment construction for promoting recharge **(Ongoing/Planned)**
- Ensure discharge of treated wastewater into water bodies only in compliance with national standards. **(Ongoing/Planned)**
- Conduct periodic water quality monitoring and remedial actions to protect the natural ecosystem. **(Ongoing/Planned)**

Potential locations: Krishna River, Water bodies and Vagus

Implementing entities

Lead: APCRDA, Water Resource Department

Supporting: APPCB, PH&MED, Forest Department

Indicative cost:

~Rs. 1.5 crore to build 1 km of concrete embankment depending on soil type, design (conventional earth, reinforced, or concrete), and protection works such as stone pitching or geo-tube systems[17]
Type of action: Climate Adaptation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Percentage of riverbank protected with riparian buffers or embankments • Number of treated wastewater discharge samples meeting national water quality standards • Area of riverbank and ecological buffer zones maintained or restored • Number of water quality monitoring cycles conducted per year for major surface water bodies
Good Practice: **Patna's** riverfront tackles soil erosion along the banks by restoring the riparian edge between ghats. This involves creating promenades, implementing proper waste disposal systems, and planting native shrubs, boulders, and gabions to prevent erosion. The project maintains and promotes the growth of local flora and fauna. Any construction uses locally sourced, eco-friendly materials and natural stone for both durability and aesthetic appeal. **Shimla** city sources its municipal water supply from seven different locations, with water treated at four different treatment plants to ensure resilience and flexibility. This multi-source approach has helped the city to meet growing water demand amid increasing tourism and urban expansion. In rural **West Bengal**, Vetiver grass was used to create low-cost, effective riparian buffers and protect riverbanks from erosion. This natural intervention has helped to stabilize channels and promote groundwater recharge while supporting local livelihoods. By diversifying water sources and investing in both centralized and decentralized water infrastructure, **Port Vila** city achieved greater resilience, reduced water demand by 35%, and improved water quality standards through stakeholder engagement and regular monitoring.

Action 2: Conservation & management of groundwater resources by limiting extraction, promoting recharge, and continuous monitoring.
Action details Regulating groundwater extraction particularly for bulk water users like high-rise apartments and large commercial buildings along with promoting groundwater recharge, will help secure the Amaravati city's water supply for the long term. These measures are important as the city continues to urbanize and will support both sustainable growth and ecological balance in the future. **Existing Initiatives**

[17] Water resources department building 1,000 km of concrete embankment, Economic Times, 2022.

Amaravati has proactively conducted a hydrogeomorphological study to map local geological features, including the identification of shear zones—fractured rock formations known for facilitating groundwater movement, as well as regions with low groundwater levels. This mapping enables the city to target these zones for strategic aquifer recharge interventions and to establish continuous monitoring systems for sustainable groundwater management.

Sub Actions

- Monitor groundwater levels through piezometers in all existing settlements **(Ongoing/Planned partly)**
- Formulate and levy volume-based charges on groundwater extraction post connection to city water supply network
- Redesign and restore ponds to maximize recharge capacity
- Mandate the construction of groundwater recharge pits for buildings with plot size >300 sq. m through issuing regulatory measures. An occupancy certificate to be provided upon inspection of the presence of appropriate recharge pits. **(Ongoing/Planned)**
- Deploy city-wide piezometer network with real-time monitoring of groundwater
- Construction of large-scale recharge pits in open spaces and public buildings as per groundwater recharge potential in different areas.
- Constitute a dedicated team to maintain and monitor the recharge pits in all public areas/buildings and to conduct annual inspections on private properties especially before monsoon
- Geotag piezometers and both public and private recharge pits and set up a portal for groundwater quality and quantity monitoring to be managed by the dedicated team.
- Disseminate technical specifications for groundwater recharge pits from hydrogeomorphology study to architects, contractors, real estate agencies, and others.

Potential locations: City-wide with focus on lower Groundwater levels for recharging in village settlements from the Hydrogeomorphology study - Nidamarru, Kuragallu, Yerrabalem, Nowluru, Penumaka, Nekkallu, Ananthavaram

Implementing entities

Lead: APCRDA, Groundwater & Water Audit Department

Supporting: PH&MED, DTCP, APPCB, Builders, Technology providers

Indicative cost:

1 piezometer cost ~INR 35,000 to 50,000 per unit[18]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- Number of piezometers installed and functional
- Annual percentage change in average groundwater level
- Public and private recharge pits geotagged and monitored through CCC

Good Practice:

[18] Tradeindia, 2025

Sixty village ponds were adopted within a 10 km radius of Gajraula town in Uttar Pradesh for the construction of a recharge structure, enabling the recharge of over 21 Lakh Cubic meters of rainwater into the saturated groundwater aquifer.

Chennai city has made the installation of rainwater harvesting (RWH) structures mandatory in all buildings, resulting in widespread adoption. The Chennai Metropolitan Water Supply and Sewerage Board monitors groundwater levels using citywide piezometers and enforces compliance with occupancy certificates linked to RWH inspection. These actions increased groundwater tables significantly.

The Rainwater Harvesting in Schools project in Jerusalem, Israel equipped 24 schools with rooftop rainwater collection systems that store harvested water for non-potable uses, including toilet flushing, cleaning, garden irrigation, and watering indoor plants.

Action 3: Reduce fresh water demand by replacing non-potable needs with alternative sources

Action details

Reducing freshwater demand by mandating rainwater harvesting, dual plumbing, and the adoption of water-saving fixtures will enable the greenfield Amaravati city to sustainably meet its water requirements for non-potable uses, such as cleaning, flushing, and irrigation.

Existing Initiatives

Amaravati has recently amended its zoning regulations to mandate the construction of rainwater harvesting structures in all new developments, ensuring that buildings contribute to local groundwater recharge. The regulations also require the adoption of dual plumbing systems, with separate pipelines and storage tanks for supplying both fresh water and treated wastewater, thus enabling safe and efficient reuse. Furthermore, the installation of low-flow plumbing fixtures, sensor-based taps, and pressure-reducing valves in wash basins, baths, and other faucets is now mandatory, significantly reducing water consumption and promoting long-term water conservation.

Sub Actions

- Mandate the construction of rainwater harvesting in buildings[19] with plot size >300 sq.m and utilisation of the collected water for meeting non-potable demands. Additional water needs to be channelled to recharge pits in applicable structures. **(Ongoing/Planned)**
- Promote the adoption of water-saving fixtures such as aerators/ sensors, to reduce water consumption. **(Ongoing/Planned)**
- Mandate dual plumbing for properties with plot area > 300 sq m, with separate storage tanks in place to ensure potable and non-potable water is not mixed. **(Ongoing/Planned)**
- Promote installation of RWH structures in existing settlements and buildings through incentives.
- Link installation of RWH systems to building permission and occupancy certificates.
- Conduct awareness and skill-building workshops for local masons and contractors.

Potential locations: City-wide

[19] Government of Andhra Pradesh G.O. Ms. No. 350A dated 9th June 2000.

Implementing entities **Lead:** APCRDA, DTCP **Supporting:** Developers, Architects, Contractors
Indicative cost: Cost for construction of RWH structure system ranges from INR 25-60 per sq ft[20]
Type of action: Climate Adaptation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Number of new buildings with RWH systems installed • Percentage of harvested rainwater reused for non-potable applications at the household level • Number of recharge pits maintained and operational • Number of contractors and masons underwent training for RWH installation
Good Practice: 100 Government Schools of Udham Singh Nagar in **Uttarakhand** were equipped with Rooftop Rain water harvesting structures and recharge pits. The structure has filters to remove debris and impurities. Stored water is used for non-potable needs like sanitation and gardening, and the rest of the water goes for groundwater recharge. An estimated 23 lakh litres of water is saved per year through this system. GuruJal Society in **Gurugram** supported the installation of 8500 aerators in 15 RWAs of Gurugram, which approximately saves 230 kilolitres per day. The city of **Austin** developed ordinances requiring new large commercial and multi-family buildings to incorporate dual plumbing systems for non-potable reuse water. These systems are being integrated into building codes for properties above specified sizes (e.g., >250,000 sq ft). The **Tucson** city offers financial rebates of up to $2,000 for the installation of rainwater harvesting systems (cisterns and tanks). Rebates are contingent on residents completing a city-run training program, ensuring best practices in implementation. Similarly, greywater-harvesting rebates of up to $1,000 are available for systems that use recycled water within homes.

Strategy 1 - Financing Modes/Sources
APCRDA budget, State budget, AMRUT 2.0, 15th Finance Commission

[20] Guide for Rainwater Harvesting System Cost in India. Houseyog. 2025.

Strategy 2: Provision of year-round supply of clean and adequate drinking water to all

Proposed Targets

Action area	Target Parameter	2028	2043	2058
Continuous supply of drinking water	Extent of 24x7 water supply system in the city	100%	100%	100%
Quality of drinking water	Provision of safe water supply at all times	100%	100%	100%
Metering of service connections	Installation of meters in existing properties	10%	100%	100%
	Installation of meters in new connections	100%	100%	100%

Proposed Actions

Action 1: Commission a 24/7 water supply system of optimum quality and quantity

Action details

Implementing a 24/7 water supply system of high quality and required quantity in greenfield Amaravati city will significantly enhance the availability of safe drinking water for every resident and businesses. By constructing a robust, city-wide water distribution network with smart-metered service connections, the city can track real-time water usage and reduce both physical and commercial losses.

Existing Initiatives

Amaravati has planned a 24/7 water supply system that will be supplied through a direct-pumping transmission and distribution network. The system is engineered to minimize energy losses and maintain a consistent residual pressure at consumer endpoints. The city will divide its water supply network into District Metered Areas (DMAs), each serving about 4,000 people with clearly defined boundaries and equipped with advanced controls. The system will enable real-time non-revenue water (NRW) monitoring, facilitate easy maintenance, support water quality monitoring, and automatically shut down if security issues arise; regular leak detection surveys and controls will be conducted within each DMA through SCADA for optimal performance.

Sub Actions

- Construction of a city-wide water distribution network **(Ongoing/Planned)**
- Ensure a 24/7 supply of drinking water with a demarcated district metering area (DMA) and sufficient balancing storage in place. **(Ongoing/Planned)**
- Continuous monitoring of water quality parameters as per applicable standards, such as IS 10500:2012, at all storage reservoirs and integrated with SCADA and monitored at CCC in real-time. **(Ongoing/Planned)**
- Construction of water treatment plants with future capacity expansion potential. **(Ongoing/Planned)**

Potential locations: City-wide

Implementing entities

Lead: APCRDA, ADCL

Supporting: APPCB, Technology/ Service Provider

Indicative cost: At a per capita cost of INR 1,840 for the formation of the District Metering Area[21]
Type of action: Climate Adaptation
Climate resilience benefits: High
Timeline: Medium term
Monitoring Indicators: • Number of functional District Metering Areas (DMAs) established • Number of water samples meeting quality standards
Good Practice: **Puri** launched the "Drink from Tap" mission and became the first city to offer 24/7 high-quality drinking water directly from taps, removing the need for boiling and filtering. The initiative depended on active community involvement, with women-led Jalsathis from SHGs managing billing, handling complaints, and raising awareness. **Seosan** city created nine sub district metered area systems within two district metered areas integrated with smart water metering, reducing NRW from 32% to 10%. According to Singapore's National Water Agency, all buildings in **Singapore** with annual water usage of 60,000 m^3 or higher must install dedicated water meters at critical usage points within their premises to accurately track and monitor water use.

Action 2: Ensure efficient management of bulk water users

Action details

To ensure responsible and sustainable water usage in Amaravati city, it is essential to identify all bulk water users (BWUs) that have high daily water consumption. These BWUs should be prioritized for targeted water supply monitoring and management. By monitoring water consumption among large-scale consumers, the city can implement targeted, data-driven interventions.

Existing Initiatives

As mentioned in the Water Supply DPR, the installation of bulk flow meters at points supplying water to bulk consumers will facilitate regular monitoring of the water supply and the overall gap between water produced and water billed each month. Over time, these meters support systematic leak detection and control efforts, aiding in the reduction of Non-Revenue Water (NRW) and improving the efficiency and financial sustainability of Amaravati's water supply system.

Sub Actions

- Identify BWUs with high consumption (eg. >5,000 liters/day) including residential societies, public buildings, hotels, hospitals, malls, stadiums

[21] Installation of flow control valves, bulk flow meters, pressure reducing valves, and the replacement of house service connections (HSC) with mechanical water meters. https://mohua.gov.in/pdf/620235209 28a0advisory-on-water%20supply-final-new.pdf

- Establish a dedicated BWU monitoring team, incorporate periodic updation of new BWUs into the list
- Facilitate centralized reporting of water consumption and Extended User Responsibility certification for environmentally sound management of water by BWUs

Potential locations: City-wide

Implementing entities
Lead: APCRDA

Type of action: Climate Adaptation

Climate resilience benefits: Medium

Timeline: Short to Medium term

Monitoring Indicators:

- Percentage of total city water demand consumed by BWUs
- Number and percentage of BWUs certified under the Extended User Responsibility (EUR)

Good Practice:
Puri launched the "Drink from Tap" mission and became the first city to offer 24/7 high-quality drinking water directly from taps, removing the need for boiling and filtering. The initiative depended on active community involvement, with women-led Jalsathis from SHGs managing billing, handling complaints, and raising awareness.

Water utilities such as Thames Water in **Greater London**, maintain registers of large household and non-household customers and implement targeted water metering, real-time data dashboard monitoring, and conduct audits.

Action 3: Ensure minimal extent of Non-Revenue Water (NRW)

Action details
Minimizing NRW is critical for sustaining Amaravati's water supply by reducing losses, improving operational efficiency, and ensuring financial viability. Setting up an NRW team, deploying smart meters, and implementing real-time SCADA monitoring will help quickly identify and address leaks.

Existing Initiatives
Amaravati's water supply DPR sets an ambitious target to restrict Non-Revenue Water (NRW) to less than 10%. To achieve this, NRW will be tracked continuously using a SCADA system and smart meters, ensuring accurate and real-time monitoring of water use and losses throughout the network. The city also plans to establish a dedicated NRW team to undertake an NRW reduction program that includes forming District Metered Areas (DMAs) for leak assessment, detection, and control. Additionally, Amaravati proposes 100% metering of all water supply connections to reduce unbilled losses.

Sub Actions

- Establish NRW cell & Quick Response Team to undertake planning and actions for NRW minimization, and early redressal of grievances on physical losses
- Develop SOP for the NRW management

- Conduct regular training of department officials on advanced NRW management techniques and solutions
- Implement SCADA across the water supply system (from water extraction to entire transmission and distribution network) for real-time monitoring, fault identification and efficient operation
- Install smart meters to monitor usage and levy volume-based water tariffs, with surcharges for excess consumption beyond service level
- Integrate water connection requests into building permission process for 100% coverage and metering

Potential locations: City-wide

Implementing entities

Lead: APCRDA

Supporting: Water Resource Department, Technology/ service Providers, Research organizations

Indicative cost:

Agra's smart city project allocated around INR 3.44 crore for citywide installation of water supply SCADA system (excluding O&M and hardware renewals)[22]

The average installation cost for a smart water meter ranges from INR 10,000 to 15,000 per connection.[23]

Type of action: Climate Adaptation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- Number of water department officials trained in NRW techniques
- Percentage of the water supply system covered by SCADA monitoring
- Percentage of total consumer/service connections equipped with smart meters

Good Practice:

Surat established a dedicated Non-Revenue Water (NRW) cell to maintain NRW levels at 20%. The NRW cell focused on improving water supply efficiency, raising awareness about water conservation, and conducting regular water audits, leading to a decrease in pipeline leakage and the quick redressal of customer complaints.

Seosan city installed smart water meters and sub-district metered areas in Chari Village to address a high non-revenue water rate of 32%. Smart metering facilitated accurate leak detection, daily monitoring, and a quicker response to complaints. As a result, NRW decreased to 10% in just three months.

Strategy 2 - Financing Modes/Sources

State budget, APCRDA budget, AMRUT, 15th FC, Public Private Partnership (PPP), loan from multilateral development bank, grant from donor agency

[22] Providing 24 x 7 water supply to ABD area with water meters and SCADA system, Agra Smart City Limited, 2020
[23] NDMC to spend INR 31 crores on smart water meter plan, Times of India, 2025

Strategy 3: Adopt high-efficiency water supply system powered by renewables

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Adoption of high-efficiency equipment for water pumping	Energy-efficient equipment and pumps in water supply facilities	100%	100%	100%
Renewable energy in water supply facilities	Electricity consumption in water supply facilities to be met by renewables	50%	100%	100%
Non-Revenue Water (NRW) reduction in water supply	Percentage of NRW	10%	10%	10%

Proposed Actions

Action 1: Implement energy efficiency in water pumping

Action details

Implementing energy efficiency in water pumping will significantly help Amaravati advance toward its 100% energy efficiency target by reducing the overall electricity demand from water and wastewater infrastructure, which is one of the major energy-intensive sectors in urban systems.

Existing Initiatives

The Amaravati water supply DPR emphasizes the preparation of an Action Plan to conduct an energy audit and reduce energy consumption. Accounting for monthly energy consumption and performing an annual energy audit are essential performance indicators that enable necessary remedial action to control consumption within approved and guaranteed energy parameters. All pumping motors in the water supply system are specifically selected for their energy efficiency and are equipped with a Variable Frequency Drive (VFD), which helps save electricity and reduce operational costs. The efficiency of the entire VFD system also considers supporting components such as drive isolation transformers, cooling systems, output sine filters, power factor correction units, and harmonic filters, ensuring the water pumping remains energy-efficient.

Sub Actions

- Enable the use of energy-efficient equipment including pumping motors (atleast IE4 or above), variable frequency drives, automatic power factor correction panels, advanced transformers in all facilities by including requirements in public tenders for procurement and deployment. **(Ongoing/Planned partly)**
- Conduct regular energy audits to monitor the energy performance of electromechanical equipment
- Optimize energy use by reducing NRW & leakages.

Potential locations: City-wide with focus on water treatment plants and pumping stations

Implementing entities
Lead: APCRDA, ADCL
Supporting: APCPDCL, NREDCAP, Technology and service providers

Indicative cost:
Energy Audit: INR 10 – 15 lakhs

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Short

Monitoring Indicators:

- Number of pumps and motors meeting high-efficiency classes (IE4 or above)
- Percentage reduction in energy consumption achieved through leakage control
- Number and frequency of energy audits conducted

Good Practice:

In **Brazil**, the water utility implemented measures to optimize water distribution operations and reduce electricity consumption costs by utilizing automation and high-efficiency equipment. These measures reduced electricity consumption by 88 GWh over a four-year period, resulting in annual savings of $2.5 million.

The **Pune** Water Supply Energy Efficiency project aimed to reduce electricity consumption costs and boost the efficiency of the city's aging distribution system along with implementing energy audits, training engineers, and adopting both capital and low-cost improvements at water pumping stations. The initiative resulted in annual electricity savings of 38 lakhs kWh, the avoidance of 38,000 tonnes of CO_2, and a yearly savings of INR 146 lakh, along with a 10% increase in water supplied to the community without expanding infrastructure, primarily achieved by reducing energy intensity and system losses.

Action 2: Utilise renewable energy in water supply facilities.

Action details
Using renewable energy in water supply facilities will help Amaravati reach its 100% renewable energy target. Major operations, such as water pumping and treatment, will utilize solar and wind power, supplemented by batteries to ensure a 24/7 renewable electricity supply.

Sub Actions

- Integrate provision for renewable energy integration (on-site and off-site) in the design of pump houses, treatment plants, and site planning from an early stage.
- Include requirements for relevant electrical infrastructure and space considerations in tender documents for the construction of water supply facilities.

• Adopt a combination of on-site and off-site RE resources, including solar and wind energy, which can help deliver 24/7 renewable electricity for day and night-time water supply operations when deployed with battery energy storage solutions.
Potential locations: City-wide with focus on water treatment plants and pumping stations
Implementing entities **Lead:** APCRDA, ADCL **Supporting:** APCPDCL, NREDCAP, Technology and service providers
Type of action: Climate Mitigation
Climate resilience benefits: High
Timeline: Short to Medium term
Monitoring Indicators: • Percentage of use of renewable energy in water supply operations • Number of water supply facilities with RE Integration
Good Practice: SA Water deploys the world's largest moveable solar site in **Adelaide** as part of an ambitious renewable energy initiative. Over 30,000 solar panels are positioned at happy valley reservoir to generate more than 17,000 megawatt hours of renewable energy yearly, supplying power to key water facilities and reducing fossil fuel-based electricity use, and reducing emissions by more than 7,600 tonnes.

Strategy 3 - Financing Modes/Sources
State budget, APCRDA budget, ESCO model with private sector investment, AMRUT 2.0, 15th FC

2.3 Wastewater Management

Baseline Status (2024-25)	**Key Statistics:** • Existing settlements with 46,224 households generate 10.3MLD of wastewater, with no centralized sewerage network or treatment facilities. • Households rely on septic tanks, with faecal sludge collected by private desludging operators and disposed of in the open fields and natural drains. • **GHG Emissions:** 3,837 tCO_2e (1.8% of total GHG emissions)

Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:**
	• GoI's AMRUT 2.0 supporting sewage infrastructure
	• National Policy on Faecal Sludge and Septage Management
	• Energy Efficient Wastewater Management System
	• National Framework on Safe Reuse of Treated Water has set year-wise state-level targets for the reuse of treated wastewater
	• Toolkit For Preparing City Action Plans for Reuse of Treated Used Water by National Institute of Urban Affairs (NIUA), National Mission for Clean Ganga (NMCG) and Council on Energy, Environment and Water (CEEW)
	State/Local Policy/Programme/Targets:
	• AP State Sanitation Policy 2016
	• Andhra Pradesh Building Rules, 2017 specifies requirement for on-site sewage treatment plants and dual plumbing system for wastewater recycle and reuse in new building and construction for 50,000 to 150,000 sq. m. plot area
	• Faecal Sludge and Septage Management Policy and Operative Guidelines for Urban Local Bodies
	• Wastewater Reuse and Recycle Policy 2017
	• Standard Operating Procedure (SOP) For Cleaning of Sewers and Septic Tanks
	City Policy and Initiatives
	• Decentralized sewerage system divided into 13 zones – 12 STPs for domestic sewage and 1 CETP for industrial effluents.
	• Planned infrastructure:
	  ○ Phase-1 (upto 2043): 284MLD capacity (12STPs + 35 MLD CETP)
	  ○ Phase-2 (2043-2058): Expansion to 586MLD STP capacity and 53MLD CETP capacity for projected 723MLD wastewater.
	• 1035km of trunk sewer network with 58 intermediate lifting stations and main pumping stations in each zone.
	• 193MLD of treated wastewater is planned to reuse for urban greening, district cooling and irrigation.
	• Modular treatment plants with SBT, A2O and MBBR technologies recommended.

Opportunities and Gaps	• 100% wastewater collection and treatment planned through a decentralized, modular STP network with SCADA-enabled real-time monitoring for efficient operations. • Treated water reuse in urban greening, district cooling, waterbodies recharge, firefighting, construction activities, flushing, and industries can reduce freshwater demand and create revenue opportunities for the city.

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- Current untreated sludge discharge into vagus poses a serious water quality risk to Prakasam Barrage until full network implementation.

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<tr><td>Climate Risk and GHG Emissions Scenario</td><td>

GHG Emissions:

<table>
<tr><th colspan="4">GHG Emissions in BAU scenario (tCO_2e)</th></tr>
<tr><th>2024</th><th>2028</th><th>2043</th><th>2058</th></tr>
<tr><td>7,613</td><td>46,076</td><td>145,609</td><td>329,241</td></tr>
</table>

Climate Risk Status: Medium

- During heavy rainfall and flooding situations, there is a risk of STP, pumping station, and sewer network inundation, leading to untreated sewage overflow and water contamination.
- Higher temperatures can reduce biological treatment efficiency and increase energy demand for aeration in STPs
- Mixing of floodwater and untreated sewage can spread waterborne diseases and create vector-breeding hotspots.

</td></tr>
<tr><td>Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions</td><td>

GHG Mitigation Potential and Indicative Cost of Interventions:

<table>
<tr><th rowspan="2">Parameters</th><th colspan="3">Climate Action Scenario</th></tr>
<tr><th>2028</th><th>2043</th><th>2028</th></tr>
<tr><td>GHG Emissions in Climate Action Scenario (tCO2e)</td><td>5,111</td><td>16,318</td><td>35,786</td></tr>
<tr><td>GHG emissions reduction from BAU</td><td>89%</td><td>89%</td><td>89%</td></tr>
<tr><td>Total cost of mitigation actions by 2058 (Million INR)</td><td colspan="3">9,056</td></tr>
</table>

Climate Resilience Impacts and Co-benefits:

- Improved quality of water resources, reduces water contamination and related health issues.
- Improves city sanitation standards and mitigates urban flooding risks
- Promotes circular economy by reusing treated wastewater, lowering freshwater demand
- Decreases methane emissions by capturing and utilising gas from Anaerobic Treatment Plant

Strengthened Resilience to Hazards:
Urban flood, cyclones

</td></tr>
<tr><td>SDGs</td><td>GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 7: Affordable and Clean Energy, GOAL 9: Industry, Innovation and Infrastructure, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 15: Life on Land</td></tr>
</table>

Climate Strategies, Actions and Targets

Strategy 1: Commission efficient and adequate wastewater collection network

Proposed Actions

Action 1: Deploy city-wide sewer network to prevent cross-contamination of water supply and stormwater during heavy rain and floods.
Action details Implement a city-wide underground sewerage network covering all properties, with gravity-based designs prioritized to reduce pumping needs. Ensure resilience against floods and high groundwater, link building permissions for mandatory sewer connections, phase out septic tanks, and prevent stormwater-sewage cross-contamination through integrated planning and enforcement mechanisms. **Existing Initiatives** A 1,035 km underground sewer network was planned across 13 zones, with 58 lifting stations and modular STPs. Phase I (up to 2043) work includes trunk sewers, pumping stations, and initial STP capacity of 284 MLD, ensuring 100% network coverage for all new developments and gradual conversion of septic tank systems in existing settlements. **Sub Actions** • Conduct a comprehensive geo-hydrological feasibility assessment of the citywide underground sewer network. **(Ongoing/Planned)** • Prioritize gravity-based sewer designs, wherever possible, to minimize mechanical pumping and enhance cost and energy efficiency.**(Ongoing/Planned)** • Assess feasibility of using solutions such as automated vacuum sewer systems to ensure network connectivity in areas with high groundwater levels and narrow streets. • Ensure network connection to all new buildings by linking to building permission system and conducting inspections prior to building occupancy. • Connect all existing buildings having septic tank systems to the sewer network through service connections. Integrate connection status into property tax system to promote compliance
Potential locations: Citywide
Implementing entities **Lead:** APCRDA, ADCL **Supporting:** PH&MED, DTCP, Technology/service providers
Type of action: Climate Mitigation
Climate resilience benefits: Medium
Timeline: Short term
Monitoring Indicators:

- Percentage of properties connected to sewer network
- Percentage of existing properties connected to sewer network

Action 2: Ensure optimum management and maintenance of sewer network

Action details

SCADA-enabled real-time monitoring and integrated grievance redressal systems are planned for O&M under the Central Command Centre. DPR provisions include sensor-based block detection, periodic cleaning using robotic systems, and integration of stormwater and sewer inspections into building permissions for long-term network sustainability.

Sub Actions

- Establish systematic maintenance plan to ensure optimal performance, prevent sewer blockages and overflows.
- Formulate an immediate response team to address maintenance-related grievances.
- Implement SCADA for efficient, real-time sewer network monitoring and operation. **(Ongoing/Planned)**
- Integrate robotic cleaning solutions such as HomoSEP in the manhole to reduce manual intervention.
- Install intelligent sensors in manholes to detect blockages, stop stormwater inflow and trigger response actions.
- Ensure provision of dedicated stormwater and wastewater systems at property-level through site inspections in the building occupancy permission process.
- Continuous and coordinated planning with Urban Greening for tree placement near sewer lines to minimize root intrusion risks.

Potential locations: Citywide

Implementing entities

Lead: APCRDA

Supporting: ADCL, PH&MED, DTCP, Technology service providers

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- No. of SCADA sensors & manhole monitoring devices installed & functional.
- No. of issues identified through SCADA, and percentage of thems correlated with the grievances.
- Response time to blockage/overflow complaints (average hours/days).
- Percentage of sewer network covered under maintenance schedule
- Percentage of properties inspected for separate stormwater & sewerage systems

Good Practice:

The HomoSEP robotic cleaning system, developed by IIT Madras–incubated startup Solinas Integrity, was deployed by **Madurai Municipal Corporation** across 16 sites in five residential areas. The system

mechanizes septic and manhole cleaning, using high-speed cutters and suction units, eliminating manual entry and improving sewer maintenance efficiency.

Action 3: Provision of facilities for safe containment, collection and treatment of wastewater during the first phase of construction.

Action details

As full sewer connectivity will be completed in phases, bio-digester-based mobile toilets and dual plumbing systems have been proposed for construction sites and public facilities in Phase I areas, ensuring interim sanitation solutions before central STPs become fully operational.

Sub Actions

- Prioritize construction of public toilets early on, equipped with dual plumbing to use treated wastewater for flushing.
- Establish size-based sanitation requirements at construction sites. Smaller projects to provide access to public toilets for workers and larger projects (over 3,000 sq.m) to install mobile toilets supported by appropriate enforcement/penalty mechanisms.
- Adopt sustainable in-situ solutions such as bio-digester technology (a self-sufficient containment and treatment unit that requires no further processing) in mobile and public toilets to be constructed.

Potential locations: Construction Sites

Implementing entities

Lead: APCRDA

Supporting: ADCL, PH&MED, DTCP, private contractors, NGOs

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- Percentage of public toilets with dual plumbing for reuse of treated wastewater.
- Percentage of construction sites with mobile toilets provision.

Good Practice:

In **Banka, Bihar,** the BioLoo bio-digester toilets treat human waste onsite using anaerobic bacteria, converting it into pathogen-free water for gardening and biogas for energy, requiring no sewer linkages.

Strategy 1 - Financing Modes/Sources

APCRDA fund, State government grants and schemes, AMRUT, loan from multilateral development bank (World Bank, ADB, GEF)

Strategy 2: Ensure sustainable and scientific wastewater treatment and reuse

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Efficiency of treatment process	Percentage of quality compliance of treated water	100%	100%	100%
Adoption of decentralised wastewater treatment system	Percentage of wastewater collected and treated safely through decentralised wastewater treatment system (DeWATS)	100%	100%	100%
Adoption of treated wastewater for reuse.	Percentage of safe reuse of treated water	30%	50%	50%

Proposed Actions

Action 1: Adopt well-managed, efficient treatment system & infrastructure able to sustain extreme climate events

Action details

Amaravati needs to develop modular, flood-resilient STPs and CETPs equipped with SCADA-based monitoring, buffer storage, and interlinked systems to ensure continuous, compliant treatment under extreme weather. Regular assessments, operator training, and capacity expansion will enhance efficiency, resilience, and adaptability to future growth.

Existing Initiative

Phase I includes 12 modular STPs (284 MLD) and 1 CETP (35 MLD) with provision for flood-resilient designs, buffer storage tanks, and SCADA-based monitoring. Phase II will expand capacities to 586 MLD STPs and 53 MLD CETP by 2058, ensuring safe treatment under extreme weather events.

Sub Actions

- Commission innovative treatment infrastructure such as multi-storey STP configurations to optimise land use and address high groundwater table conditions.
- Conduct periodic assessments to enhance treatment infrastructure, accounting for population and city growth.
- Implement SCADA-based real-time monitoring to optimise STP performance and support reporting to SPCB and CPCB. Monitoring to cover all STP modules (e.g. clogging in the grit removal chamber, level of aeration, tracking flow hydraulic) and inflow and outflow quality. **(Ongoing/Planned)**
- Validate SCADA results through periodic external labaratory-based quality tests and to support system calibration.
- Ensure treated water discharged from STP meets the required norms as laid out by the concerned regulatory authorities. **(Ongoing/Planned)**
- Establish water quality monitoring stations at strategic locations across the city's natural drainage network including STP discharge points, upstream city boundaries, and outfall locations

- Study the feasibility of interlinking STPs for diversion of wastewater during failures or climate events such as floods.
- Provide adequate buffer storage capacity to accommodate additional inflows during system failures, scheduled maintenance, and to support retreatment of wastewater effluent (in cases when prescribed treatment norms are not met)
- Train plant operators regularly on efficient, low-carbon STP operations and new technologies.

Potential locations: Citywide

Implementing entities

Lead: APCRDA, ADCL

Supporting: APPCB, STP operator, Technology/ Service providers, academic Institutes, research organisations

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- % STP & CETP capacity commissioned vs demand.
- % wastewater treated vs total generation (MLD).
- % treated wastewater complying with CPCB/APPCB discharge norms.
- % of STPs installed with SCADA real-time monitoring

Good Practice:

A 20 MLD double-storey STP built in 2018 in Pune Cantonment, Maharashtra, uses SBR technology and spans 1.40 acres (5,665 m^2) at a cost of ₹32 crore. The multi-storey design offers a cost-effective solution for both capital and operational expenses.[24]

Action 2: Adopt decentralised wastewater management approaches

Action details:

Amaravati will promote decentralized wastewater management systems to complement centralized infrastructure and ensure efficient treatment at the source. Large developments and individual plots will be mandated to install on-site treatment units such as DEWATS or prefabricated STPs.

Sub Actions

- Mandate on-site wastewater treatment for projects with 50,000–150,000 sq.m built-up area or plots over 1,000 sq.m.[25] Link compliance to building occupancy permit process. **(Ongoing/Planned)**
- Use of DEWATS or prefabricated STPs for on-site treatment based on feasibility studies.
- Establish request-based, fee-for-service facility for maintenance of on-site decentralized systems. Delivery of such service by centralized STP operators functioning within the same service area can be facilitated

[24] Multi-storey STP in Pune Cantonment, Pune, Maharashtra, sbmurban, e-library
[25] Andhra Pradesh Building Rules 2017.

Potential locations: Citywide with focus on public buildings, institutions, large-scale commercial and residential projects.
Implementing entities **Lead:** APCRDA **Supporting:** PH&MED, DTCP, Technology/ service providers, DEWATS operators
Type of action: Climate Adaptation
Climate resilience benefits: Very High
Timeline: Short to Medium term
Monitoring Indicators: • No. of properties installed with on-site STPs. • % compliance of on-site systems with O&M standards. • Volume of wastewater treated by decentralized systems (MLD).
Good Practice: 15 kLD capacity DEWATS was set up at Pristine Temple Tree Apartment**, Bengaluru,** in 2019, catering to 40 flats. The treated water is re-used for gardening/landscaping, with safe disposal of the remaining wastewater into the nearby municipal sewer line.

Action 3: Enable high level of safe reuse of tertiary treated wastewater

Action details

Amaravati will promote safe and sustainable reuse of treated wastewater by enforcing reuse regulations, optimizing tertiary treatment, and integrating reclaimed water use across sectors such as construction, landscaping, and cooling, thereby reducing freshwater demand and enhancing water security.

Existing Initiative

Treated water reuse for landscaping, district cooling, and construction has been integrated into Phase I DPR plans. About 193 MLD of treated water is earmarked for reuse, with dual plumbing.

Sub Actions

- Assess potential for safe reuse of treated wastewater by bulk consumers and select suitable tertiary treatment based on end use.
- Enforce regulations to mandate safe reuse of treated wastewater, limit groundwater extraction, and raise awareness of its benefits.
- Mandate treated wastewater reuse with dual plumbing and separate storage in properties using DEWATS (plots over 1,000 sq.m) to prevent potable water contamination **(Ongoing/Planned)**
- Mandate the use of recycled water for construction activity through building approval process, once planned centralised STPs become operational **(Ongoing/Planned)**
- Ensure 100% treated wastewater reuse for urban green areas through coordination with relevant stakeholders **(Ongoing/Planned)**
- Adopt optimal treated wastewater use in district cooling systems while meeting necessary technical and quality standards **(Ongoing/Planned)**

• Pilot provision of reusing treated wastewater for flushing and gardening at property level.
Potential locations: Citywide with focus on AGC area in the initial development phase.
Implementing entities **Lead:** APCRDA, ADCL **Supporting:** PH&MED, APPCB, DTCP, Research organisations, Consultants, APIIC
Indicative cost: INR 13 million/km of pipeline for conveying treated used water. Tanker for conveying - INR 0.2-0.8 million/ vehicle[26]
Type of action: Climate Adaptation
Climate resilience benefits: Very High
Timeline: Short to Medium term
Monitoring Indicators: • Volume of treated water reused for urban greening, construction, district cooling (in MLD). • % buildings with dual plumbing for recycled water. • % treated water reuse mandated & enforced in bulk user sectors.
Good Practice: **Singapore's** NEWater initiative treats municipal wastewater using microfiltration, reverse osmosis, and UV disinfection to produce ultra-pure reclaimed water. NEWater currently meets around 40% of national demand, projected to reach 55% by 2060. It's used for industries, power generation, cooling systems, and indirect potable reuse via reservoir augmentation. **Surat** Municipal Corporation (SMC) has converted the wastewater generated in the city into the resource by establishing 4 Tertiary Treatment Plants with installed capacity of 116 MLD thereby reducing dependency on fresh water resources & creating treated wastewater as an economic resource, to promote Sustainability and circular economy, Surat has started reuse of treated waste water in various non potable purposes like Industrial use, rejuvenation of lakes, Agriculture – mass plantation, sewer cleaning, Gardening, etc. through direct service line as well as Tanker Filling Station.

Strategy 2 - Financing Modes/Sources
APCRDA fund, State government grants and schemes, AMRUT, loan from multilateral development bank (World Bank, ADB, GEF)

[26] NIUA, NMCG, CEEW, Toolkit for Preparing City Action Plans for Reuse of Treated Used Water, 2024.

Strategy 3: Adopt low-carbon technologies, enhance energy and performance efficiency of treatment

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Adoption of high-efficiency equipment for water pumping	Energy-efficient equipment and pumps in water supply facilities	100%	100%	100%
Renewable energy in water supply facilities	Electricity consumption in water supply facilities to be met by renewables	50%	100%	100%
Low-carbon and efficient performance management of wastewater treatment plants	Percentage of wastewater treatment capacity using anaerobic treatment system with methane gas capture and recovery	33%	33%	33%
	Percentage of wastewater treatment capacity using aerobic treatment system operated with optimum and efficient performance management measures	67%	67%	67%

Proposed Actions

Action 1: Adopt anaerobic treatment technology with efficient methane gas capture and utilisation

Action details

Anaerobic sludge digestion for energy recovery at STPs and co-treatment of faecal sludge from existing settlements until sewerage coverage is complete. GIS tracking for desludging vehicles is planned for operational monitoring.

Sub Actions

- Ensure anaerobic STPs are installed with an efficient methane gas capture mechanism and utilisation for energy generation **(Ongoing/Planned Partly)**
- Adopt scientific treatment of sewage sludge generated from STPs through anaerobic digestion process to curb GHG emissions
- Conduct an assessment to identify suitable pre-treatment technology to optimise biogas yield from anaerobic digestion of sewage sludge

Potential locations: Citywide

Implementing entities

Lead: APCRDA

Supporting: ADCL, PHMED, APPCB, STP operators, Academic institutions, Research Organisations

Indicative cost:

Anaerobic Wastewater Treatment Plants

2028: 4,612 lakh INR

2043: 12,976 lakh INR

2058: 29,452 lakh INR

Type of action: Climate Mitigation
Climate resilience benefits: Very High
Timeline: Short term
Monitoring Indicators: • Quantity of sludge generated vs treated. • Volume of biogas generated and utilized for energy (m^3/year).
Good Practice: **Chennai** Metropolitan Water Supply & Sewerage Board in Chennai anaerobically digests sludge in 7 STPs of 498 MLD cumulative capacity to produce biogas. Around 523.92 m3 per hour (12,574 m3 per day) of gas is produced and utilized for the production of power through a biogas engine. The average electrical energy production from biogas is 2 kWh / m3 of biogas.

Action 2: Enhance performance efficiency of wastewater treatment plants
Action details Automated controls, energy audits, and operator training programs for STPs under SCADA integration to optimize treatment processes and energy use **Sub Actions** • Optimise aerobic treatment processes by upgrading to high-efficiency aeration, motor and pumping systems. **(Ongoing/Planned)** • Organise regular trainings for operational staff to enhance treatment efficiency and operational performance of STPs.
Potential locations: All proposed STPs in the city
Implementing entities **Lead:** APCRDA **Supporting:** ADCL, PH&MED, APSECM, monitoring agencies and training institutes
Indicative cost: Aerobic Wastewater Treatment Plants 2028: 9,569 lakh INR 2043: 26,924 lakh INR 2058: 61,111 lakh INR
Type of action: Climate Mitigation
Climate resilience benefits: Very High
Timeline: Medium term
Monitoring Indicators: • Energy consumption per MLD of wastewater pumping and treatment (kWh/MLD). • % operators trained in low-carbon/energy-efficient STP operations. • No. of energy audits & performance reviews completed annually
Good Practice:

The **City of Riverbank** in California, Wastewater Treatment Plant integrated SCADA-based automation with upgraded fine-bubble diffusers, blowers, and high-efficiency motors to optimize dissolved oxygen control and reduce energy use. The plant achieved ~75% energy savings and 65% cost reduction, saving over USD 240,000 annually. Regular operator training on SCADA systems and maintenance ensured sustained efficiency gains and performance optimization.

Action 3: Reduce energy demand and integrate renewable energy sources

Action details

STPs to include solar PV systems and biogas-to-energy conversion at treatment plants to reduce operational costs and carbon footprint

Sub Actions

- Use high-efficiency equipment such as pumping motors (atleast IE4 or above), variable frequency drives, automatic power factor correction panels to minimize energy use in all wastewater treatment facilities. Facilitate deployment by including requirements for energy efficient equipment in public tenders for construction and commissioning of STPs. **(Ongoing/Planned Partly)**
- Include requirements for energy efficient operation and performance of STPs in contracts of third-party facility operators
- Undertake periodic energy audits to monitor the performance and undertake improvement measures.
- Adopt a mix of on-site and off-site RE resources including solar and wind energy for meeting energy demand of wastewater treatment facilities. Use of solar and wind energy along with battery energy storage solutions can be assessed to provide round-the-clock renewable power for day and night-time operation of wastewater management facilities.
- Build facilities to be ready for RE integration (on-site and off-site) from an early-stage, considering infrastructure inclusions (electrical, metering, sanctioned load) and space provision. Relevant requirements can be reflected in tender documents for STP construction.

Potential locations: All proposed STPs in the city

Implementing entities

Lead: APCRDA, ADCL

Supporting: APCPDCL, APSECM, NREDCAP, STP facility operators, Technology/service providers

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Short to Medium term

Monitoring Indicators:

- % STPs powered by onsite solar PV or hybrid renewable systems.
- % reduction in grid electricity use compared to baseline year.
- GHG emissions avoided through biogas & renewable energy use (tCO_2e/year)

Strategy 3 - Financing Modes/Sources

APCRDA funds, State government grants and schemes, AMRUT, funding from multilateral development bank (World Bank, ADB, GEF), ESCO/RESCO models through PPP

Strategy 4: Adopt safe and sustainable faecal sludge treatment system

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Scientific treatment of fecal sludge	Percentage of faecal sludge treated	100%	100%	100%

Proposed Actions

Action 1: Ensure scientific management of faecal sludge from the existing village settlements for the near-term

Action details

Until full sewer network coverage is achieved, Faecal Sludge Treatment Plants (FSTPs) and co-treatment in central STPs are proposed. Private desludging operators will be empaneled and GIS-monitored to ensure safe sludge disposal.

Sub Actions

- Treatment of faecal sludge from existing settlements can be carried out by establishing an FSTP or co-treatment STP until the integration with city-level sewer network.
- Empanel private desludging operators, thereby scientifically enabling the emptying process as per GO 134.[27] **(Ongoing/Planned Partly)**
- Mandating the use of GIS-enabled tracking for all desludging vehicles and monitoring at the command control centre to ensure waste reaches the processing facility. **(Ongoing/Planned)**

Potential locations: Existing Settlements, STPs in the city

Implementing entities

Lead: APCRDA, ADCL

Supporting: Technology/service providers, academic/research institutes

Indicative cost:

Establishing a FSTP is approximately INR 7 million per kLD of treatment capacity

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- % faecal sludge safely collected & treated vs total generation.
- % desludging operators empaneled & tracked through CCC.
- No. of unauthorized sludge disposal incidents & enforcement actions taken.

Good Practice:

Maharashtra has implemented co-treatment of faecal sludge in existing STPs, enabling nearby towns to discharge septage into larger treatment facilities, ensuring efficient use of infrastructure. Sludge volumes

[27] Faecal Sludge and Septage Management Policy and Operative Guidelines for Urban Local

and quality are monitored to avoid overloading. This approach optimizes resources, reduces operational costs, and promotes sustainable sanitation.

Strategy 4 - Financing Modes/Sources

APCRDA funds, State government grants and schemes, AMRUT, Smart City funds, funding from multilateral development bank (World Bank, ADB, GEF)

2.4 Stormwater Management

Baseline Status (2025)	**Key Statistics:** Amaravati is located downstream of the Kondaveeti Vagu catchment. Kondaveeti Vagu and Pala Vagu form a network of 31.15 km in the catchment, with approximately 11 km lying within Amaravati, where it eventually joins the Krishna River at Undavalli. Plans are in place to widen Kondaveeti and Pala Vagu to accommodate the anticipated increase in runoff. Three reservoirs are planned within the city and two more in the Kondaveeti Vagu catchment. The capacity of the existing Undavalli pumping station will be enhanced, and a new pumping station at Vykuntapuram will be constructed.
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • GoI's AMRUT 2.0 • River Centric Urban Planning Guidelines (2021), MoHUA • Manual on Storm Water Drainage Systems (2019), CPHEEO • SMART City Mission. **State/Local Policy/Programme/Targets:** • AP Building Rules 2017. • AP ECBC guidelines. • Blue Master Plan • Completion of the first phase of flood mitigation works by 2028. • Completion of construction of underground stormwater drainage network by 2028.
Opportunities and Gaps	• The bund wall to block backwater of the Prakasam barrage entering the city necessitates mechanical engineering interventions for reaching the runoff into the River Krishna. • Preserving and integrating existing water bodies with the vagu network. • Demarcating the FTLs of existing water bodies. • Rainfall events taking place in the upstream catchment will impact the city. • Sedimentation carried by runoff can impact the operation of the pumping stations.

	• The effectiveness of mitigation strategies heavily relies on centralised pumping stations. • Responsibilities for protecting and maintaining water bodies are divided among multiple departments, resulting in a lack of coordination, compromising the maintenance operations and protection of the water bodies.
Climate Risk Scenario	**Climate Risk Status**: Extreme Due to the prevailing flat terrain of the Amaravati and black cotton soil permeability of the stormwater into the ground is very limited which converts the major extent of rainfall into runoff. Effective management of the runoff through interventions is required to avoid any instances of pluvial flooding and with anticipated high intense rainfall events the vulnerability of public infrastructure is high and disruption of day-to-day activities of the citizens.
Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions	**Climate Resilience Impact and Co-benefits:** • Understanding the hydrological dynamics of stormwater is essential for identifying flood-prone areas. • Implementing strategies to mitigate urban flooding and its consequential impacts, including public health risks. • Constructing engineered retention basins and adopting nature-based solutions effectively reduces surface runoff and enhances groundwater recharge. • Rainwater harvesting and groundwater replenishment initiatives at the property level will significantly decrease pressure on limited freshwater resources.
SDGs	GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 14: Life under Water

Climate Strategies, Actions and Targets

Strategy 1: Adopt principles of Integrated Urban Water Management for effective stormwater management

Proposed Targets:

Action area	Target Parameter	2028	2043	2058
City network of stormwater	Stormwater network coverage	100%	100%	100%

Proposed Actions:

Action 1: Conserve and optimise utilization of natural water bodies and drainage network for runoff management and flood control

Action details

Amaravati's green field capital is planned on areas where the majority of land use is agriculture. This region contains a network of natural stormwater systems formed through vagus and water bodies. Preserving and expanding the use of this natural system for runoff management is crucial, as stormwater flow at a micro level will remain the same regardless of city-scale infrastructure. Any retention and detention measures can be planned along this natural network.

Existing Initiatives

APCRDA is working to identify the FTLs of existing water bodies nad conserving the natural drainage system. Additionally, widening works for the Kondaveeti vagu and Pala vagu to discharge runoff generated for a 1 in 100-year return period rainfall are underway. These enhancements are supported by increasing the pumping capacity at Undavalli and constructing another pumping station at Vykuntapuram, as planned in the Blue master plan.

Sub Actions:

- Demarcate and notify the Full Tank Levels of existing and proposed water bodies and drains (vagus).
- Map and communicate boundaries of natural stormwater system to government departments. Establish shared responsibilities for ecosystem protection.
- Notify and enforce legal actions against the encroachments of water bodies and vagus.
- Implement the identified measures to reduce runoff from each sub-catchment as identified in the flood mitigation study.
- Ensure the widening of the natural drainage network as per the flood mitigation plans to accommodate the increased runoff due to anticipated urbanisation and enforce protection measures supported with city-wide coverage of the storm water drain network.

- Ensure all water bodies are integrated with the flood mitigation network through the identification and protection of inlet and outlet channels for all existing and planned water bodies in the city.
- Define SOPs for year-round desilting and cleaning of water channels and water bodies to sustain the design capacities.
- Increase the capacity of the existing bund road to protect the surrounding areas from the backwaters of Prakasam barrage and accommodate higher traffic volumes.
- Protect the existing irrigation canals to handle expected excess runoff by converting them into stormwater channels and ensuring their durability.
- Assess sedimentation risk in the network of waterbodies and vagus and implement necessary measures.

Implementation agency

Lead: APCRDA, Water Resource Dept.

Supporting: ADCL, MA&UD

Type of action: Climate Adaptation

Timeline: Short to medium

Climate resilience benefits: High

Potential locations: Citywide

Monitoring indicators:

- Percentage of existing and planned waterbodies FTL notified.
- Percentage of existing waterbodies linked with the stormwater network.
- Percentage of waterbodies and length of stormwater network that conducted maintenance /desilting works in a maintenance cycle period.

Good practice:

Canal rehabilitation in Johannesburg, South Africa:
Canal rehabilitation aims to achieve a 100-year return period flood relief through a combination of reed removal, planting biodiverse vegetation, geo-matting to prevent soil erosion, and minimising reed growth.

Lake redevelopment in Ahmedabad:
The Ahmedabad Lake redevelopment links lakes to address waterlogging, insecurity, and groundwater depletion by integrating sustainable urban water management. It involves creating lake clusters with natural slopes, sluice gates, and valves for flow control, redeveloping waterfronts for recreation, installing sewage and stormwater drains, and desilting to increase storage.

Canal network rejuvenation in Kochi:

In 2019, Kochi faced extreme rainfall, and reduced canal water capacity was a key cause of flooding. Rejuvenating the canal system was vital for flood management. The Kochi Canal network rejuvenation involves implementing resilience actions identified by the technical committee. The Government of Kerala allocated around USD 3.2 million for structural measures. These included desilting, widening, clearing vegetation, removing debris, demolishing and reconstructing culverts, and widening canals to increase capacity.

Action 2: Establish a unified real-time monitoring system for all urban water systems to enable comprehensive water management.

Action details

A monitoring system providing real-time information on all water systems, including drinking water supply, groundwater, wastewater, and stormwater, enables better urban water circularity management. This reduces the need for external water intake and minimises the pumping of wastewater and stormwater runoff from the city to outside. The potable water demand can be met through drinking water supply, non-potable demands can be met with treated wastewater and stormwater, and the availability of these can reduce the raw water pumping demand and meet the future needs. The shortage of water supply is reflected in the extraction of groundwater. The stress on one system is reflected in the pressure building up on other system.

Implementation agency

Lead: APCRDA, Water Resource Dept.

Supporting: IMD, Research institutions, and Technology service providers.

Type of action: Climate Adaptation

Timeline: Medium

Climate resilience benefits: Medium

Potential locations: Citywide

Good practice:

Waternet, Amsterdam

Waternet, a public organization responsible for the entire water cycle, manages drinking water, wastewater, surface water, and flood control efficiently, sustainably, and with a focus on customer needs.

Strategy 1 - Financing Modes/Sources

AMRUT and APCRDA funds, CSR funds, Water Resource Department funds, multilateral development bank loan, and grants from donor agencies.

Strategy 2: Integrate green spaces with blue infrastructure and adopt decentralised flood resilience measures.

Proposed Targets:

Action area	Target Parameter	2028	2043	2058
Runoff management	Permeable/semi-permeable surface in footpaths	100%	100%	100%
Installation of the RWH system in the properties	Percentage of new properties with RWH system	100%	100%	100%
	Percentage of existing properties retrofitted with RWH system	10%	100%	100%

Proposed Actions:

Action 1: Mainstream nature-based solutions in land use planning and building regulations

Action details

Increasing flood resilience through the adoption of decentralised, nature-based solutions is cost-effective as it requires limited external materials and is mostly made of natural resources available locally. Integrating nature-based solutions into infrastructure offers greater benefits compared to standalone engineering solutions or solely nature-based ones. Allocating dedicated space for developing NBS solutions makes them unfeasible in urban settings where land costs are high and availability is limited. Incorporating these solutions into micro-level land use planning and mandating them at the property level enhances implementation and yields larger results.

APCRDA is adopting semi-permeable materials for the development of pathways/paving and parking areas and suggesting the same for individual developers as well.

Sub Actions:

- Conduct a city-scale study to assess the detention potential of green areas, prioritising high runoff sub-catchments that can be integrated with the stormwater network.
- Create rain gardens connected to conveyance channels for redirection.
- Mandate the utilisation of semi-permeable materials for pavements/pathways and parking.
- Promote the installation of percolation pits in all commercial and industrial premises.
- Adopt climate resilient street design by including solutions such as bioswales, innovative inlet design and weir walls to slow down run off and support effective rainwater retention and infiltration.

Implementation agency

Lead: APCRDA

Supporting: ADCL, Architects, Civil Engineers, Subject experts.
Indicative cost: Permeable pavers can vary from Rs. 40-100 per square feet depending on material[28]
Type of action: Climate Adaptation
Timeline: Short term
Climate resilience benefits: High
Potential locations: Citywide
Monitoring indicators: • Percentage of runoff absorbed through Nbs solutions. • Percentage of length of footpaths/pavements made with semi-permeable materials. • Percentage of commercial and industrial premises installed with percolation pits. • Percentage of installed NBS solutions for which maintenance works are completed in a maintenance cycle.
Good practice: **Sponge Park, Chennai:** In Chennai, parks feature pond-like formations and channels that capture and infiltrate rainwater in urban areas. These channels divert water from nearby roads into the pond through storm drains. The pond is surrounded by a stone barrier topped with a protective layer of railing. **Raincity, Vancouver, Canada:** The Raincity Strategy of Vancouver is a 30-year plan to manage rainwater as a resource, using green rainwater infrastructure like rain gardens, permeable pavements and green roofs, and the target is to capture 90% of annual rainfall and manage 40% of runoff from impervious areas by 2050.

Action 2: Ensure city-wide adoption of rainwater harvesting and its sustained operation

Action details

Introducing a decentralised runoff management system, with RWH systems installed at a plot level, helps capture runoff at its source. The systems can be emptied ahead of time when high-intensity rainfall is predicted, or the amount of runoff that can be captured can be used to reduce system surcharge time.

As mentioned in the AP building rules, APCRDA is mandating the construction of RWHs in all properties above 300 sq. m, and execution of the same will be verified during the building permission approval and issuance of the occupancy certificate.

[28] India Mart

Sub Actions:

- Mandate the construction of RWH systems in all properties with a plot area of >300 sq. m
- Include specifications on RWH design in building bye-laws stating that the minimum storage capacity should be able to accommodate peak-month rainfall runoff.
- Pilot AI and IoT-enabled monitoring and decision-making system.
- Establish a system to monitor the operation of RWHs periodically, link this analysis of runoff volume from each catchment to the censors' recordings. (Target properties with excess water utilisation).

Implementation agency

Lead: APCRDA, DTCP

Supporting: Architects, Civil Engineers, Real estate developers, Contractors, Technology/service providers

Type of action: Climate Adaptation

Timeline: Short to medium term

Climate resilience benefits: High

Potential locations: City-wide, with a focus on sub catchments 9, 10, and 12 for the pilot study.

Monitoring indicators:

- Percentage of properties installed with RWH systems.
- Percentage of properties installed with real-time monitoring sensors.
- Percentage of properties with real-time monitoring sensors receiving instructions on emptying or capturing the runoff.
- Percentage of installed RWH systems monitored in a cycle.

Good practice:

Residential Stormwater Smartgrid Utility Technology in Canada:
RainGrid's Residential Stormwater Smartgrid Utility Technology (RSSUT) manages rain runoff from rooftops, aiming to disconnect roofs from storm sewers and supply harvested water for recharge or use. It provides real-time rainfall data and micro-climate analytics for individual properties and networks. The system reduces stormwater runoff by 90% in cisterns serving roof areas.

Action 3: Incorporate a river-centric approach in land use planning

Action details

As the Amaravati is situated on the banks of the river Krishna, it is crucial to safeguard the existing ecosystem and biodiversity, avoiding disruption from changes in land use within the city limits. Preserving

the river ecosystem and maintaining flood plains as buffer zones minimises the risk by reducing exposure to hazards.

APCRDA will maintain a buffer of 100 meters from the Krishna River line, and the riverfront development plans are being carried out with minimal interventions to preserve the natural ecosystem.

Sub Actions:

- Prevent concretization of river bank and adopt ecological and people-centric development following natural hydrogeology.
- Designate and notify no-construction areas based on comprehensive flood risk assessments (both extreme and most probable flooding scenarios).

Implementation agency

Lead: APCRDA, Water Resource Dept.

Supporting: DTCP, AP Urban greening and beautification Corporation Ltd.

Type of action: Climate Adaptation

Timeline: Short to medium term

Climate resilience benefits: Medium

Potential locations: Along the Krishna riverbank

Good practice:

Urban River Management Plan, Kanpur:
The Urban River Management Plan of Kanpur aims to sustainably integrate the Ganga and Pandu rivers into the urban landscape. It designates a 100-meter no-development zone for Ganga and a 30-meter zone for Pandu to protect their riverfronts. This plan is intended as a living document for future updates, detailed project reports, and adaptive management. It encourages community ownership, coordinated governance, and long-term river health.

Strategy 2 - Financing Modes/Sources

AMRUT and APCRDA funds, CSR funds, multilateral development bank loan, and grants from donor agencies.

Strategy 3: Effective monitoring, forecasting and readiness to respond to extreme climate events.

Action 1: Implement Early Flood Warning System.

Action details

Based on the rainfall forecasting information for Amaravati and the overall Kondaveeti Vagu catchment, runoff generated upstream of the Kondaveeti catchment flows through Amaravati before reaching the Krishna River. This could cause a flood-like situation in Amaravati even without any rainfall if not prepared. The planned network within the city can be developed to manage the anticipated runoff based on forecasting data, including the expected volume and velocity of runoff, supported by an early warning system. In extreme events, flood-prone areas can be identified, and communities within those areas can be informed and prepared.

APCRDA is planning to install a network of AWS stations that will be integrated into a central monitoring system. Also, warning dissemination is in place in a few existing villages, which can be implemented throughout the city.

Sub Actions:

- Deploy a network of automated weather stations with a lower recording interval (preferably 15 minutes) across all city sub-catchments and upstream vagu/drainage areas and integrate data with the Command and Control Centre (CCC).
- Install sensors to monitor water level and flow rates in all water bodies, vagus, and the underground stormwater network.
- Implement upstream flow monitoring systems to pre-emptively regulate water levels in water bodies and prevent urban flooding.
- Integration of all the existing rain gauges in the Kondaveeti vagu catchment with CCC and replace them with automatic weather stations over time.
- Develop a robust warning dissemination mechanism. Form community groups trained in interpreting public alerts and in emergency response coordination. Establish evacuation routes using hydrological and spatial information and local community knowledge.

Implementation agency

Lead: APCRDA, IMD, Water resource department (Go. A.P)

Supporting: SDMA, Krishna River Management Board, Health Department, NGOs, Police Department, RWAs, and Community associations.

Indicative cost: INR 1 million for 1 AWS[29]

Type of action: Climate Adaptation

Timeline: Short to medium term

Climate resilience benefits: High

Potential locations: Kondaveeti catchment and city wide

Monitoring indicators:

- Percentage of sub catchments installed with AWS systems.

[29] The Hindu, 39-more-automatic-weather-stations-installed-in-kerala-ahead-of-monsoon, 2022

- Percentage of sub catchments for which runoff is measured.
- Percentage of waterbodies installed with monitoring sensors.
- Percentage of rainfall events monitored based on forecasting information.

Good practice:

Community-based flood forecasting and early warning system in Semarang, Indonesia:
Early flood warning system in Semarang, involve local communities in regular risk mapping exercises by documenting their knowledge and identifying potential communication and coordination features, including but not limited to evacuation routes and flood protection shelter management. These preparedness efforts help communities become better equipped to respond in case of floods.

Action 2: Develop a comprehensive flood analysis system and mechanism to minimise urban flood risk.

Action details

Flood risk of an urban area depends on the rate of urbanisation, which includes changes in land use, infrastructure development, and modifications of the natural storm drainage network. The analysis to forecast the risk should be updated promptly with these modifications. Forecasting analysis helps in taking necessary measures before an event occurs, and infrastructure can be planned to mitigate the risk. As flood risk analysis is a continuous process, in-house capacity building reduces dependency on external resources and utilises the crucial minimum time available for emergency response activities. Integrating infrastructure proposals can help identify the probability of expected outcomes and provide final verification before proceeding with execution.

Sub Actions:

- Develop a predictive flood modelling system to map catchment-wise exposed areas and flood extents. Periodically update model parameters to support accurate runoff modelling.
- Build institutional capacities for flood data analysis and effective information dissemination to government departments and the public.
- Install a network of real-time monitoring sensors in the near-term to validate and calibrate flood modelling analysis, while improving forecasting accuracy.
- Maintain comprehensive rainfall and flood event records including rainfall data (hourly intensity, duration), exposure levels (spatial extent, duration and maximum depth of water logging specific to locations), and damage assessments to enhance future flood risk studies and planning.

Implementation agency
Lead: APCRDA, SDMA
Supporting: Andhra Pradesh Space Applications Centre, Andhra Pradesh State Planning and Development Society, Academic institutions, and Research organisations.

Type of action: Climate Adaptation

Timeline: Short to Medium

Climate resilience benefits: High

Potential locations: City-wide and Kondaveeti vagu catchment
Monitoring indicators: • Annual updation of runoff influencing variable parameters with reference to on-ground changes. • Percentage of flood events recorded and data records available for future reference. • Percentage of error in estimated results (spatial extent, runoff quantity, failure points) with actual results.

Strategy 3 - Financing Modes/Sources
APCRDA funds, Water resource department funds, SDMA funds, multilateral development bank loan, and grants from donor agencies.

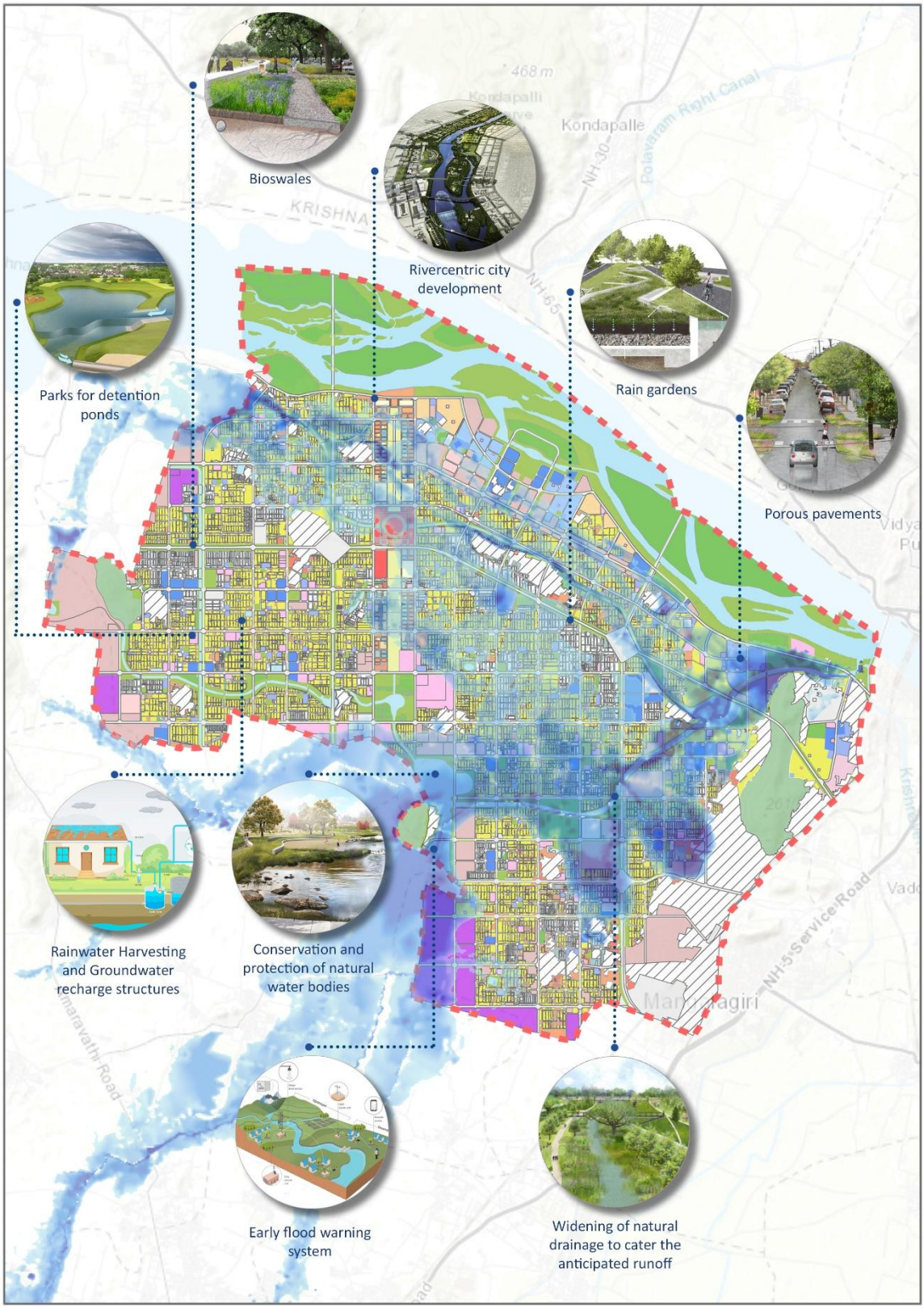

Figure 2-2: Interventions for Urban Flooding

Integrating Interventions to Improve Resilience to Urban Flooding in Amaravati

Addressing rainwater runoff surcharging the Vagu network is essential to reducing flood risk vulnerability. It is important to implement actions that focus on minimizing runoff generation and effectively managing runoff through engineering and nature-based solutions. Stormwater management planning starts with conserving and protecting natural water bodies and drainage systems.

Amaravati is situated on the banks of the River Krishna and upstream of the Prakasam barrage. A river-centric design that protects the river's ecology and encourages interaction between citizens and nature needs to be planned, with the capacity of its existing bund road running along the River Krishna to be enhanced to accommodate higher traffic movement and enhance protection of surrounding areas against backwater of the Prakasam barrage. Identifying and notifying the boundaries of lakes and vagus in the city is crucial for protection and legal enforcement against encroachments over time. Since Amaravati lies in the lower reaches of the Kondaveeti Vagu catchment, most runoff passes through the city before reaching the River Krishna. The design measures for widening of Kondaveeti Vagu should accommodate upstream runoff and the anticipated runoff from developed spaces and infrastructure in Amaravati. Additionally, the existing irrigation canals that previously served the irrigation needs should be preserved, even though the irrigation demand is expected to significantly reduce once urbanization increases. However, the canals will still assist in channeling rainwater runoff out of the city.

Reducing runoff generation is fundamental to effective stormwater management. Using nature-based solutions is both effective and cost-efficient. Incorporating bio-swales and rain gardens in green buffer zones along the roads E5, E10, N6, N7, N9, and N13 can help. Maintaining land cover porosity through porous pavements and parking areas aids in groundwater recharge and aquifer replenishment, which will be crucial during events of erratic and low rainfall. Decentralized solutions such as rainwater harvesting structures and recharge pits should be mandated across properties through building guidelines and codes. Additionally, strict enforcement through monitoring cells once properties are occupied is essential to ensure compliance and continued utility of such solutions.

Detention ponds in parks can serve as temporary storage basins that capture and slowly release stormwater, reducing peak runoff and mitigating urban flood risks. Planning a detention pond network that spans across parks in different zones and neighbourhoods is important. This intervention requires a detailed study, identification of relevant priority parks, and designing runoff diversion systems. An early flood warning system provides additional preparation time and enables communication with vulnerable groups to increase proofing measures and coordination with authorities. Automatic rain gauges and sensors should be installed throughout the Kondaveeti Vagu catchment to monitor rainfall, water levels, velocity, and rainfall on a real-time basis, especially as high-intensity rainfall events are anticipated to become more common. The data specific to each rainfall event, including information on the spatial extent of waterlogging, depth, and duration, must be collated and made available for effective mitigation measures in the future. This meticulously recorded long-term historical data helps validate models and in turn supports flood protection.

2.5 Solid Waste Management

Baseline Status (2024-25)	**GHG Emissions:** 15,983 tCO_2e (7.7% of total GHG emissions) **Key Statistics:** • Total waste generation: 70 MT, 100% door-to-door collection • Waste composition: Wet waste (51%), Dry waste Recyclables (11%), Dry waste RDF (26%) and Inert (12%) • Waste to Energy: 56 TPD, Landfill disposal: 14 TPD • 2.25 lakh metric tonnes of legacy waste were bioremediated at Kolanukonda in 2023-24
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • GoI's Swachh Bharat Mission[30] 2.0 supporting solid waste management infrastructure • National Policy on Biofuels, 2018[31] • Sustainable Alternatives for Affordable Transportation (SATAT)[32] • 15th FC and National Clean Air Programme (NCAP) • Waste to Energy Programme, 2022 **State/Local Policy/Programme/Targets:** • Clean Andhra Pradesh (CLAP) programme supporting source segregation and door-to-door collection • Formulation of Andhra Pradesh Integrated Municipal Solid Waste Management Strategy 2014, which aims for 100% door-to-door collection, 100% segregation and 100% treatment and scientific disposal in all ULBs • Andhra Pradesh State Sanitation Strategy, 2016 promotes recycling of wastewater and proper collection, conveyance, treatment and disposal system and treatment of sludge from on-site installations.
Opportunities and Gaps	• Limited segregation at source, collection, and transport of mixed waste leads to inefficient processing. • Littered solid waste blocks sewerage and stormwater drains during extreme rainfall. • Awareness campaigns for source segregation and promoting reduce, reuse and recycling to boost the circular economy
Climate Risk and GHG Emissions Scenario	**GHG Emissions:** **GHG Emissions in BAU scenario (tCO_2e)** **2024** | **2028** | **2043** | **2058** 8,370 | 36,042 | 64,239 | 152,996 **Climate Risk Status: Medium** | Medium risk during high temperature and high intensity rainfall • High intensity rainfall events increase the moisture content and weight of the solid waste, making it difficult to collect, transport and process subsequently.

[30] Swachh Bharat Mission (Urban), Ministry of Housing and Urban Affairs (MoHUA), Accessed 7 January 2025.
[31] Ministry of Petroleum and Natural Gas, National Policy on Biofuels, 2018.
[32] Targets Under SATAT Scheme, Press Information Bureau, 2022.

<table>
<tr><td></td><td>

During high-intensity rainfall, littered solid waste is likely to get washed into drains, blocking outflow and resulting in water stagnation. This aggravates the flood situation, leading to a public health menace.
Higher temperatures may cause fires at open dumpsites, causing toxic gas emissions and creating health risks to the neighbourhood.

</td></tr>
<tr><td>Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions</td><td>
GHG Mitigation Potential and Indicative Cost of Interventions:
<table>
<tr><th rowspan="2">Parameters</th><th colspan="3">Climate Action Scenario</th></tr>
<tr><th>2028</th><th>2043</th><th>2058</th></tr>
<tr><td>GHG Emissions in Climate Action Scenario (tCO2e)</td><td>36,042</td><td>52,904</td><td>123,245</td></tr>
<tr><td>GHG emissions reduction from BAU</td><td>-</td><td>18%</td><td>19%</td></tr>
<tr><td>Total cost of mitigation actions by 2058 (Million INR)</td><td colspan="3">11,297</td></tr>
</table>
Climate Resilience Impacts and Co-benefits:

Achieving higher resource efficiency and promoting a circular economy
Enhancing public health outcomes
Reduced GHG emissions from effective waste treatment

Strengthened Resilience to Hazards:
Urban flood, cyclones
</td></tr>
<tr><td>SDGs</td><td>GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 7: Affordable and Clean Energy, GOAL 9: Industry, Innovation and Infrastructure, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 15: Life on Land</td></tr>
</table>

Climate Strategies, Actions and Targets

Strategy 1: Adopt 3R principles and decentralised processing at source

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Enforcement of Source segregation	Percentage of source segregation	100%	100%	100%

Proposed Actions

Action 1: Promote decentralised processing of wet waste at households through home-composting

Action details

Promoting the decentralised processing of wet waste at households through home composting to manage biodegradable waste at the source. Home-composting reduces the burden on municipal solid waste

management infrastructure, decreases landfill usage, and mitigates greenhouse gas emissions from unprocessed organic waste.

Sub Actions

- IEC campaigns to raise awareness on practices and solutions for home composting
- Encourage early practitioners by providing composting kits at discounted rates.
- Develop a system to record the households/non-bulk waste generators (BWGs) practicing composting.
- D2D collection staff to verify adherence to on-site composting practices by households and properties and report non-compliance.

Potential locations: City-wide with focus on Residential colonies, High-rise apartments, Gated communities, zones with rooftop gardening initiatives

Implementing entities

Lead: APCRDA

Supporting: SAC, RWAs, NGOs

Indicative cost:

City level awareness Campaign - INR 2-2.5 crores for a city with 10 lakh population[33]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Number of households practising home-composting
- Amount of wet waste processed in home composting per month (tonnes)
- Number of IEC campaigns conducted
- Reduction in organic waste sent to transfer stations and centralized processing/landfill

Good Practice:

Indore has achieved 100% door-to-door collection and citywide source segregation through sustained IEC campaigns, GPS-tracked collection vehicles, decentralized processing facilities, and strict enforcement. This integrated system has enabled Indore to maintain the top rank in Swachh Survekshan for multiple years.

The Sunya model, implemented in select wards of **Udaipur**, Coimbatore and Siliguri, focuses on decentralized waste segregation and processing at ward level. It uses trained collection staff, community participation, and localized composting or recycling units, reducing transportation cost and landfill dependency.

San Francisco's Mandatory Recycling & Composting Ordinance, enacted in 2009, makes it compulsory for all residents and businesses to separate their waste into recyclables, compostables and landfill using a three-bin collection system. By 2010, the city's compost rate increased by 45%, growing from 400 to 600 tons per day.

[33] Estimates based on previous assessments of ICLEI South Asia.

The **European Union's** comprehensive waste framework directive establishes a five-step waste hierarchy (prevention, preparation for reuse, recycling, recovery and disposal). The directive targets to achieve 55% of municipal waste for reuse and recycling by 2025, increasing to 65% by 2035.

Action 2: Establish compost pits in parks for on-site treatment of garden waste and implement flower waste processing into incense sticks and cones.

Action details

By treating garden and flower waste on-site in Amaravati's proposed parks and supporting innovative reuse of flower waste, the city could reduce the amount of waste transported to treatment sites.

Sub Action

- Promote management of flower waste by supporting engagement of religious places with service providers.
- Engage flower waste recyclers with event organisers, community halls.

Potential locations: Community parks and urban gardens, Major religious temples and prayer halls, Community halls

Implementing entities

Lead: APCRDA

Supporting: ADCL, Organisations/ startups, Event and function organisers, Religious place administrators, NGOs

Indicative cost:

CAPEX: INR 12 lakhs for a 0.9 TPD capacity flower waste plant[34]

INR 35,000–40,000 per garden for basic twin-pit composting systems[35]

INR 3.5–4 lakh for engineered aerobic pits with a civil structure in gardens[36]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Number of compost pits established and operational
- Tonnes of garden/flower waste processed per park/month
- Number of events/organisations linked to recycling initiatives
- Number of religious places/events adopting the circular waste approach

Good Practice:

At Mahakaleshwar temple in **Ujjain**, daily 5-6 tons of floral and religious waste is recycled into incense sticks, cones and compost by local SHGs and startups, reducing river pollution and creating livelihoods.[37]

[34] Solid Waste Management Initiatives in Urban India: A Compendium, NIUA, 2019
[35] MC to construct compost pits in 100 Chandigarh parks, Times of India, 2018
[36] Waste to manure: Chandigarh civic body refloats tender for compost pits in parks, Times of India, 2020
[37] Flower Power: India's Temple Waste Transformation, PIB, 20th September 2024

Tirupati city processes over 6 tons of daily floral waste from temples, converting it into valuable products and employing around 150 self-help group women. Recycling takes place at the Tirumala Tirupati Devasthanam agarbatti plant, with products packaged in recycled and plantable Tulsi seed paper to ensure a zero-carbon footprint.[38]

Action 3: Conduct IEC and Behavior Change Communication (BCC) campaigns

Action details

As Amaravati is a new city, training people to manage waste properly from the inception will be beneficial in the long run. By doing so, the city will be able to follow NGT directives on waste management and encourage people to segregate their waste at the source for better processing and recycling.

Sub Actions

- Conduct IEC activities to improve the segregation, recycling and waste reduction.
- Establish annual public recognition and certification programs to recognize best-performing citizens, sanitation workers, and D2D in source segregation and innovative waste reduction practices.
- Conduct public exhibitions on 3R themes with a focus on reuse and waste minimization practices.

Potential locations: City-wide

Implementing entities

Lead: APCRDA, SAC

Supporting: Bulk waste generators, NGOs, RWAs

Indicative cost:

City level awareness Campaign - INR 2-2.5 crore for a city with 10 lakh population[39]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Number of IEC/BCC events conducted monthly
- Number of households reached through campaigns
- Number of schools/institutions that participated
- Number of D2D collection staff trained
- Percentage of total households practising segregation
- Number of public recognitions/certifications awarded

Good Practice:

Trichy city boosted source segregation by launching the Students@Clean Trichy contest in June–August 2018 across 350–365 schools, distributing Green Report Cards to 1.5–1.7 lakh students whose parents and sanitary workers countersigned to verify daily segregation at home; 1,100 students won prizes (e.g., bicycles). As a result, waste segregation is increased from 70% to 100%, reducing waste quantity reaching

[38] Floral Waste is boosting circularity in economy — Press Information Bureau, Government of India
[39] Estimates based on previous assessments of ICLEI South Asia.

landfill, enabling full use of micro-composting centres, generating jobs for 677 SHG women, and reducing the secondary collection vehicles for waste transportation from 28 to 18.

Indore city conducted a wide range of IEC activities, including traditional, audio-visual, print, electronic, and social/digital media, which played a pivotal role in driving behavioural change. Innovations such as street plays, wall paintings, and FM radio were constantly updated by incorporating new thematic awareness messages to be communicated. Major cultural events, such as the Ganesh festival and Gandhi Jayanti, were utilized as platforms to disseminate the awareness message of cleanliness.

Action 4: Notify and implement green protocol guidelines for eco-friendly material use and waste management at community gatherings.

Action details

Implementing green protocol guidelines enables Amaravati to address waste reduction at its source, reduce plastic pollution, increase waste recycling, and minimise extra waste from mass gathering events, thereby supporting a circular economy.

Sub Actions:

- Promote use of alternate, eco-friendly, reusable materials (bio-degradable packaging, cloth banner, steel) for mass gathering events.
- Mandate prior approval of community celebrations with specifications of key materials and waste-generating items to be used.
- Mandate requirements for proper waste storage with appropriate segregation protocols during all mass gathering events.

Potential locations: Citywide with focus on all major event venues, large open spaces designated for festivals or celebrations, and frequent or large gatherings.

Implementing entities

Lead: APCRDA

Supporting: SAC, Event organizers, NGOs

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Number of large events with prior approval as per green protocol guidelines
- Number of events with 100% source segregation and waste collection
- Share of biodegradable/recyclable material use in total event-generated waste

Good Practice:

Kerala's Suchitwa mission promotes zero-waste events by banning single-use plastics, mandating the use of reusable or biodegradable materials, and enforcing strict waste segregation.[40]

[40] Suchitwa Mission (The State Nodal Agency for Sanitation) Local Self Government Department Government of Kerala

Gurugram city has established two steel utensil banks in sectors 10 and 48, which have approximately 2,000 sets of utensils each. These utensil banks provide residents with utensils free of charge, discouraging them from using disposable plastics.[41]

Action 5: Efficient collection and recycling of E-Waste.

Action details

Amaravati is projected to generate around 198 tonnes of e-waste per day by 2058, which demonstrates the need for effective recycling and environmentally sound methods of disposal.

As per EC directives, Amaravati city must facilitate the establishment of E-waste Collection Centers by producers and ensure e-waste is sent to authorized recyclers or dismantlers.

Sub Actions:

- Notify and enforce CPCB guidelines for handling E-waste with clearly defined responsibilities for manufacturer, producer, refurbisher or recycler, consumers, recyclers, concessionaires.
- Map and engage all key stakeholders for integrated e-waste management.
- Establish a collection system for collecting e-waste from MRFs and bulk consumers such as the proposed Quantum Valley and IT parks.
- Equip MRFs with E-waste dismantling facilities and mandate to segregate and dismantle e-waste fractions coming in the MSW stream.
- Integrate the e-waste management value chain-specific information into the command control centre by adding a separate module for e-waste.
- Ensure the collection and processing of solar photovoltaic modules.
- IEC activities to raise awareness on e-waste management.

Potential locations: City-wide with focus on IT Parks (such as proposed Quantum Valley, IT offices), residential, commercial and institutional zones.

Implementing entities

Lead: APCRDA

Supporting: APPCB, SAC, E-Waste Recyclers, NGOs and RWAs.

Indicative cost:

INR 48 lakh for plant and machinery with a capacity of 1,500 tonnes per annum for an e-waste recycling plant[42]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Quantity of e-waste collected from bulk generators
- Number of MRFs equipped with e-waste dismantling

[41] Documentation of Best Practices on 3R's (Reduce, Reuse, Recycle) — MoHUA and GIZ, 2023.
[42] Electrical and Electronic Equipment Waste Recycling — Council on Energy, Environment and Water, accessed 28th September 2025.

- Quantity of e-waste safely recycled/disposed (Tonnes/year)
- Number of IEC activities conducted on e-waste management
- Quantity of solar PV waste separately collected and recycled

Good Practice:

Namo E-waste operates collection centres across 12 states and union territories, arranging pickups and transporting electronic waste to its recycling plant in Faridabad to extract reusable parts and sustainably dispose of the rest in an environmentally friendly manner.

Switzerland operates one of the most robust national e-waste systems globally through EPR. It is financed by an advanced recycling fee paid by consumers at the time of purchasing electronic equipment. Recycling companies such as SWICO and SENS coordinate the collection and recycling of waste electrical and electronic equipment.

Strategy 1 - Financing Modes/Sources

State and APCRDA budget, SBM 2.0, AMRUT, 15th FC, CSR, PPP, Development banks, CSR contributions

Strategy 2: Ensure efficient waste collection and transportation

Proposed Target

Action Area	Target Parameter	2028	2043	2058
City-wide coverage of MSW collection And transportation	Percentage of waste collected and transported	100%	100%	100%

Proposed Actions

Action 1: Ensure 100% collection across solid waste management operations (for both in-house and third-party services).

Action details

To ensure 100% coverage of waste collection in Amaravati's greenfield city, it is essential to adopt real-time information technology across all SWM operations to prevent the formation of garbage vulnerable points.

Existing Initiative

As outlined in the SWM Master Plan 2016, Amaravati city has already planned to equip waste collection vehicles with GPS tracking systems, enabling waste managers to monitor and track the vehicles.

Sub Action

• Ensure 100% daily waste collection with real-time monitoring through QR codes and GPS-enabled vehicles integrated with centralized command control systems. **(ongoing/planned)**

• Commission transfer stations and secondary transportation system to accommodate unloading and dispatch of segregated waste stream to designated processing facilities • Implement performance-based contractor payments linked to daily coverage of designated areas by waste collection vehicles. • Equip transfer stations with weighbridge systems that have real-time integration for automated waste quantum monitoring and streamlined contractor payments
Potential locations: City-wide, transfer stations, waste processing sites
Implementing entities **Lead:** APCRDA **Supporting:** SAC, technology service providers
Indicative cost: Costing for transfer stations: INR 10 crores for 100 TPD transfer station including pre-sorting line[43] INR 8 crores for 10 lakh population size ULB (only for SWM module integration in CCC)
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short term
Monitoring Indicators: • Number of properties mapped on GIS for monitoring of waste collection • Integration of D2D vehicles with QR & GPS tracking • Quantity of segregated vs mixed waste reaching transfer stations
Good Practice: **Vijayawada** city has implemented QR code-enabled RFID tags to monitor waste collection, installed smart bins and equipped collection vehicles with GPS for effective route monitoring, resulting in effective door-to-door waste collection. **Kakinada** city has adopted the Facial Recognition System (FRS) technology to register sanitation worker attendance and ensure that all sanitation staff reach their assigned reporting locations on time, thereby delivering effective waste management collection.

Action 2: Establish specialized waste collection mechanisms for non-routine and oversized residential waste.
Action details A demand-based collection system should be established, where residents can request on-demand pickup of bulky waste (e.g., furniture, mattresses, appliances) and small quantities of construction & demolition (C&D) debris from household repairs. These items should be collected separately and taken to proper facilities for safe recycling or disposal to prevent illegal dumping and recover valuable materials.

[43] Estimates based on previous assessments of ICLEI South Asia.

Sub Actions • Establish on-demand collection & dismantling services for bulky household items and small-scale C&D waste from residential repairs • Develop SOPs for residential ceremonial/event waste collection (outside standard BWG protocols)
Potential locations: City-wide with focus on Residential and commercial zones
Implementing entities **Lead:** APCRDA **Supporting:** SAC, RWA, event organisers
Type of action: Climate Adaptation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Number of demand-based pickups requested and fulfilled • Quantity of bulky waste collected and recycled
Good Practice: In **Indore** city, the households are covered by the door to door collection system while the semi bulk and bulk generators are covered by the on-demand bulk collection system.

Strategy 2 - Financing Modes/Sources
APCRDA and State budget, PPP, SBM 2.0, 15th FC, grant from donor agencies and multilateral development bank loan, CSR

Strategy 3: Enforcing extended bulk waste generators' responsibility (EBWGR)[44] practices for waste minimization and on-site processing

Proposed Actions

BWGs (Resident Welfare Associations, Gated Communities, Restaurants, Commercial complexes, Institutions) are identified based on the criteria indicated below,

- Buildings with a floor area of 20,000 sq. m. or above
- Water consumption of 5000 litres per day
- Solid waste generation of 100 kg per day

[44] Draft Solid Waste Management Rules 2024

Action 1: Establish a dedicated team to monitor and facilitate EBWGR implementation.
Action details A dedicated team should be deployed to monitor the BWGs process their organic waste on-site. This approach will reduce the amount of waste sent to treatment plants and generate local value through the production of compost or biogas at the source. In accordance with NGT and EC directives, all bulk waste generators must segregate waste at the source and ensure all wet waste is processed by composting or biomethanation within their premises. **Sub Actions** • Ensure on-site processing of complete wet waste generated by the BWGs through inspection and suitable incentive and recognition measures. • Maintain an updated list of BWGs through coordination between multiple departments (town planning, water supply, solid waste management). • Create public awareness on the implementation of activities and regulatory requirements as per EBWGR guidelines. • Conduct regular inspections to monitor the performance and efficiency of onsite waste treatment facilities. • Identify and engage with organizations, service providers to support BWGs with on-site waste treatment.
Potential locations: City-wide
Implementing entities **Lead:** APCRDA **Supporting:** SAC, RWA, BWGs
Indicative cost: INR 40 Lakh for Organic Waste Composting Machine for processing 1.5 tonnes per day; INR 2.3 lakh for Large Scale Composting Pits for processing 130 kg per day[45]
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short term
Monitoring Indicators: • Number of BWGs with functioning on-site wet waste treatment • Quantum of organic waste processed at source • Number of workshops/awareness programs conducted on wet waste treatment at on-site • Number of BWG incentives/recognitions awarded
Good Practice: **Ranchi** city deployed nine dedicated teams to oversee compliance by BWGs. These teams include sanitary supervisors, food inspectors and enforcement officers. They conduct daily inspections, monitor source

[45] Advisory on On-Site and Decentralized Composting of Municipal Organic Waste. Ministry of Housing and Urban Affairs, 2018

segregation, issue notices to violators and ensure the continuous supply of wet waste to compressed biogas plants at Jhiri.

Action 2: Implement quantum-based fees for services to collect and transport dry waste from BWGs.

Action details

BWGs that do not have their own on-site composting facilities should be charged a service fee based on the quantity of waste. The implementation of this action will encourage BWGs to reduce, segregate, and manage their waste more sustainably.

Sub Actions

- Equip waste collection vehicles with portable weighing equipment for on-site quantification at generation points.
- Establish daily logging systems for efficient user charge calculation and billing.

Potential locations: City-wide with focus on Commercial and Institutional zones, Hotels, Hospitals, and High-rise Residential zones, Start-Up Areas

Implementing entities

Lead: APCRDA

Supporting: SAC, RWA, BWGs

Type of action: Climate Adaptation

Climate resilience benefits: Medium

Timeline: Short to Medium term

Monitoring Indicators:

- Number of BWGs identified and enrolled in quantum-based fee program
- Quarterly reduction trends in total waste generated per BWG
- Increase in segregation rate at source among BWGs

Good Practice:

Bengaluru city enforces a quantum-based fee system for BWGs. Those BWGs without in-situ composting or dry waste processing must pay a service fee of INR 12 per kg for collection and processing; those with on-site processing pay INR 3 per kg. These service fees are regularly reviewed and are intended to recover the costs associated with dedicated dry waste collection and transportation services.

Many **European states** have adopted the Pay As You Throw (PAYT) model, which discourages individuals from producing excess waste by directly linking the waste fee to the actual quantity of waste generated.

Strategy 3 - Financing Modes/Sources

State and APCRDA Budget, SBM 2.0, 15th FC, PPP, CSR fund

Strategy 4: Maintain cleanliness in public places and water courses.

Proposed Actions

Action 1: Impose a spot fine against littering and open dumping.
Action details Deploy special teams throughout Amaravati to impose strict fines for littering and open dumping, with a special focus on high-footfall areas such as AGC, commercial stretches, bus stops, terminals, depots, and railway stations, as well as river or canal promenades. By implementing spot fines for littering and open dumping, Amaravati will reduce such incidents and ensure compliance with environmental regulations and directives issued by the NGT. **Sub Action** Install AI-enabled smart bins[46] at suitable intervals in public places
Potential locations: City-wide
Implementing entities **Lead:** APCRDA **Supporting:** SAC, technology service providers
Indicative cost: INR 1.9 lakh for one solar-powered bin with a capacity of 120 litres[47]
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short term
Monitoring Indicators: • Number of AI-enabled smart bins installed and operational • Number and frequency of spot fines issued
Good Practice: **Vijayawada** city has installed 45 smart bins and 32 smart semi-underground garbage collection bins at various locations. All these bins are equipped to send real-time alerts to authorities after they are filled.[48] **Singapore** has installed solar-powered "BigBelly" smart bins that include compactor units, fill-level sensors and Wi-Fi hotspots. These smart bins use sensors to track the amount of waste deposited and automatically send alerts via email or text message to cleaners when they are nearly complete. The built-in compactor allows each bin to hold up to eight times as much rubbish as a standard bin, enhancing waste collection efficiency.[49]

[46] AI-based device, designed for public places, enabling them to simplify recycling. It sorts and compresses the waste automatically, controls the fill level and processes data for convenient waste management.
[47] Smart Dustbin With Solar Panel, Indiamart, 2025.
[48] Waste-Wise Cities Best Practices in Municipal Solid Waste Management, NITI Aayog, 2021
[49] Solar-powered smart bins that act as Wi-Fi hot spots launched at Orchard Road, The Straits Times. 2016.

Action 2: Enforce strict regulation on the disposal of festival waste and ensure regular cleaning of watercourses.
Action details Adopting strict regulations and standard operating procedures for the disposal of festival waste in Amaravati's greenfield city is essential to protect local water resources, maintain ecological balance and public health. Improper disposal of festival waste, particularly during idol immersion and associated rituals, frequently results in substantial pollution of watercourses, introducing harmful chemicals, microplastics, and non-biodegradable debris that degrade water quality and harm aquatic life. **Sub Actions** • Provision of artificial ponds with suitable post-treatment for environmentally safe idol immersion. • Use synthetic liners in specific river stretches to capture idol debris and enable efficient cleanup. • Install floating screens/mesh systems at regular intervals along water channels to capture and contain debris.
Potential locations: City-wide with focus on the Krishna River Banks, Kondaveeti vagu, temple sites near water bodies, water bodies in neighborhoods
Implementing entities **Lead:** APCRDA **Supporting:** APPCB, Water Resources Department
Indicative cost: INR 12,000–20,000 per meter of floating screen[50]
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short
Monitoring Indicators: • Number of water quality tests performed in waterbodies (before/after major festivals) • Number of artificial ponds constructed • Quantity of waste captured from floating screens/mesh (in tonnes)
Good Practice: The **Greater Hyderabad Municipal Corporation** has installed floating trash barriers across key nalas and lakes to intercept solid waste before it enters major water bodies, such as Hussain Sagar, thereby improving cleanup efficiency and reducing downstream pollution. Introduced drone-based monitoring and surveillance integrated with a command control centre for monitoring littering, especially around waterfront areas, areas with more floating population and after festival and mass gathering events. During the Ganesh Chaturthi festival, the **Brihanmumbai Municipal Corporation (BMC)** deployed drones to monitor immersion sites, track idol processions, and crowd movements in real-time, ensuring

[50] Heavy Duty Safety Floating Barrier and Trash Boom, Adart Publicity, Indiamart,

compliance with waste disposal norms. The BMC has established 288 artificial ponds across Mumbai, designating 68 natural water bodies for immersing idols taller than six feet. According to the SOP, public organisations are responsible for managing the artificial ponds, where idol remnants will be retained in the tanks for a minimum of 15 days before being collected for subsequent processing.

Strategy 4 - Financing Modes/Sources
State and APCRDA funds, SBM 2.0, Donor grants, CSR funds, PPP

Strategy 5: Efficient handling of Construction and Demolition Waste

Proposed Actions

Action 1: Implement 100% C&D waste collection to achieve zero open dumping.
Action details Setting up the city-wide C&D waste collection centres will cater to the massive construction waste that is going to come up in the greenfield city of Amaravati, will facilitate organised disposal and prevent illegal dumping on vacant plots. In accordance with NGT and EC directives, C&D waste must be collected separately and sent to dedicated recycling facilities. According to the SWM Master Plan 2016, Amaravati city is expected to generate about 105.7 lakh tonnes of C&D waste by 2058. **Sub Actions** • Adopt a demand-based collection system dedicatedly to larger as well as smaller C&D waste volumes from minor repairs of buildings to ensure timely collection in lieu of pre-defined charges on the basis of quantity and distance • Ensure timely collection of C&D waste to prevent illegal dumping in nearby vacant lands. • Establish a wider network of temporary C&D collection centres during the initial construction phase with improved collection frequency. • Imposition of fines on property owners, real estate developers, and contractors for the open dumping of C&D waste. • Identify the producer of C&D waste as per the Environment (Construction and Demolition) Waste Management Rules, 2025 and ensure EPR compliance[51]
Potential locations: City-wide with focus on construction sites
Implementing entities **Lead:** APCRDA **Supporting:** APPCB, C&D waste generator, contractors and real estate developers
Type of action: Climate Adaptation
Climate resilience benefits: High

[51] "producer" means a waste generator, who is occupier or in charge of a building or building complex project having a built-up area of 20000 square meters and above;

Timeline: Short term
Monitoring Indicators: • Quantity of C&D waste collected vs. estimated generation • Number of illegal C&D waste dumping cases detected and fined • Number and location of C&D drop-off centers operational • Quantity of C&D waste collected, processed and recycled
Good Practice: **Pimpri Chinchwad** addressed illegal C&D waste dumping through a third-party engagement contract by implementing GPS tracking on collection vehicles and applying strict penalties. Authorised private agencies are responsible for the collection and transportation of C&D waste exclusively to designated C&D waste transfer stations. As a result, illegal dumping of C&D waste has decreased.[52]

Action 2: Deploy processing infrastructure with flexibility to handle initial peak C&D generation volumes and meet long-term needs.
Action details Planning and designing C&D waste storage and processing plants will help Amaravati meet both its ongoing and future construction needs. In line with NGT and EC directives, C&D waste should be collected separately and sent to dedicated processing facilities. To enable this, Amaravati city should involve private contractors to strategically plan and set up a dedicated C&D waste transfer station and processing facility. **Sub Actions** • Set up an intermediate waste storage facility at the city level to cater to ongoing construction until the C&D processing plant is operational. • Ensure that the establishment of the processing facility does not degrade air quality by adopting water sprinklers, covering debris during transport, and storing it in collection and processing centers. • Establish a C&D processing facility with the potential to enhance capacity as needed.
Potential locations: City-wide with focus on active construction sites
Implementing entities **Lead:** APCRDA **Supporting:** APPCB
Indicative cost: INR 17 – 20 Crores for a 1000 TPD capacity C&D plant[53]
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short to Medium term

[52] Factsheet: C&D Waste Management in Pimpri-Chinchwad, Centre for Science and Environment.
[53] Guide on Business Models and Economic Assistance for Municipal Solid Waste Projects, Ministry of Housing and Urban Affairs, 2025

Monitoring Indicators:

- Quantity of C&D waste stored, processed and recycled
- Air quality readings near active construction facilities (PM2.5, PM10 and dust levels)

Good Practice:

Gurugram city has a C&D waste processing plant with a 1,500 TPD capacity and has collected nearly 1.2 million tonnes of C&D waste from unclaimed dumpsites, processing around 3.5 lakh tonnes. The city has made significant progress in primary waste collection, on-call removal, grievance redress, and the implementation of penalties for non-compliance with C&D waste management rules.

Action 3: Ensure the maximum reuse of C&D-treated waste.

Action details

Mandating the reuse of recycled C&D materials will boost the circular economy in Amaravati's construction sector.

The ready reckoner developed by the Building Materials and Technology Promotion Council provides comprehensive guidance to policymakers, urban planners, contractors, and civic bodies for the management, processing, and utilization of recycled C&D waste.[54]

Sub Actions

• Establish requirements through the building approval process for submission of C&D waste utilization plan for large sites (> 20,000 sq. m. built-up area) .

• Develop a digital portal that provides real-time material availability and facilitates early material requests.

• Facilitate partnerships between C&D waste processors and product manufacturers.

Potential locations: City-wide (all large construction sites)

Implementing entities

Lead: APCRDA

Supporting: DTCP, contractors, real estate developers

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Quantity of recycled C&D materials used
- Number of construction projects using the products of recycling of C&D waste, especially in affordable housing, government buildings and public places.

Good Practice:

[54] Utilisation of Recycled Produce of Construction & Demolition Waste, Building Materials & Technology Promotion Council, Ministry of Housing & Urban Affairs, 2018.

In **North Delhi**, the Burari C&D processing plant scientifically processes 2,000 TPD of mixed C&D waste into recycled aggregates that are converted to make ready-mix concrete, cement and hollow bricks, paver blocks, kerbstones and concrete blocks, thereby reducing demand for construction raw material. Notably, more than 16 lakh recycled concrete blocks have been utilized in the construction of the new Supreme Court building.[55]

Strategy 5 - Financing Modes/Sources

State and APCRDA budget, SBM 2.0, NCAP, AMRUT and PPP mode

Strategy 6: Decarbonise the MSW value chain by integrating sustainable technologies appropriate to waste fractions

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Sustainable waste processing and disposal infrastructure	Percentage of waste sent to composting facilities	0%	13%	13%
	Percentage of waste sent to bio-methanation/bio-CNG facilities	0%	10%	10%
	Percentage of waste recovered for recycling at material recycling facilities (MRF)	0%	5%	5%
	Percentage of waste sent to waste-to-energy facilities	88%	60%	60%
	Percentage of waste sent to sanitary landfill	12%	12%	12%
	Extent of landfill gas capture	80%	80%	80%
Electrification of waste collection vehicles and services	Use of electric vehicles in waste collection and management	100%	100%	100%

Proposed Actions

Action 1: Conduct scientific techno-financial viability of various types of processing technologies.

Action details

To conduct a comprehensive techno-financial assessment of municipal solid waste management (MSWM) processing technologies planned for Amaravati. The Business Models & Economic Assistance for MSW Projects Reference Guide offers practical guidance for cities on technology selection, financial planning and environmental management to establish sustainable, economically viable waste processing infrastructure.

Sub Actions

- Assess physico-chemical composition and properties of generated waste periodically

[55] Waste-Wise Cities Best Practices in Municipal Solid Waste Management, NITI Aayog, 2021

- Conduct market assessment to identify the potential revenue generation from recycled and processed waste products.
- MSWM processing facilities to comply with environmental norms.

Potential locations: City-wide with focus on waste processing and transfer station facilities

Implementing entities
Lead: APCRDA
Supporting: APPCB, consultants, research and academic institutions, technology service providers

Indicative cost:
Composting Plant: Rs. 2 Crores per 100 TPD of waste, **Biomethanation Plant:** Rs. 30 – 35 Crores per 100 TPD of waste, **Mechanized MRF Plant:** ~12 lakhs per TPD, **Waste to Energy Plant**: Rs. 23 – 29 Crores per 100 TPD capacity excluding cost of land, **Construction and Demolition Plant:** Rs. 17 – 20 Crores for a 1000 TPD capacity plant[56]

Type of action: Climate Mitigation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- Number of viable processing technologies identified and evaluated
- Total revenue generated from recycled and processed products
- Number of waste processing facilities compliant with pollution norms

Good Practice:

Pune city has established a 300 TPD PPP-based compressed biogas (CBG) facility that uses anaerobic digestion to process organic food waste into CBG and organic manure. The city pays a tipping fee of INR 570 per tonne to partially offset processing costs, given market-linked CBG pricing, with CBG sales routed through oil marketing companies retail networks under the SATAT scheme. The plant is estimated to operate at a roughly 20% margin, with approximately INR 12 crore in annual revenue, implying a payback period of 5 to 7 years.

Stockholm city achieved a 30% increase in recycling efficiency through the use of optical sorting technology, with 55% of municipal solid waste being recycled and 40% converted into energy, resulting in a reduction in landfill dependency to 5%.

Action 2: Explore the adoption of Bio-CNG facilities for wet waste processing

Action details

Prioritising modular bio-CNG facilities that process pure wet waste ensures the efficient utilisation of organic waste streams, maximising renewable energy recovery while minimising methane emissions from landfills. These facilities promote a circular economy by converting waste into clean energy and valuable organic fertilisers, reducing dependency on fossil fuels, and mitigating climate change.

[56] Guide on Business Models and Economic Assistance for Municipal Solid Waste Projects, Ministry of Housing and Urban Affairs, 2025

As per EC directives, Amaravati shall ensure daily collection of waste from markets and the installation of decentralized composting or biomethanation plants within these markets.

Sub Actions

- Identify establishments that generate pure wet waste (vegetable markets)/neighbourhoods/ wards that practice 100% segregation.
- Determine appropriate technology by evaluating feedstock type, plant location, capital cost, output gas yield, and O&M expenses.
- Adopt modular plant design to initiate wet waste processing in targeted areas and scale-up progressively
- Enable bio-CNG off-take by city gas distribution entities or gas marketing companies.

Potential locations: City-wide with focus on vegetable, fruit and flower markets, areas with established 100% source segregation and Bulk wet waste generators

Implementing entities
Lead: APCRDA
Supporting: NREDCAP, APPCB, SAC

Indicative cost:
Bio-CNG Plant: Rs. 25 Crores for a 100 TPD capacity plant

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Bio-CNG generated per tonne of processed wet waste
- Revenue generated through bio-CNG and related by-products.

Good Practice:

Indore Municipal Corporation (IMC), the cleanest city in India, has set up a 550 TPD centralised CBG plant on a PPP mode. At full capacity, the plant produces 17 TPD of CBG. Thus, by replacing fossil fuel with CBG generated from this plant to run waste trucks, the facility contributes to 1,30,000 tCO_2e GHG emissions reduced per year.[57]

France implements a progressive roll-out of separate food waste collection, processing organic waste through a network of biomethane injection and anaerobic digestion facilities, which inject into the GRDF gas network. The target is to increase capacity from 1,320 GWh in 2019 to 12 TWh by 2023.[58]

Action 3: Implement effective dry waste recycling and adopt market-driven secondary segregation for higher market value.

[57] Advisory on CBG Plants Based on Municipal Solid Waste, SBM 2.0, 2025
[58] Biomethane: the future of natural gas. GRDF. Accessed on 30th September 2025.

Action details

Design and implement scientifically optimized dry waste recovery infrastructure. Commissioning MRFs with automation and segregation lines ensures efficient and high-quality recovery of recyclables and RDF, diverting significant waste from landfills and abatement of methane emissions.

Sub Actions

- Select automation levels appropriate to technology and feedstock type.
- Explore setting up small scale semi-automated MRFs at transfer stations for enhanced waste stream processing and recovery
- Equip the centralised MRF with segregation lines for waste categories as identified in characterization studies to recover high quality recyclables
- Establish a prior agreement with the off-takers (recyclers for recyclables, cement plants such as Nagarjuna Cement or Penna Cement for RDF co-processing) on the guaranteed quantity, pricing, and frequency of off-take.
- Implement Extended Producer Responsibility (EPR) enforcement through collaboration between Producers, Importers and Brand Owners (PIBOs) and MRF operators
- Promote plastic reuse as construction material with robust quality control. Ensure shredded plastic availability for road construction, implement mandatory utilization policies, and support R&D.
- Study the feasibility of implementing a small-scale plastic waste to fuel refinery plant. The plant can convert plastic to crude oil which can then be refined to automotive grade diesel or petrol.

Potential locations: City-wide

Implementing entities

Lead: APCRDA

Supporting: APPCB, SAC, recyclers, cement plants, PIBOs for EPR enforcement

Indicative cost:

Mechanized MRF Plant: ~12 lakhs per TPD

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- Quantity and quality of recovered recyclables and RDF delivered to off-takers
- Quantity of shredded plastic supplied for road construction and adherence to quality standards

Good Practice:

To move towards the 'zero waste to landfill' city, **Indore** Municipal Corporation, in PPP mode with Nepra Resource Management Private Ltd. has set up 300 TPD fully automated MRF to scientifically manage and maximise economic return from the dry waste generated in the city. About 10% of the MRF input is recovered as high-quality recyclable, while 90% is shredded and sent to a cement plant as RDF for co-

processing. [59] By recycling the single-use plastic items, this plant has supported Indore to become the first ULB in India to earn EPR credit.

The first "PlasticRoad" in **Zwolle**, Netherlands was a pioneering project where a 30 metre cycle path entirely built from prefab, modular and hollow blocks manufactured from recycled plastic in place of traditional materials.

Action 4: Commission sanitary landfill for scientific waste disposal and equipped with integrated methane capture system.

Action details

Establish a scientifically designed sanitary landfill (SLF) facility[60] in Amaravati for the environmentally compliant disposal of inert materials and process rejects generated from waste processing activities.

Amaravati has significant potential to reduce greenhouse gas emissions, by maximizing methane capture from its sanitary landfill and converting it into valuable renewable energy to power its waste processing facilities or feed into the local energy market. Exploring excess methane supply agreements with gas marketing companies to supply methane gas to consumers by integrating circular economy principles.

Sub Actions

- Develop environmentally compliant sanitary landfill with long-term capacity design (20-25 year)
- Deploy integrated leachate management for environmental protection and landfill gas (LFG) capture system to maximise methane utilisation as alternative energy source
- Minimize landfill dumping through reduced process rejects and inerts and performance monitoring of processing facilities
- Explore partnerships with gas marketing companies for off-take of any excess methane generation

Potential locations: The landfill site is proposed in Zone III as per the solid waste management master plan

Implementing entities

Lead: APCRDA

Supporting: APPCB, SAC, landfill operators, gas marketing companies

Indicative cost:

Sanitary Landfill cost: INR 15 crores for 20 TPD inert and reject disposal at a 6.25-acre area[61]

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Short term

Monitoring Indicators:

- Annual quantity of inert and process reject waste disposed of in the landfill

[59] Discussion with Nepra Resource Management Private Ltd.
[60] A Ready Reckoner for Selection of Technologies for Management of Municipal Waste, Ministry of Housing and Urban Affairs, 2017.
[61] Solid Waste Management Practices In Urban India: A Compendium, NIUA, 2019.

- Efficiency and functionality of leachate treatment and LFG capture and utilization systems
- Conduct performance audits of the landfill

Good Practice:

As part of the integrated municipal solid waste management facility in **Hyderabad**, ReSustainability Limited has started capturing gas from the capped landfill through strategically placed wells. The landfill gas is being purified, converted to automotive fuel and marketed through Bhagyanagar Gas Limited (BGL).

Texas city has deployed methane gas detectors to monitor methane levels in the landfill. These detectors connect to a centralized data system, enabling landfill operators to track and analyze methane emission trends continuously. This data will help the operator increase efficiency in methane capture and ensure compliance with regulations.

Action 5: Deploy integrated digital monitoring systems in all MSW operations for real-time tracking of quality, quantity & environmental compliance.

Action details

By integrating monitoring processes for the quality and quantity of all MSW inputs (waste collected) and outputs (processed/recycled/landfilled), as well as critical environmental compliance parameters, directly with the city's Command & Control Centre (CCC), Amaravati will maintain a high standard of transparency, accountability, and responsiveness. As a result, the city can better enforce regulations, optimize resource use and proactively address environmental concerns, significantly improving overall waste management performance.

Potential locations: City-wide with focus on all MSW collection zones at source, waste processing plants, transfer stations and sanitary landfills.

Implementing entities

Lead: APCRDA

Supporting: APPCB, SAC, Treatment Facility Operators (MRF, composting, WtE, landfill contractors), technology service providers

Indicative cost:

INR 8 crores for 10 lakh population Size ULB (only for SWM module integration in CCC)

Type of action: Climate Mitigation

Climate resilience benefits: High

Timeline: Short to Medium

Monitoring Indicators:

- Percentage of MSW collection and processing sites integrated with CCC data reporting.
- Number of staff trained on digital monitoring technologies and protocols.

Good Practice:

Bengaluru city has introduced ICT tools, such as RFID attendance system and geotagging of collection routes, to monitor its waste management services. The Ezetap mobile app facilitates real-time monitoring

of areas prone to garbage and imposes penalties on offenders. Together, these measures achieved 100% door-to-door garbage collection and eliminated garbage-vulnerable points across the city.[62]

Action 6: Electrify solid waste vehicle fleet and integrate renewable energy into SWM operations.

Action details

This action focuses on transforming Amaravati's solid waste management services by adopting electric vehicles (EVs) for the collection and transportation fleet, installing EV charging stations at key operational sites, and integrating on-site renewable energy generation, primarily solar, into day-to-day facility operations and by shifting from diesel or petrol vehicles to electric and powering these vehicles with locally produced renewable energy.

Sub Actions

- Adopt EVs for the solid waste collection and transportation fleet
- Deploy EV charging stations at transfer stations and parking lots of the waste management fleet
- Integrate renewable energy into the operations of facilities such as transfer stations, processing facilities and fleet EV charging stations

Potential locations: City-wide with a focus on transfer stations and waste processing facilities

Implementing entities

Lead: APCRDA

Supporting: SAC, NREDCAP, EV charging service providers

Indicative cost:

15 lakhs per one waste electric vehicle

Financing Modes/ Sources:

State and APCRDA budget, SBM 2.0, 15th FC, PPP mode, CSR funds, grant from donor agencies, multilateral development bank loan

Type of action: Climate Mitigation

Climate resilience benefits: Very High

Timeline: Short

Monitoring Indicators:

- Number of EV Waste Management fleet
- Number of EV Charging Points Installed
- Percentage of EV Fleet Powered by On-Site Renewable Energy

Good Practice:

Guntur city has introduced over 200 electric autos for door-to-door garbage collection replacing diesel trucks with electric vehicles equipped with GPS for real-time tracking. The EV shift has eliminated the need for 71,000 litres of diesel each year, mitigating GHG emissions by around 21,000 tonnes over ten years and improving air quality.

[62] Waste-Wise Cities Best Practices in Municipal Solid Waste Management, NITI Aayog, 2021

Belgrade city has implemented an innovative waste management system integrating renewable energy within SWM. The city combines a waste-to-energy plant and a biogas engine plant for landfill gas utilization, both of which feed electricity and thermal energy not only to the waste management facility but also to the city grid and district heating system. The facility generates about 216 GWh of electricity and 174 GWh of heat yearly, all from MSW and landfill gas.

Strategy 6 - Financing Modes/Sources
State and APCRDA budget, SBM 2.0, 15th FC, PPP mode, CSR funds, grant from donor agencies, Ministry of New and Renewable Energy grants, Urban Challenge Fund , Climate finance and concessional loans from multilateral development banks (e.g., World Bank, ADB, GEF), PPP mode

2.6 Transportation

<table>
<tr><td>Baseline Status (2024-25)</td><td>GHG Emissions: 31,405tCO₂e (11.3% of total GHG emissions)
Centrally located in Amaravati Capital Region, well-connected regionally via Vijayawada/Guntur rail hubs, two NH corridors, and Vijayawada International Airport.
Daily mobility dominated by private two-wheelers and autos/IPT, no formal intra-city public transport operating in Amaravati.
APSRTC services halted during COVID-19, some village routes not resumed as of 2024, reducing inter-settlement accessibility.
Existing population commute to Vijayawada and Guntur for work and education</td></tr>
<tr><td>Existing Policy, Plans and Initiatives</td><td>National Policy/Programme/Targets:
Voluntary Vehicle-Fleet Modernisation Program (V-VMP)
Scheme to promote manufacturing of electric passenger cars
National Clean Air Action Plan 2019
National Urban Transport Policy
State/Local Policy/Programme/Targets:
New Andhra Pradesh Sustainable Electric Mobility Policy (4.0), 2024-29
AP Logistics Policy, 2022-27
Transit Oriented Development (TOD) Policy, 2022
City Policy/Programme/Targets:
1,693 km total roads, including 593 km major and 1,100 km internal roads with dedicated NMT paths.
168 km of mass transit corridors (BRT/MRT) planned within the city by 2050
100% of roads designed with dedicated pedestrian and cycling infrastructure.
City plans to achieve 80% passenger trips through non-motorized, mass transport and electrically powered vehicles by 2050</td></tr>
<tr><td>Opportunities and Gaps</td><td>Greenfield context enables early deployment of integrated BRT/MRT, grid bus feeders, and NMT-first street design.
Persuading citizens to shift from private modes requires strong policy incentives, fare structures, awareness, and reliability in service.
Scope to align high density, mixed use and transit corridors early on, which can support ridership and reduce private vehicle dependence
Strong regional anchors (Vijayawada/Guntur) can seed high-ridership intercity corridors and seamless multimodal hubs.
Electrified IPT can bridge last-mile gaps during transition phases
Need clearer phasing, funding, and governance capacity (depots, terminals, O&M, EV charging) to operationalize plans.</td></tr>
<tr><td>Climate Risk and GHG Emissions Scenario</td><td>GHG Emissions:<table><tr><th colspan="4">GHG Emissions in BAU scenario(tCO₂e)</th></tr><tr><th>2024</th><th>2028</th><th>2043</th><th>2058</th></tr><tr><td>31,405</td><td>29,656</td><td>287,726</td><td>710,347</td></tr></table>Climate Risk Status: Medium | Medium risk during high temperature and high intensity rainfall</td></tr>
</table>

<table>
<tr><td></td><td>

During high-intensity rainfall and urban flooding, the water overflows onto the roads, leading to restricted mobility and hindering connectivity with other areas and hampering productivity.
Increased temperature leads to preference of air-conditioned private transport modes and hinders non-motorised mobility such as walking and cycling.

</td></tr>
<tr><td>Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions</td><td>
GHG Mitigation Potential and Indicative Cost of Interventions:
<table>
<tr><th rowspan="2">Parameters</th><th colspan="3">Climate Action Scenario</th></tr>
<tr><th>2028</th><th>2043</th><th>2058</th></tr>
<tr><td>GHG Emissions in Climate Action Scenario (tCO2e)</td><td>77,821</td><td>162,665</td><td>233,094</td></tr>
<tr><td>GHG emissions reduction from BAU</td><td>2%</td><td>43%</td><td>67%</td></tr>
<tr><td>Total cost of mitigation actions by 2058 (Million INR)</td><td colspan="3">31,022</td></tr>
</table>
Climate Resilience Impacts and Co-benefits:

Shift to public, electric, and non-motorized transport lowers GHG emissions and improves air quality.
Resilient transport networks minimise disruptions from climate-related events, ensuring more reliable service.
Active mobility modes and cleaner transport systems promote healthier, safer, and more liveable communities.

Strengthened Resilience to Hazards:
Urban flood, Heat and cyclones
</td></tr>
<tr><td>SDGs</td><td>GOAL 3: Good Health and Well-being, GOAL 7: Affordable and Clean Energy, GOAL 8: Decent Work and Economic Growth, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action; GOAL 15: Life on Land</td></tr>
</table>

Climate Strategies, Actions and Targets

Strategy 1: Develop an integrated public transit system

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Establish a reliable, city-wide public transportation system	Mode share of Public Transport	24%	46%	46%

Proposed Actions

Action 1: Deploy a city-wide electric public bus system in near to mid-term

Action details

Establish a clean, reliable electric bus system with charging depots, solar shelters, and centralized fleet management to provide immediate, sustainable mobility options during Amaravati's early development phase

50 e-buses have been allocated under the Government of India's PM e-Bus Sewa scheme

Sub Actions:

- Conduct an early-stage demand survey among current residents, government employees, and workers to estimate demand, identify priority bus routes, optimal bus stop locations and frequency. **(ongoing/planned)**
- Develop a phased implementation roadmap of electric buses, aligned with projected population, key institutional and commercial destinations and early stage ridership potential.
- Deploy an electric bus fleet to serve the city's mobility requirements during the initial 3 to 5 years of infrastructure development. 50 E-buses have already been allocated to Amaravati under the Government of India's 'PM e-Bus Sewa' scheme **(ongoing/planned)**
- Install prefabricated solar powered bus shelters for interim use, with the ability to relocate them as the city develops.
- Develop electric bus depots with required civil works, electric transformers, fast/slow chargers, vehicle washing systems and driver rest zones.
- Integrate public bus system with a centralised Command Control Centre for performance monitoring, route optimization and fleet management.

Implementation agency

Lead: APCRDA

Supporting: ADCL, Transport Department, APSRTC, Research Organizations, Technology service providers

Estimated targeted scale

Number of Electric buses required[63]:

2028: 135

[63] Number of buses estimated based on projected mode share and considering 30 buses per 1lakh population as per the Service level benchmarks

2043: 537
2058: 1133

Indicative cost:

Cost for bus procurement:
2028 – 2025 million INR
2043 – 8055 million INR
2058 – 16,995 million INR

Type of action: Climate Mitigation

Timeline: Short to Medium term

Climate resilience benefits: High

Potential locations: Citywide

Monitoring indicators:

- Number of e-buses deployed and operational
- Average km travelled per bus per day and dead km travelled per bus per day
- Annual average passenger ridership

Good practice:

Pune has pioneered the procurement and operation of electric buses, integrating two exclusive depots and solar-powered infrastructure. In parallel, it has retrofitted and expanded pedestrian and cycling infrastructure under a "complete streets" model, improving multimodal access.

Action 2: Expand to develop an integrated, high-capacity and scalable public transit system

Action details

Plan and expand public transit system such as Bus Rapid Transit (BRT), Metro, and LRT corridors with multimodal hubs, ensuring scalable, future-ready mass transit that integrates with land-use and provides seamless connectivity across Amaravati.

APCRDA is conducting a study for phased development of the public transit system. BRT will serve as the core system, with upgrades to MRT as demand increases.

Sub Actions:

- Use travel demand modelling to plan BRT, Metro and LRT systems as the city population increase.
- Develop multimodal hubs, terminals and depots to ensure seamless transfers between public transit, IPT and NMT. **(ongoing/planned)**
- Integrate route planning, ticketing, fare capping and service scheduling across all public transport systems. **(ongoing/planned)**
- Establish threshold or triggers to guide upgrades in the transit system.
- Design transit infrastructure with universal design principles, sustainable and climate-responsive features.

Implementation agency

Lead: APCRDA

Supporting: Andhra Pradesh Metro Rail Corporation Ltd. (APMRC), Transport Department, APSRTC, Research Organizations

Type of action: Climate Mitigation

Timeline: Medium to Long term

Climate resilience benefits: Very High

Potential locations: Citywide

Monitoring indicators:

- Km of BRT, Metro, LRT proposed as per demand vs operational
- Daily ridership for each transit system
- Percentage of multimodal hubs functional among the transit hubs
- Percentage increase in public transport mode share annually
- Average trip time saving due to PT

Good practice:

Pune adopted a comprehensive, data-driven mobility planning approach under its Comprehensive Mobility Plan (CMP) and Pune Metro and BRT expansion programs. The city used travel demand modelling and GIS-based simulations to plan future transit corridors for BRT, Metro, and suburban rail, aligned with projected population and land-use growth

Action 3: Strengthen first and last mile connectivity

Action details

Develop feeder services, shaded walkways, cycling routes, and micro-mobility hubs to ensure seamless, safe, and affordable last-mile connectivity between residential areas, commercial areas, workplaces, and public transport nodes.

The city network features cycle tracks and shaded walkways according to the proposed street designs, and construction of this infrastructure is currently underway.

Sub Actions:

- Integrate first and last mile solutions such as e-autos, feeder vans, and shuttle services linked to public transport terminals and stations.
- Ensure cycle tracks, shaded walkways, and secure parking at terminals. **(ongoing/planned)**
- Prioritize development of shared mobility hubs and micro-mobility zones around key intersections, employment hubs, government offices, commercial, institutional and recreational spaces.
- Enable real-time integration between last-mile providers and public transport systems for seamless integration.
- Develop land use and building regulations, Urban design and architectural guidelines to promote mixed-use and transit-oriented development around transit corridors.

Implementation agency

Lead: APCRDA

Supporting: ADCL, Auto unions, Taxi unions, APMRC, Technology Service Providers

Type of action: Climate Mitigation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide

Monitoring indicators:

- Percentage of transit nodes with feeder services and
- Percentage of transit nodes having access to footpath and cycle tracks
- Regular passenger satisfaction surveys on comfort, accessibility and safety

Good practice:

Bengaluru's Metro partnered with WRI India and private operators like Yulu and MetroRide to launch app-based e-auto and e-bike feeder services. The initiative integrates real-time metro schedules, shaded walkways, and secure cycle parking at stations, improving accessibility, reducing congestion, and promoting clean last-mile mobility.

Singapore's Land Transport Authority developed the Walk-Cycle-Ride strategy integrating cycling paths, pedestrian zones, and shared mobility around MRT stations. Through the SimplyGo multimodal app, over 1,300 km of cycling paths ensure seamless, low-carbon connectivity, boosting public transport ridership and reducing car dependency.

Action 4: Implement an integrated fare and ticketing system

Action details

Implement a unified QR/NFC-based fare collection system across modes, enabling seamless transfers, fare capping, and accessible multilingual platforms that enhance passenger convenience and improve operational efficiency

Sub Actions:

- Deploy QR-based, near field communication (NFC)-enabled ticketing across modes
- Offer fare capping, transfer discounts, and integrated tourism passes to promote public transit use
- Ensure multilingual, accessible, user-friendly ticketing interfaces compatible with diverse payment systems.

Implementation agency

Lead: APCRDA

Supporting: APSRTC, APMRC, Payment and Technology Service Providers
Type of action: Climate Mitigation
Timeline: Short to Medium term
Climate resilience benefits: Medium
Potential locations: Citywide
Monitoring indicators: • Percentage of PT modes under single ticketing platform • Share of digital ticketing transactions • Average transfer time saved for passengers
Good practice: **Kochi** introduced the Kochi1 smart card usable across metro, buses, and other modes. City rolled out electronic ticketing machines (ETMs), vehicle location tracking, and passenger information systems under a PPP model, structuring revenue sharing with private operators.

Action 5: Promote low-carbon public transit technologies
Action details Adopt advanced technologies such as regenerative braking, lightweight materials, and smart HVAC systems in buses and metros to improve energy efficiency, reduce operating costs, and minimize emissions. **Sub Actions:** • Mandate adoption of energy-efficient design features such as regenerative braking, smart HVAC systems and lightweight composite materials in transit vehicles. • Install onboard driver advisory systems to optimize acceleration, braking and energy consumption patterns.
Implementation agency **Lead:** APCRDA **Supporting:** APSRTC, APMRC, Technology Service Providers
Type of action: Climate Mitigation
Timeline: Short to Medium term
Climate resilience benefits: Medium
Potential locations: Citywide
Monitoring indicators:

- Percentage of fleet with energy-efficient technologies
- Energy saved (in kWh) per year from regenerative systems
- GHG emissions avoided annually.

Strategy 1 - Financing Modes/Sources

APCRDA budget, PPP models such as Gross Cost Contracting (GCC), Central government funding under 'Transport Planning and Capacity Building in Urban Transport for metro and non-metro projects' for research studies, National Clean Air Action Plan funds, loans/grants from multilateral development banks and donor agencies

Strategy 2: Enable and prioritize Non-Motorized Transport (NMT)

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Promote non-motorized mobility	Percentage modal share for Non-Motorized Transport (walking and cycling)	20%	24%	25%

Proposed Actions

Action 1: Establish citywide NMT infrastructure

Action details

Design and implement shaded sidewalks, cycle tracks, and PBS systems with wayfinding, secure parking, and PT integration to encourage safe, accessible, and continuous non-motorized transport across Amaravati

100% city network features cycle tracks and shaded walkways according to the proposed street designs, and construction of this infrastructure is currently underway.

Sub Actions:

- Design a continuous network of dedicated cycle tracks, shaded sidewalks and pedestrian priority streets.
- Install dedicated NMT signage, wayfinding maps and digital boards at key public spaces and transit hubs.
- Deploy a technology-enabled Public Bicycle Sharing (PBS) system integrated with app-based booking, docking and payment features.
- Ensure all PT terminals and major bus stops include NMT access routes, bicycle racks and shaded walking corridors.
- Establish interim pedestrian safety infrastructure using quick-build footpaths, signage, and lighting in existing village settlement areas during early-stage construction.

Implementation agency

Lead: APCRDA, ADCL

Supporting: PBS Operators, Contractors
Type of action: Climate Mitigation
Timeline: Short term
Climate resilience benefits: Medium
Potential locations: Citywide
Monitoring indicators: • Percentage of road network with cycle tracks and footpath • Percentage of transit stations with public bike sharing system
Good practice: **Bhopal** launched India's first fully automated Public Bicycle Sharing (PBS) system with 500 bikes and over 50 stations, integrated with its MyBus BRTS and a unified smart-card/digital app for seamless first- and last-mile connectivity.

Action 2: Improve NMT safety and accessibility
Action details Introduce pedestrian crossings, traffic calming measures, and universal design features like ramps, tactile paving, and audible alerts to ensure safe, inclusive, and accessible walking and cycling for all. **Sub Actions:** • Implement traffic calming measures such as raised table-top pedestrian crossing, speed bumps, and modal filters in residential, institutional, and commercial zones. • Install pelican crossings at high footfall and high-risk junctions to allow safe pedestrian movement, particularly for children, elderly and differently abled persons. • Equip pedestrian infrastructure with accessible features including audible alerts, step free ramps, tactile paving, and shaded rest points.
Implementation agency **Lead:** APCRDA, ADCL **Supporting:** Traffic Police
Type of action: Climate Mitigation
Timeline: Short term
Climate resilience benefits: Average
Potential locations: Citywide
Monitoring indicators:

- Percentage of streets with accessibility features such as ramps, tactile paving
- Number of safe crossings installed
- User satisfaction scores on safety and comfort

Good practice:

In **Chennai** Street Design Project, more than 100 km of streets were redesigned following the Complete Streets and Universal Design principles. The project introduced raised pedestrian crossings, tactile paving, shaded walkways, and traffic calming elements, ensuring safety and accessibility for all, including elderly and differently abled citizens.

Action 3: Promote behavioral shift to active mobility

Action details

Encourage walking and cycling through public campaigns, institutional policies, subsidized PBS rides, and community partnerships, creating cultural acceptance of NMT as a preferred daily commuting choice.

Sub Actions:

- Organize recurring public campaigns such as walk to work or cycle to school weeks, and provide app-based rewards for using NMT modes
- Encourage offices and educational institutions to support walking and cycling by implementing parking disincentives for two-wheelers and cars, and limiting private vehicle use
- Partner with public bike sharing service providers to offer subsidized ride vouchers, especially for short-distance commutes and metro/bus station access
- Partner with universities and colleges to promote cycling through student clubs, group rides, and subsidized access to public bicycle sharing schemes

Implementation agency

Lead: APCRDA

Supporting: Traffic Police, Educational Institutions, NGOs, PBS Operators, Private Companies

Type of action: Climate Mitigation

Timeline: Short to Medium term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Modal shift to walking/ cycling compared to baseline year
- Percentage reduction in short-distance motorized trips

Good practice:

Surat, Gurugram, Delhi and other Indian cities host Raahgiri Day — weekly car-free mornings where main streets are closed to motor vehicles, promoting walking, cycling, play and public life, raising awareness of active mobility.

Strategy 2- Financing Modes/Sources

APCRDA budget, Central government funding under 'Transport Planning and Capacity Building in Urban Transport for metro and non-metro projects' for research studies, National Clean Air Action Plan funds, Nirbhaya fund for women's safety, loans/grants from multilateral development banks and donor agencies

Strategy 3: Promote Clean, Electric Mobility for Public and Private Transport

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Electrification of public and private transport	Percentage of electric public bus fleet	100%	100%	100%
	Percentage of electric 2-wheelers registered within Amaravati	100%	100%	100%
	Percentage of electric cars registered within Amaravati	100%	100%	100%
	Percentage of electric light freight vehicles in Amaravati	100%	100%	100%
Renewable integration in public electric charging infrastructure	Percentage of EV electricity consumption to be met by renewables	20%	40%	60%

Proposed Actions

Action 1: Mandate electrification of government and institutional fleet

Action details

Transition all government and institutional fleets to EVs, provide shared electric commuting options, and train staff in EV operations to showcase leadership and accelerate e-mobility adoption.

Sub Actions:

- Transition 100% of government and institutional fleets to EVs in a phased manner.
- Promote shared electric transport solutions such as e-buses, e-autos and pooled cabs for daily commuting of government staff and workers
- Encourage infrastructure contractors and large institutions e.g., educational institutions and hospitals to provide electric shared mobility options for staff and site workers
- Train municipal staff in EV operations, maintenance, and safety protocols to ensure compliance.
- Involve EV manufacturers, service providers, and fleet operators to co-develop use cases, support pilot projects, and build the institutional EV ecosystem

Implementation agency

Lead: APCRDA

Supporting: ADCL, Transport Department, EV Manufacturers
Type of action: Climate Mitigation
Timeline: Short to Medium
Climate resilience benefits:
Potential locations: Citywide
Monitoring indicators: • Percentage of ICE fleet converted to EVs

Action 2: Develop city-wide charging infrastructure

Action details

Plan and implement charging stations, depots, and battery-swapping facilities across PT, freight, and private vehicle segments, supported by grid upgrades and renewable energy integration for long-term sustainability.

Sub Actions:

Develop citywide EV charging and battery-swapping infrastructure.

- Identify and classify EV charging needs for private vehicles, public buses, IPT and freight fleet.
- Integrate EV infrastructure into spatial plans, LPS layouts and public buildings.
- Designate land for charging stations at public transport depots, IPT stands, parking facilities, logistics hubs and trip attraction zones.
- Enforce regulations requiring all government buildings, commercial, institutional and residential developments to include EV charging infrastructure.
- Include provisions for battery-swapping stations.
- Involve EV manufacturers, service providers, and fleet operators to co-develop use cases, support pilot projects, and build the institutional EV ecosystem
- Include planning for EV charging infrastructure at an early-stage during fleet procurement in PT terminals and depots for both overnight charging and on-route fast charging.
- Identify locations for deployment of on-route charging fast charging of public bus fleets to facilitate charging without disruption of service, minimize dead or non-operational kms and time, optimize operational efficiency and revenue.
- Coordinate with APCDPCL for grid infrastructure upgrades and smart metering to cater to city-wide EV-charging requirements. Conduct annual assessments of electricity demand from transport electrification and help inform grid capacity upgrades, charging infrastructure, and distribution planning accordingly.

Ensure sustainable EV battery lifecycle and circularity.

- Promote EV battery circularity through collection, recycling and reuse.
- Establish partnerships with authorized recyclers and EV manufacturers end of life battery management, ensuring compliance with the Battery Waste Management Rules, 2025
- Encourage adoption of second life applications for used EV batteries in stationary storage or renewable energy integration.

Implementation agency

Lead: APCRDA

Supporting: ADCL, APCPDCL, APSRTC, Private Charging Companies

Type of action: Climate Mitigation

Timeline: Short to Medium term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Number of community EV charging stations (privately owned and operated)
- Number of community EV charging stations (publicly owned and operated)
- Number of community EV charging stations (PPP / FDI)
- Area (sq. km) served per EV charging station
- Total number of freight-specific EV charging stations installed
- Percentage of PT depots with overnight/ on-route charging

Good practice:

Ahmedabad's on-route solar-powered charging pilot resulted in the elimination of 120 hours of non-productive time and saved Rs.15 million by reducing non-revenue generating dead kilometres travelled by the city's electric buses. About 40-45 buses are able to use this on-route charging station of 500 kW size. A 120 kWp solar PV system is installed on-site, that generates about 170,000 kWh of renewable energy per year, helping mitigate around 140 tCO2e of GHG emissions.

Action 3: Integrate renewable energy in EV charging infrastructure

Action details

Deploy solar PV and renewable-powered charging infrastructure in bus depots, parking hubs, and logistics centres to reduce emissions, enhance energy resilience, and promote zero-emission e-mobility.

Sub Actions:

- Adopt renewable energy powered EV charging for emission-free mobility. Prioritise its early adoption in charging facilities at bus terminals and logistics hubs.
- Implement pilot projects for integration of renewable energy in EV charging infrastructure

Implementation agency

Lead: APCRDA

Supporting: ADCL, APCPDCL, Private Charging Companies, NREDCAP

Indicative Cost:

RE for EV Charging

2028 – 2,313 million INR 2043 – 40,409 million INR 2058 – 140,270 million INR
Type of action: Climate Mitigation
Timeline: Short to Medium term
Climate resilience benefits: High
Potential locations: Citywide
Monitoring indicators: • Percentage of EV charging stations powered with renewable energy • Percentage of energy demand met through renewable energy
Good practice: **Amsterdam Smart Charging Program, Netherlands**: Amsterdam developed 3,000 smart charging points integrated with renewable energy grids and real-time demand management. The city uses open data platforms to optimize grid load balancing and prioritizes solar-powered chargers for taxis, logistics, and buses.

Action 4: Incentivize electric vehicle uptake and phase out ICE vehicles
Action details Introduce financial incentives, scrappage policies, congestion pricing, and green zones to accelerate EV adoption, discourage ICE vehicles, and shift Amaravati towards a cleaner, low-carbon mobility future. **Sub Actions:** • Provide financial incentives, including registration waivers, scrapping bonuses, parking discounts, and low-interest financing for EV buyers. • Designate green zones and low-emission corridors allowing only zero-emission vehicles. • Pilot congestion pricing and time-based access restrictions for ICE vehicles based on traffic congestion and air quality levels.
Implementation agency **Lead:** APCRDA **Supporting:** ADCL, APPCB, Vehicle Manufacturers
Type of action: Climate Mitigation
Timeline: Short to Medium term
Climate resilience benefits: Medium
Potential locations: Citywide

Monitoring indicators:

- Percentage of annual vehicle registrations that are EVs
- Number of ICE vehicles scrapped annually
- Annual EV adoption rate in 2W, 3W, 4W and freight categories

Action 5: Mandate EV-ready development regulations

Action details

Mandate EV-ready parking slots and charging infrastructure in all new residential, commercial, and institutional developments to future-proof Amaravati's transport systems and support rapid EV growth.

Ongoing

Sub Actions:

- Amend building byelaws to mandate EV-ready parking slots in residential, commercial and institutional projects. **(ongoing/planned)**
- Ensure that the building occupancy or completion certificate are issued only after compliance with EV-readiness in parking infrastructure.

Implementation agency

Lead: APCRDA

Supporting: DTCP, RWAs, Developers, Builders and Contractors

Type of action: Climate Mitigation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of new development projects with EV charging infrastructure in parking
- Percentage of building occupancy certificates linked to EV readiness

Good practice:

Delhi's Charging/Swapping Infrastructure Action Plan 2022-25, under Delhi EV policy mandates the setting up charging and battery swapping stations across Delhi in multiple phases by porting and providing concessional locations for charging stations at bare minimum lease rentals. It mandates 20% of parking spaces in new buildings and 5% of all existing parking spaces under the purview of different agencies must be EV ready with at least 3.3 kW output charging points. Five swap points will be considered equivalent to one charging point.

Strategy 3- Financing Modes/Sources

APCRDA budget, National Clean Air Action Plan funds, Non-banking financial companies (NBFCs) and Fin-tech firms,[64] banks & private financial services companies offering loans and credit schemes for EVs (Mahindra Finance, TVS credit), Electric Mobility Promotion Scheme by Ministry of Heavy Industries for two and three-wheelers, Incentives under AP's Electric Mobility Policy, Green Climate Fund's India E-Mobility Financing Programme, FAME scheme (Phase III), PM E-Bus Sewa Scheme

Strategy 4: Enable Sustainable, Low-Carbon Freight

Action 1: Implement immediate controls on construction-related freight movement
Action details Enforce restricted access for heavy vehicles during peak hours, establish holding yards, and mandate compliance with emission norms to minimize congestion, dust, and pollution during Amaravati's construction phase. **Sub Actions:** • Restrict the entry of ICE-based heavy freight vehicles into the core urban areas during peak congestion hours • Designate freight corridors, entry/exit points and enforce time window-based access. • Mandate BS-VI compliance, GPS tracking, emission certificate and dust suppression mechanisms for freight vehicles. • Create a freight holding yards at city periphery with batch dispatch during construction phase. • Encourage adoption, provide incentives and priority access for electric freight vehicles.
Implementation agency **Lead:** APCRDA **Supporting:** Traffic Police, Freight Operators, APPCB
Type of action: Climate Mitigation
Timeline: Short term
Climate resilience benefits: High
Potential locations: Citywide
Monitoring indicators: • Percentage of freight vehicles BS-VI compliant • Number of peripheral holding yards operational • Number of permit violations detected monthly
Good practice: **Beijing's** Low-Emission Zone launched in 2017, bans heavy-duty freight vehicles below National IV emission standards to curb air pollution. Supported by WRI China, the initiative improved air quality,

[64]5 FinTechs fueling Electric Vehicle Loans in India

prevented about 43 premature deaths annually, and achieved $37 million in yearly social cost savings, influencing similar actions across other Chinese cities.

Action 2: Electrify last-mile freight and introduce e-logistics mandates

Action details

Mandate electrification of two/three-wheeler delivery fleets and develop digital aggregation platforms to ensure low-emission, efficient, and cost-effective last-mile logistics in the city.

Sub Actions:

- Mandate phased electrification of light freight and delivery fleets.
- Promote battery swapping models for two and three-wheeler fleets.
- Enable logistics fleet aggregation and digital platforms.
- Develop freight decarbonization guidelines and promote data-backed emission tracking.

Implementation agency

Lead: APCRDA

Supporting: Logistics Companies, EV Manufacturers, Freight Operators

Type of action: Climate Mitigation

Timeline: Short to Medium term

Climate resilience benefits: High

Potential locations: Citywide

Monitoring indicators:

- Percentage of light freight vehicle electrified
- Percentage of last-mile deliveries done by EVs

Action 3: Establish integrated urban freight and logistics management zones and implement freight routing

Action details

Establish logistics hubs at Amaravati's periphery with shared warehousing, EV charging, and multimodal connectivity, supported by dedicated freight corridors and smart routing systems to reduce core-area congestion.

Sub Actions:

- Identify and operationalize logistics hubs near the city periphery and regional corridors
- Identify and reserve land for shared warehousing, EV charging, and logistics handling infrastructure
- Promote multimodal connectivity for bulk movement into the city
- Restrict ICE-based heavy freight vehicles in inner city zones in the mid-term
- Enable dedicated freight corridors with real-time route advisory

Implementation agency **Lead:** APCRDA **Supporting:** Warehouse companies, Freight associations, Transport Department
Type of action: Climate Mitigation
Timeline: Short to Medium term
Climate resilience benefits: Medium
Potential locations: Logistics hub proposed as per Master Plan
Monitoring indicators: • Number of operational freight or logistics hubs in the city • Km of dedicated freight corridor active within city • Percentage reduction in freight vehicles travelled in core city

Strategy 4- Financing Modes/Sources

APCRDA budget, Incentives under AP's Electric Mobility Policy, OEMs like Tata, iXEnergy and Kalyani Powertrain who offer retrofitting kits,[65] Non-Banking Financial Companies (NBFCs) and FinTech firms,[66] International funding sources such as the German government's International Climate Initiative (IKI) supporting a sustainable freight project in India, Green Climate Fund's India E-Mobility Financing Programme, Multilateral development banks

Strategy 5: Develop Climate-Resilient and Low-Emission Transport Infrastructure

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Incorporate nature-based and water-sensitive design elements	Permeable/semi-permeable and high-albedo paving surfaces in NMT lanes	100%	100%	100%

[65] JMK Research & Analytics, White Paper, E truck Market in India, March 2024.
[66]5 FinTechs fueling Electric Vehicle Loans in India.

Proposed Actions

Action 1: Adopt climate-resilient transport infrastructure design

Action details

Adopt climate resilient construction materials, elevate roads in flood-prone areas, and integrate stormwater drains into road cross-sections to ensure Amaravati's transport infrastructure withstands climate risks and extreme weather.

Sub Actions:

- Mandate the use of climate resilient construction material such as fly ash concrete, ground granulated blast furnace slag (GGBS), fibre-reinforced concrete, and geo-grid stabilization in bridges, bus terminals, bus depots and transit stations.
- Elevate critical road infrastructure such as major roads, PT terminals, depots in low-lying areas and flood-prone zones based on the flood risk maps developed by APCRDA and ADCL's flood management studies.
- Integrate stormwater drains, recharge pits, slit traps and percolation chambers in the road cross sections to minimize surface logging.
- Use heat-resistant asphalts and concrete mixture with high solar reflectance index for transport infrastructure exposed to prolonged sun.

Implementation agency

Lead: APCRDA, ADCL

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide with focus on inundation areas identified in Kondaveti Vagu Flood Management Plan

Monitoring indicators:

- Km of roads elevated or flood proofed
- Percentage of roads with laid with heat and flood resilient specification

Action 2: Incorporate nature-based and water-sensitive design elements

Action details

Introduce bioswales, rain gardens, permeable pavements, and tree-lined boulevards to reduce surface heat, manage runoff, and create cooler, greener, and climate-adapted transport corridors across Amaravati.

Sub Actions:

- Include bio-swales, rain gardens and vegetated detention basins along pedestrian and NMT corridors to manage run-off, improve groundwater recharge and reduce temperature.

- Use permeable paving and high-albedo materials for pavements to reduce surface temperature.
- Provide tree-lined boulevards using native species along major NMT corridors, with wide plantation strips and tree guards.
- Install cool roofs or solar PV-integrated shading in NMT shelters, bike parking zones, and intersections
- Incorporating green buffers into sidewalk landscaping and around public transport zones to reduce noise, dust and surface temperature.

Implementation agency

Lead: APCRDA, ADCL

Supporting: R&B Department, APG&BC

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of pavement with permeable and high albedo surfaces
- Tree canopy cover increase (in hectares)
- Reduction in average surface temperature

Good practice:

Street design and urban form features for improved wind flow in Singapore

Wind corridors are carefully planned urban design features that channel natural wind flows through cityscapes to enhance ventilation, reduce ambient temperatures, and improve pedestrian comfort. These corridors are typically aligned with prevailing wind directions, and their effectiveness depends on the placement, orientation, and height of buildings and streets.

Marina South locality in Singapore integrates wind corridors by aligning streets with prevailing winds, spacing buildings, and using varied heights to channel airflow. This design lowers ambient temperatures by up to 2°C and enhances pedestrian comfort and climate resilience.

Action 3: Implement the Adaptive Traffic and Smart Parking Management System

Action details

Implement AI-enabled adaptive traffic signals, smart pedestrian crossings, and sensor-based parking systems to optimize traffic flow, improve safety, and reduce congestion-related emissions across the city.

Sub Actions:

- Deploy an AI-enabled adaptive traffic signal system that responds to the real-time congestion, pedestrian volumes and vehicle types, ensuring optimal signal phasing and reduced idling emissions.

• Integrate real-time weather data into traffic control systems to proactively manage disruptions caused by extreme climate events. • Prioritize signal clearance and corridor access for public transport vehicles, ambulances and emergency services. • Enable smart pedestrian crossing with pelican or HAWK signals in high footfall zones, ensuring safety. • Set up solar-power traffic kiosks at major junctions with battery backup, surveillance connectivity and emergency communication tools to ensure uninterrupted operations. • Implement a citywide smart parking system using sensors, cameras and a digital interface to track space availability and regulate curbside usage. • Introduce demand-based parking pricing and restrictions in high traffic zones.
Implementation agency **Lead:** APCRDA, Traffic Police **Supporting:** ADCL, Technology service providers
Type of action: Climate Adaptation
Timeline: Short to Medium term
Climate resilience benefits: Medium
Potential locations: Citywide
Monitoring indicators: • Number of AI-enabled adaptive traffic signal system • Reduction in average delays and idle time at junctions
Good practice: **Nagpur Municipal Corporation** piloted an AI-driven Intelligent and Integrated Traffic Management System (IITMS) at three major junctions, featuring adaptive signals, ANPR violation detection, speed radars, LED messaging, all monitored from a command centre**.**

Strategy 5- Financing Modes/Sources
APCRDA budget, Central/state govt. grants

Strategy 6: Integrated transport governance and smart mobility planning

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Deploy Smart mobility platforms and real-time passenger tools	Major PT stops and terminals with real-time tracking and passenger information systems	50%	100%	100%

Proposed Actions

Action 1: Establish Unified Metropolitan Transport Authority (UMTA) and build institutional capacity

Action details

Amaravati has a Unified Metropolitan Transport Authority (UMTA) formed under APCRDA. It needs to be strengthened to effectively implement and oversee infrastructure development and emerging needs in the city.

Sub Actions:

- Strengthen UMTA for multimodal planning, fare regulations, EV oversight, ITS management and other mobility projects.
- Prepare and update the Amaravati Mobility Master Plan every five years based on evolving land-use and transport demand.
- Establish a Mobility Innovation Cell within UMTA to pilot new solutions.
- Build internal capacity through regular training for city officials on NMT, EVs, ITS, Gender Equity and Social Inclusion (GESI), and mobility innovations.

Implementation agency

Lead: APCRDA, UMTA

Supporting: ADCL, APMRC, Transport Department, APSRTC, Traffic Police, APPCB, South Central Railway, Research Institutes

Type of action: Climate Adaptation

Timeline: Short

Climate resilience benefits:

Potential locations: Citywide

Monitoring indicators:

- No. of training sessions conducted annually

Action 2: Deploy smart mobility platforms and real-time passenger tools

Action details

Develop a unified mobility platform with feeds from PT, IPT, NMT, freight and parking systems for real-time PT tracking, multimodal journey planning, safety monitoring, and dynamic fleet deployment, ensuring efficient, resilient, and passenger-friendly transport services across Amaravati.

Sub Actions:

- Integrate feeds from PT, IPT, NMT, freight and parking systems with a central command control centre for real time monitoring and decision making.
- Use real-time monitoring to track crash data, identify black spots and coordinate with traffic police for enforcement and response.

• Enable dynamic service adjustments and predictive fleet deployment during congestion or climate disruptions. • Launch a multilingual journey planner app with live PT vehicle tracking, multimodal routing and tourist support • Install digital displays at all major terminals and stops for real time information and route guidance
Implementation agency **Lead:** APCRDA, UMTA **Supporting:** ADCL, APMRC, Transport Department, APSRTC, Traffic Police, Research Institutes
Type of action: Climate Adaptation
Timeline: Short to Medium term
Climate resilience benefits: Medium
Potential locations: Citywide
Monitoring indicators: • Percentage of PT routes live-tracked on the smart mobility platform • Monthly active users of the real-time passenger tools/ app • Number of PT stops with real-time information displays • Percentage reduction in response time to crashes/ incidents
Good practice: **Seoul** operates a centralised real-time command platform that aggregates data from transit cards, vehicle sensors, and operations systems. This enables live analysis for route planning, interval management, and immediate response to disruptions via dynamic traffic signalling and coordination with emergency services.

Strategy 6- Financing Modes/Sources
APCRDA budget, Central/state govt. grants

2.7 Biodiversity and Urban Greening

Baseline Status (2024-25)	**Key Statistics:** • Amaravati has a number of scenic natural features providing abundant water and greenery within the city. • Several scenic natural islands exist within the river Krishna. • Amaravati supports diverse resident and migratory birds and contains ecologically sensitive habitats along the Krishna River floodplains. • Amaravati has about 251 acres of forest land, which acts as the green lungs of the city. • Amaravati has 3 major hills: Undavalli, Neerukonda, and Ananthavaram. The Undavalli Hill area is categorized as a Reserved Forest Area, and no interventions are proposed.
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • Nager Van Yojana[67], National Clean Air Program[68] supports increasing green cover in the city • Biological Diversity Act, 2002 • National Biodiversity Strategy and Action Plan[69] **State/City Policy/Programme/Targets:** • Swarna Andhra@2047 Vision Plan targets to achieve more than 50% green cover in the state of Andhra Pradesh.[70] • Draft Urban Design and Architectural Guidelines 2025 recommends "Blue and Green Network" is a planning strategy that seeks to protect the ecological and hydrological assets of Amaravati.[71] • Green Policy is being formulated by the Urban Greening Committee of Amaravati city
Opportunities and Gaps	• All existing hills and the river Krishna must be protected as they provide the Amaravati city with critical natural open spaces and green cover. • The 25 km long river Krishna waterfront can be developed as a vibrant centre for active and passive recreational uses. • A seamless network of green and blue networks can be created by interweaving the existing water tanks and canals together. This network can be supported with reservoirs to mitigate flood-related issues within the city. • The cluster of islands on the river Krishna should be protected and developed as eco-tourism attractions within the city.
Climate Risk	**Climate Risk Status**: High | High risk from elevated temperatures and extreme rainfall events

[67] Implementation Guidelines: Nagar Van Yojana, Ministry of Environment, Forest and Climate Change, Government of India, 2017.
[68] Portal for Regulation of Air-pollution in Non-Attainment cities, Ministry of Environment, Forest and Climate Change, Government of India.
[69] India launches updated National Biodiversity Strategy and Action Plan (NBSAP) at COP 16 to the Convention on Biological Diversity (CBD), in Colombia, Ministry of Environment, Forest and Climate Change, Government of India.
[70] Swarna Andhra @ 2047 Vision Plan. Andhra Pradesh State Development Planning Society (APSDPS). 2025.
[71] Draft Urban Design and Architectural Guidelines 2025

	• Extreme heat conditions intensify the urban heat island effect. • Intense rainfall events lead to urban flooding due to stormwater runoff.
Potential Climate Resilience Impact and Wider Co-benefits of Climate Actions	**Climate Resilience Impact and Co-benefits:** • Reduces urban heat island effect and surface temperatures • Improved health of existing natural ecosystems • Nature-based solutions help absorb storm surges and reduce the risk of flooding. • Increased carbon sequestration • Improved air and water quality through natural filtration **Strengthened Resilience to Hazards:** Heat stress, urban flood, cyclones
SDGs	GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 11: Sustainable Cities and Communities, GOAL 13: Climate Action, GOAL 15: Life on Land

Climate Strategies, Actions and Targets

Strategy 1: Conserve and restore ecosystems to enhance climate and ecological resilience

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Restore degraded and ecologically sensitive areas using nature-based solutions	Restoring a degraded ecosystem during the construction phase	50%	100%	100%

Proposed Actions

Action 1: Protect and conserve natural water bodies, hills and eco-sensitive zones

Action details

Existing natural water bodies, including lakes, ponds, and wells, must be protected against pollution, encroachment, dumping, and any activities that may threaten their ecological integrity and health.. Restoration of existing water bodies should be carried out by shaping their contours and maintaining the natural flow of water. Water bodies should be protected with buffer zones to prevent development from encroaching too closely to the water's edge.

Existing Initiatives

The Amaravati city master plan has addressed the demarcation of protected areas under P3 zoning to conserve and protect environmentally sensitive areas, such as steep slopes and rivers, which are rich in natural biodiversity.

Sub Actions

- Conduct a citywide survey to map natural assets like wetlands, ridges, streams, and hills.[72] **(Ongoing/Planned)**
- The Advanced Locality Management[73] committee of each area should be tasked with overseeing the protection and management of local water bodies.
- Enforce buffer zones: 30m for streams/canals, 50m for ponds/tanks, 100m for the Krishna River **(Ongoing/Planned)**
- Remove invasive species and replant native, climate-resilient vegetation.
- Ban cement lining of water bodies; use vegetation for edge stabilization.
- Install eco-friendly fencing and vegetated buffers around lakes and ponds.
- Use coir log barriers and native grass bunds to prevent erosion on banks and slopes.
- Restrict construction on hills/ridges and promote afforestation and erosion control with native plants. **(Ongoing/Planned)**

Potential locations: City-wide with focus on water bodies, Parks and Open Spaces (P1, P2, P3)

Implementing entities

[72] Toolkit for management of wetlands and water bodies in urban areas, National Mission for Clean Ganga

[73] Advanced Locality Management represents a designated locality or neighborhood where residents collaborate closely with the government department to collectively enhance the "Quality of Life" within their community.

Lead: APCRDA **Supporting:** ADCL, APG&BC, DTCP, AP Biodiversity Board, Water Resources Department, Forest Department
Type of action: Climate Adaptation
Climate resilience benefits: Medium
Timeline: Short term
Monitoring Indicators: • Percent of total city area surveyed and digitized for natural assets • Area of riparian buffers restored with native species • Number of shoreline stabilization works using nature-based solutions • Mapped water bodies conforming to minimum buffers and physical demarcation
Good Practice: The SOUL (Saving Open Space and Urban Lakes) project in **Hubli-Dharwad**, Karnataka, was launched in 2008 to revive urban lakes, protect open spaces, and strengthen the city's cultural heritage. Through inter-departmental coordination, the project restored lake boundaries, diverted sewerage, planted 5,000 saplings, and enhanced water storage by over 1 lakh cubic meters. It also promoted cultural activities, attracting over 1 lakh tourists per month and generating a sustainable revenue of more than INR 10 Lakh per month. The initiative successfully combined environmental restoration with cultural rejuvenation, earning the Prime Minister's Award for Excellence in Public Administration.[74] The Neknampur Lake Restoration by Dhruvansh Organization in **Hyderabad** focused on reviving a severely polluted lake by restoring biodiversity, enhancing water retention, and creating a community space for recreation. Key interventions included phytoremediation, floating treatment wetlands, desilting, and garbage removal. The project achieved a 90% reduction in Biological Oxygen Demand, improved water quality, and transformed the lake into a vibrant ecological and recreational place for the community.[75]

Action 2: Restore degraded and ecologically sensitive areas using nature-based solutions
Action details Restoring degraded and ecologically sensitive urban areas with nature-based solutions helps Amaravati reduce flood risk, decrease heat islands, and improve water quality by integrating wetlands, bioswales, riparian buffers, and urban forests into streetscapes and waterways. Amaravati city has plans to plant vegetation on slopes to help minimize soil erosion. **Sub Actions** • Identify and survey degraded areas like eroded slopes and dry stream beds. • Undertake ecological restoration of the degraded landscapes. • Use geo-jute matting and brush layering for slope stabilization in high erosion risk zones.

[74] NIUA. (2021). Rejuvenation and conservation of water bodies and open areas: Training manual. Climate Centre for Cities.
[75] NITI Aayog (2023). COMPENDIUM OF BEST PRACTICES IN WATER MANAGEMENT - 3.0.

- Rejuvenate streams and wetlands via desilting, buffer planting, and restoring drainage.
- Designate restored sites as protected zones to prevent encroachment.
- Develop an invasive species control protocol and establish a native plant nursery for the Krishna basin.

Potential locations: City-wide with focus on Hill slopes, Krishna river and Kondaveeti vagu

Implementing entities

Lead: APCRDA

Supporting: APG&BC, APSBB, Water Resource Department, NGOs/ CSOs

Indicative cost:

INR 1.2 lakh per hectare hill slope renaturation (Construction and the first two years of maintenance, including preparation of the plants in the nursery and transplantation and manual harvesting)[76]

Type of action: Climate Adaptation

Climate resilience benefits: Medium

Timeline: Short to Medium term

Monitoring Indicators:

- Length of slopes treated with geo-jute and brush layering
- Number of restored sites notified as protected zones
- Increase in native plant species per plot

Good Practice:

In Jaipur, Rao Jodha Desert Rock Park was restored by the removal of Prosopis juliflora and the reintroduction of native xeric vegetation, which restored the degraded rocky terrain.

A stretch of the French Broad River bank in **Tennessee** state, experienced severe erosion during flooding that occurred while a new bridge was under construction. The erosion posed risks to both the newly installed bridge infrastructure and the nearby railroad line. To stabilize the slope, a vegetative riprap system was applied at the toe, combining rock with dormant cuttings to reinforce the stream bank. The estimated cost of this slope stabilization is approximately INR 65 lakh per kilometer.

Action 3: Safeguard culturally and ecologically sensitive zones

Action details

Special zones can be designated to safeguard the existing heritage structures and cultural assets, as heritage zones are currently not specified within the planning regulations and P3 consists of only hills and existing water bodies. Preserving heritage and integrating local art and culture will help create a unique image and identity for the city.

Existing Initiatives

Amaravati city has amended its zoning regulations to take appropriate measures for the protection of Undavalli caves and ensure that no development activity is permitted within a Zone of 100 to 300 meters around Undavalli caves, as per ASI regulations.

[76] Sustainable Cities - Integrated Approach Pilot (SCIAP), The United Nations Human Settlements Programme (UN-Habitat), 2022, Accessed September 2023

Sub Actions

- Notify and demarcate no-development zones around heritage sites and sensitive areas as per ASI and environmental rules. **(Ongoing/Planned)**
- Introduce guided eco-trails with bilingual signs and controlled access.
- Digitally map and monitor heritage zones with drones to spot encroachments.
- Protect reserve forest, allow diversion only with ecological justification and mitigation plans. **(Ongoing/Planned)**

Potential locations: City-wide

Implementing entities

Lead: APCRDA, Tourism Department

Supporting: ASI, DTCP, Forest Department

Type of action: Climate Adaptation

Climate resilience benefits: Medium

Timeline: Short term

Monitoring Indicators:

- Number of heritage/sensitive sites with physical boundary demarcation
- Periodic drone monitoring of heritage sites and sensitive areas to spot encroachments

Strategy 1 - Financing Modes/Sources

APCRDA and State budget, AMRUT 2.0, 15th FC, CSR funds

Strategy 2: Expand and diversify green spaces for ecological, recreational and climate co-benefits

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Develop a citywide green space network	Total green cover area	4 sq.km	16 sq.km	64 sq.km

Proposed Actions

Action 1: Develop a city-wide green space network

Action details

The introduction of a green space protection and management policy proposed in the urban design guidelines will protect and manage green spaces planned as primary greens, secondary green links, and recreational landscapes to maintain their productivity in stormwater retention. Planting large canopy trees along streets improves the microclimate by providing shade and promoting evapotranspiration, creating a comfortable environment that encourages people to walk.

Sub Actions

- Create green spaces across Amaravati, including primary and secondary green areas at walkable distances of 300-500m for all residents. **(Ongoing/Planned)**
- Connect parks, water bodies and forest patches using greenways, NMT corridors and shaded paths. **(Ongoing/Planned)**
- Establish "Urban forest micro hubs" using native dry deciduous species.
- Use geotagged tree canopy monitoring tools and satellite imageries to assess green cover expansion.

Potential locations: City-wide with focus on landuse zones (P1&P2)

Implementing entities

Lead: APCRDA, ADCL

Supporting: APG&BC

Estimated targeted scale

Total green cover area required:

2028 – 4 sq.km

2043 – 16 sq.km

2058 – 64 sq.km

Indicative cost:

Cost for increasing green cover:[77]

2028: INR 360 crore

2043: INR 1,440 crore

2058: INR 5,760 crore

Type of action: Climate Adaptation

Climate resilience benefits: Very High

Timeline: Short to Medium term

Monitoring Indicators:

- Availability of green space area per person (m^2/person)
- Total length of kilometers of continuous, shaded greenways and NMT corridors
- Number of micro forests established
- Number of trees planted and mapped on GIS

Good Practice:

The City of **Baltimore** utilizes GIS monitoring tools and satellite imagery to manage its urban forest. Between 2017 and 2018, the city conducted a detailed inventory of over 1.2 lakh trees, stumps, and planting sites, integrating geospatial data into TreeKeeper software for ongoing analysis and maintenance

[77] Consider INR 900 per sq. m. for increasing green cover (ICLEI South Asia).

planning. Satellite imagery complements this by providing updated canopy coverage maps, helping prioritize planting and maintenance efforts. Using i-Tree Streets software, Baltimore quantifies the environmental and economic benefits of its trees, estimating an annual savings of $9.3 million through energy conservation, stormwater management, and improved air quality. This monitoring tool has supported targeting canopy expansion and sustained urban forest health across neighborhoods.

Action 2: Develop biodiversity parks

Action details

Biodiversity parks protect natural areas that store carbon, keep places cooler through shade and evapotranspiration, and reduce the risk of floods through stormwater retention.

Existing Initiatives

Amaravati city plans to develop approximately 500 parks throughout the city, which will feature amenities for both commercial and recreational use, while enhancing the city's natural landscape. Incorporation of bio-retention swales is prioritized in areas at high risk of inundation due to their high water retention capacity.

Sub Actions

- Develop biodiversity parks with wetlands, grasslands, woodlands, pollinator gardens, and educational spaces using native plants. **(Ongoing/Planned)**
- Incorporate passive water harvesting features like recharge pits and bio-retention swales to enhance groundwater recharge. **(Ongoing/Planned)**
- Provide shaded rest areas, accessible trails, tactile and interpretive signage for inclusive, educational access.
- Design parks to be walkable and connected to public transport and pedestrian networks.

Potential locations: Parks and Open Spaces Zones (P1, P2, P3)

Implementing entities

Lead: APCRDA, ADCL

Supporting: APG&BC, APSBB

Indicative cost:

INR 3-22 lakhs per hectare to develop biodiversity park[78]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- Number of biodiversity parks developed
- Number of bio-retention swales installed
- Total capacity of recharge pits constructed

Good Practice:

[78] List of Biodiversity Park Projects. National Mission for Clean Ganga.

Adyar Eco-park, Chennai, covering 358 acres along the Adyar estuary, this restored wetland park reintroduced mangroves, mudflats, marshes and tropical dry evergreen forest using 172 native species. Features include boardwalks, interpretation centres, birdwatching points, and eco-trails, making it both a biodiversity hotspot and an environmental education hub.[79]

Action 3: Scale urban afforestation and native forest clusters

Action details

Scaling urban afforestation and native forest clusters in Amaravati can reduce the heat island effect in dense neighborhoods through shade and evapotranspiration, lower energy demand for cooling, mitigate runoff and flooding and enhance soil infiltration along streets, canals and open spaces.

Existing Initiatives

Amaravati city has mandated that no trees be cut down during the development phase. Instead, existing trees are being carefully relocated using modern techniques. The city maintains a comprehensive inventory of existing trees and has recently prepared a list of native species well-suited to the local environment. The greening initiatives also include the adoption of Miyawaki plantations and nutrition gardens to enhance carbon sequestration rates, thereby accelerating the capture of carbon from the atmosphere.

Sub Actions

- Afforest institutional lands, medians, and buffers using Miyawaki[80] or dry deciduous native planting. **(Ongoing/Planned)**
- Select native plant species native to the Krishna basin and Eastern Ghats, as recommended by APCRDA. **(Ongoing/Planned)**
- Use only locally adapted, non-exotic species suited to the semi-arid climate.
- Reserve urban forest, green corridors, and floodplain zones for endemic species.
- Install perforated tree guards and aerated pits to improve survival and root growth in urban settings.
- Organize annual tree planting drives with schools, colleges, and residents, led by city and state agencies.

Potential locations: City-wide

Implementing entities

Lead: APCRDA, ADCL

Supporting: APG&BC, Horticulture Department, APSBB, Educational Institutions, RWAs, NGOs

Indicative cost:

Miyawaki gardening cost is INR 2,000 per sq.m[81]

Type of action: Climate Adaptation

Climate resilience benefits: Very High

Timeline: Medium term

[79] Adyar Eco Park Phase 1, Chennai Rivers restoration trust.
[80] ICLEI South Asia. Guidelines for Development of Miyawaki Forests in India. Prepared under SDC Supported CapaCITIES II project. 2022.
[81] Miyawaki gardening, Indiamart

Monitoring Indicators:

- Number of plantations of native species
- Number of Miyawaki forests developed

Good Practice:

The **Prayagraj Municipal Corporation** has developed dense forests at various locations within the city to prepare for the Mahakumbh 2025. The corporation has planted trees using the Miyawaki technique covering an area of 55,800 square meters. Over 1.2 lakh trees of 63 species were planted in the Naini industrial area, and 27,000 trees of 27 species at Baswar after cleaning a major dumping yard. These fast-growing forests can reduce temperatures by 4–7°C, enhance biodiversity, and promote environmental restoration more effectively than traditional forests.

Strategy 2 - Financing Modes/Sources

APCRDA and State budget, AMRUT 2.0, 15th FC, CSR funds

Strategy 3: Integrate blue-green infrastructure into urban planning and infrastructure development

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Develop shaded and green mobility corridors	Green Corridors	100%	100%	100%
Promote Green roofs and living facades in urban buildings	At least 20% rooftop area in public buildings and large private developments with more than 4000sq.m plot area should be green roofs	100%	100%	100%

Proposed Actions

Action 1: Embed blue-green infrastructure in city planning and development regulations

Action details

The Blue and Green Infrastructure (BGI) network is a planning approach designed to protect the ecological and hydrological resources while shaping a city that is liveable and resilient. The BGI network plays a crucial role in enhancing flood resilience by integrating flood management functions into urban open spaces. To effectively incorporate the BGI network into city planning and development regulations, Amaravati should institutionalize the integration of draft Urban Design and Architectural Guidelines in existing zoning regulations.

As per the directives of the NGT and EC, Amaravati should develop a green and blue network that interconnects all reservoirs, water bodies, green areas and open spaces.

Sub Actions

- Incorporate bioswales, rain gardens, permeable pavements, tree pits in all townships and road designs. **(Ongoing/Planned)**
- Develop a belt of 2-3 km of broad running parallel to the Krishna River with mixed native plantations and urban flood belts.
- Design dual-use landscapes such as water plazas and floodable parks in low-lying areas.
- Integrate BGI requirements into zoning laws and building codes.

Potential locations: City-wide with focus on blue and green infrastructure

Implementing entities

Lead: APCRDA, ADCL

Supporting: APG&BC, DTCP, landscape designers and architects

Indicative cost:

INR 500–1,000 per sq. m. for the construction of permeable pavement[82]

INR 830-1,245 per sq. m. for setting up a Rain garden

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- Development of at least one BGI element in designing all roads
- Length of roads retrofitted with permeable pavement per year (km)
- Plantation of native trees and shrubs per hectare

Good Practice:

The City of **St. Paul** developed permeable pavements along sections of Jackson Street, Kellogg Boulevard, St. Peter Street, 9th Street, and 10th Street, using porous asphalt for construction. A rain garden has been developed at Riverfront Park in **Middlebury**, adjacent to Otter Creek Falls. Designed to manage urban runoff, the garden captures and filters stormwater from surrounding impervious surfaces such as roads, sidewalks, and parking areas, preventing direct discharge into the creek. By naturally treating this runoff, it helps improve water quality and reduce flooding risks.[83]

Action 2: Develop shaded and green mobility corridors

Action details

In addition to ensuring smooth vehicular circulation along the city's mobility corridors, Amaravati should promote a comprehensive multi-modal transit system that integrates Non-Motorized Transport (NMT) and enhanced pedestrian walkability. A well-designed street and public space network should encourage walking and create enjoyable urban experiences through shared streets, shaded sidewalks, and accessible

[82] Nature-Based Solutions to Ecosystem Management, Aga Khan Agency for Habitat India, 2021.
[83] Nature-Based Solutions to Ecosystem Management, Aga Khan Agency for Habitat India, 2021.

transit options that strengthen last-mile connectivity while ensuring comfortable microclimatic conditions.

As per the directives of the NGT and EC, Amaravati's road infrastructure must prioritize pedestrian pathways, dedicated cycle tracks, and the development of robust public mass transit systems such as BRT, LRT and MRT.

Sub Actions

- Construct shaded pedestrian and cycling corridors using high-canopy native trees. **(Ongoing/Planned)**
- Integrate bioswales, rain gardens and tree pits along roadways to reduce surface runoff. **(Ongoing/Planned)**
- Install sensors for real-time monitoring of temperature and air quality.

Potential locations: City-wide with focus on pedestrian, walking and cycling corridors

Implementing entities

Lead: APCRDA, ADCL

Supporting: APG&BC

Indicative cost:

INR 2-4 lakhs cost for the plantation of one tree using the tree trench system[84]

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Medium term

Monitoring Indicators:

- Number of planted trees that are high-canopy native species
- Number and length of roadways retrofitted with tree pits and bioswales

Good Practice:

As part of the Central Corridor Light Rail Transit project, the city of St. Paul installed an integrated tree trench system along more than five miles of the corridor. These 10-foot-wide systems consist of layered components including trees, porous pavers, CU Structural Soil, drainage rock, and perforated PVC pipes that channel street runoff into the trench. Around 1,250 new trees have been planted within these systems, which help filter sediments and pollutants from stormwater, reduce runoff volume and flow rates into the Mississippi River, and increase pervious surfaces within the right-of-way.

Action 3: Promote urban agriculture

[84] Case studies for tree trenches and tree boxes. Minnesota Stormwater Manual. Accessed 30th September 2025.

Action details

Given Amaravati's agricultural heritage, urban agriculture and community farms should be promoted as an interim use. Urban agriculture provides a number of key benefits such as environmental enhancement and economic resilience. Open spaces should incorporate urban agriculture zones, such as patches along the waterfront, and community farms near existing villages. During the interim phase, vacant plots should be put to use for urban agriculture and community farming as appropriate. The advantages of urban agriculture include generating additional income and employment opportunities, improved food security, and the ability to produce food locally.

According to EC directives, Amaravati should actively promote urban agriculture to help meet the city's food demands and reserve high-value agricultural land.

Sub Actions

- Develop urban agro zones and public orchards on peri-urban land using traditional and climate-resilient crops.
- Promote rooftop farming and composting in residential and public buildings with city-supported toolkits
- Establish agro-biodiversity parks showcasing traditional millet and native varieties.
- Use treated wastewater from STPs for urban greening **(Ongoing/Planned)**

Potential locations: City-wide

Implementing entities

Lead: APCRDA

Supporting: APG&BC, APSBB, Horticulture Department

Type of action: Climate Adaptation

Climate resilience benefits: Average

Timeline: Medium

Monitoring Indicators:

- Number of urban agro zones and public orchards established
- Percentage of residential and public buildings practicing rooftop farming and composting
- Establishment of agro-biodiversity parks
- Conduct workshop and training for the members engaged in urban agriculture

Good Practice:

To address the economic and climate crises in 2001, **Rosario** city launched an Urban Agriculture Program that transformed abandoned land into productive farms, training and equipping residents to create local markets. The initiative expanded to 75 hectares, cutting food-related emissions by 95% and enhancing flood resilience. In 2015, the Green Belt Project permanently protected 800 hectares of peri-urban land for agroecological farming, strengthening the city's climate adaptation and earning international recognition for combining food security with sustainable urban planning.

Action 4: Promote green roofs and facades in buildings

Action details

Green roofs are widely recognized as an effective measure for environmental protection. Amaravati could promote the adoption of green roofs by incorporating them into zoning regulations. Green roofs help reduce stormwater runoff generated at the plot level and can also limit the spread of dust and particulate matter, while lowering smog formation.

Sub Actions

- Mandate at least 20% rooftop area as green roofs on public buildings and large (4000+ sq.m) private developments to lower temperatures. **(Ongoing/Planned)**
- Encourage private adoption through tax rebates and green building incentives.
- Develop climate-specific rooftop garden guidelines, ensuring accessibility for all users.
- Build demo green roofs and vertical gardens in government and educational buildings.
- Promote shade-giving creepers on building peripheries and parking areas to reduce reflected heat and improve aesthetics.

Potential locations: City-wide

Implementing entities

Lead: APCRDA

Supporting: APG&BC, APSBB, Horticulture Department

Type of action: Climate Adaptation

Climate resilience benefits: Medium

Timeline: Short to Medium term

Monitoring Indicators:

- Number of public buildings and large private developments with at least 20% rooftop area converted to green roof
- Number of awareness and training programs conducted on green roofs, vertical gardens and creeper

Good Practice:

In **Tokyo**, green roofs are mandated for private buildings with a built-up area exceeding 1,000 m^2 and for public buildings larger than 250 m^2. Additionally, integrated green roofs are required to cover at least 20% of the total rooftop area.

Strategy 3 - Financing Modes/Sources

APCRDA and State budget, AMRUT 2.0, 15th FC, CSR funds

Strategy 4: Strengthen governance and community stewardship

Proposed Actions

Action 1: Institutionalize biodiversity planning and legal frameworks
Action details Establishing a robust governance and planning framework for biodiversity is essential to protect Amaravati's threatened species and habitats, mitigate flood and heat hazards, and facilitate the integration of blue–green infrastructure for a resilient and livable city. **Existing situation** Currently, Amaravati is conducting a comprehensive baseline assessment of the Krishna River's productivity and water quality. This baseline data is essential for identifying existing biodiversity patterns, detecting potential ecological impacts of urbanization, and formulating targeted interventions to protect aquatic ecosystems amid rapid planned urbanization. **Sub Actions** • Establish Biodiversity Management Committee and hold regular meetings for development, operations and management. • Prepare a Local Biodiversity Strategy and Action Plan (LBSAP) with zone-level targets and a revision of the plan every 5 years. • Update zoning and development control regulations to include minimum green cover as per URDPFI and WHO standards. **(Ongoing/Planned)**
Potential locations: City-wide
Implementing entities **Lead:** APCRDA **Supporting:** APSBB
Indicative cost: **Cost for Preparing LBSAP:** INR 25 lakhs
Type of action: Climate Adaptation
Climate resilience benefits: High
Timeline: Short term
Monitoring Indicators: • Number of Biodiversity Management Committee meetings held per year • Number of zone-specific biodiversity targets and actions formulated in the LBSAP completed within the plan period • Percentage of development projects complying with minimum green cover requirements
Good Practice: **Kochi** city became the first city in India to develop a scientifically informed and participatory Local Biodiversity Strategy and Action Plan (LBSAP). Kochi's LBSAP was designed to mainstream biodiversity conservation into urban planning by setting 29 specific goals that fall under nine focus areas across critical areas, including islands, lakes, green spaces, and wetlands. The plan incorporated extensive stakeholder

consultations at the zonal and city levels, mapped key ecosystems, and established targeted interventions, including the desilting of all inland water bodies, the establishment of decentralized sewage treatment plants, and shoreline conservation to enhance ecosystem services and climate resilience. LBSAP has guided the Kochi local government to safeguard biodiversity while supporting sustainable urban growth and resilience.[85]

Action 2: Establish monitoring systems using the City Biodiversity Index (CBI) and technology

Action details

The CBI, or Singapore Index on Cities' Biodiversity, is a self-assessment tool for cities that helps a greenfield city like Amaravati measure and monitor its biodiversity efforts over time. The data collected through the CBI, particularly during the construction phase, provides baseline data for tracking ecosystem health, species diversity, and habitat quality. Conducting the CBI assessment is essential for developing an LBSAP, as it allows for the necessary data to inform and guide the LBSAP.

Sub Actions

- Use the CBI to track progress on ecological indicators every 5 years.
- Implement tree-tagging with QR codes, GPS enabled plantation monitoring and AI-based tree health tracking.
- Develop, maintain and periodically update the People's Biodiversity Register
- Publish an open-data dashboard for public tracking of tree plantations, wetlands restored, and carbon sinks created.

Potential locations: City-wide

Implementing entities

Lead: APCRDA

Supporting: APSBB, Technology Service Provider, NGOs/ CSOs, Research Organizations

Indicative cost:

Cost for Developing CBI: INR 15 lakhs

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short term

Monitoring Indicators:

- Number of newly planted and existing trees tagged
- Number of PBR updates per year
- Analysis of the overall CBI score compared to the previous assessment

Good Practice:

Hyderabad City Biodiversity Index tracks 23 ecological indicators and guides green space planning.

[85] ICLEI South Asia. (2020). Local Biodiversity Strategy and Action Plan for Kochi Municipal Corporation. Prepared under the BMU supported INTERACT-Bio project.

In 2020, **Kochi** became one of the first cities in India to develop a baseline CBI report, scoring a total of 45 out of 72 for the 18 indicators. The CBI revealed that the city's significant backwater area highly contributed to its native biodiversity score. The assessment identified that despite Kochi's rich biodiversity, it faces mounting challenges from urbanization and population growth that are threatening its green spaces and ecosystems. The findings highlighted the need for interventions to protect biodiversity, increase green cover and strengthen its governance mechanisms. Using the CBI monitoring tool, Kochi has aligned its projects and budgets with the biodiversity priorities outlined in the LBSAP.

Action 3: Promote public participation, education and stewardship

Action details

The suggested action to promote public participation and education in nurturing a biodiversity-friendly culture is essential for Amaravati to become climate-resilient.

Sub Actions

- Build the capacity of city planners, engineers, horticulture teams, and RWAs on biodiversity-friendly practices.
- Launch city-wide "My Tree" campaign with citizen tree adoption and rewards.
- Establish eco-volunteer networks in each township to maintain parks, report encroachments and support greening.
- Organize monthly biodiversity walks, plantation drives, etc
- Introduce a "Green Scorecard" system to rate layouts, RWAs and institutions.

Potential locations: City-wide

Implementing entities

Lead: APCRDA

Supporting: APG&BC, APSBB, Horticulture Dept, Educational Institutions, RWAs, NGOs/ CSOs, SHGs, Residents

Type of action: Climate Adaptation

Climate resilience benefits: High

Timeline: Short to Medium term

Monitoring Indicators:

- Identify and monitor the number of projects required for biodiversity practices
- Number of trees adopted by citizens

Good Practice:

Toronto's Local Enhancement and Appreciation of Forests (LEAF) organization has established an Adopt-A-Street-Tree program for promoting urban forestry by engaging community members directly in tree stewardship. The program successfully addresses the post-planting survival and health of street trees by mobilizing residents and businesses to help with monitoring and maintenance. LEAF provides the initial

tree planting and necessary educational resources, while community adopters commit to tasks such as watering, weeding, litter removal, and monitoring the tree's health.[86]

Strategy 4 - Financing Modes/Sources
APCRDA and State budget, 15th FC, CSR funds

[86] Thacker, M. (2018). LEAF's Adopt-A-Street-Tree program: Impacts on urban tree health and the driving social factors of community-based urban forest stewardship. University of Toronto.

2.8 Health

Baseline Status (2025)	**Key Statistics:** Amaravati's capital city area lacks primary health centres (PHCs) within its administrative boundary. Residents currently depend on nearby urban centres such as Mangalagiri, Guntur, and Vijayawada for medical services.[87]
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • National Health Policy 2017 • National Urban Health Mission (NUHM) • Ayushman Bharat **State/Local Policy/Programme/Targets:** • Andhra Pradesh Health Systems Strengthening Project. **City Policy/Programme/Targets:** • >40 hospital beds per 10,000 population, supported by three multi-specialty hospitals in the initial 10 years. • 5–10 minute emergency response time through township-level health centres. • 300 acres of reserved public health land supporting primary and secondary care. • A 24×7 Health Command and Control Centre with telemedicine and digital monitoring for real-time response and disease surveillance.
Opportunities and Gaps	• Potential to establish model PHCs that leverage telemedicine and digital health platforms to serve both urban and peri-urban populations. • Dependence on neighbouring cities like Mangalagiri, Guntur, and Vijayawada for medical services leads to delayed treatment and overburdening of regional hospitals. • Regulatory and digital infrastructure gaps may hinder private sector participation and telemedicine scale-up.
Climate Risk	**Climate Risk Status**: Medium • High-intensity rainfall can lead to flooding and water stagnation, increasing water-borne and vector-borne diseases through contaminated water and mosquito breeding.

[87] Based on Focused Group Discussion conducted with existing settlements.

	• Rising temperatures elevate the risk of heat-related illnesses, such as heat strokes, particularly affecting vulnerable populations in slums and outdoor workers.
SDGs	GOAL 3: Good Health and Well-being, GOAL 6: Clean Water and Sanitation, GOAL 7: Affordable and Clean Energy, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action

Climate Strategies, Actions and Targets

Strategy 1: Dust and emissions control during construction and infrastructure development.

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Accessibility of health services for all communities	All health care facilities should be within 1km	100%	100%	100%
Monitor climate-sensitive diseases and pandemics	Readiness to deal with extreme climate events, vector and water borne diseases	100%	100%	100%

Proposed Actions

Action 1: Accessibility of health services for all communities

Action details

Ensuring equitable access to health services across Amaravati by planning PHCs and health centres within 1km of residential zones, prioritized underserved and vulnerable areas. Emphasizes climate-resilient, barrier free, and transit accessible facilities to serve vulnerable populations effectively.

Sub Actions:

- Plan health centers within 1km of all residential zones **(Ongoing/Planned partly)**
- Prioritize underserved areas, including heat and flood-prone areas and informal settlements.
- Establishing regulations and guidelines to ensure the development of healthcare facilities that are well-prepared to withstand and effectively respond to the impacts of climate change on public health.

- Healthcare facilities should be set up in areas that are easily accessible by the urban poor, that is, within the range of public transport facilities and should not be inaccessible due to flooding or other hazards.
- Provide barrier free access for persons with disabilities, elderly and pregnant women.

Implementation agency

Lead: APCRDA

Supporting: Medical and Family Welfare Department, Private Hospitals

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide with focus on flood-prone and heat-impacted areas. Especially near to Pichukalapalem, Dondapadu, Ananthavaram, Velagapudi, Venkatapalem, Krishnayapalem, Sakamuru, Nowluru, Yerrabalem and Neerukonda

Monitoring indicators:

- Percentage of population within 1km of a primary health centres
- Number of PHCs/ health centres established in underserved/ climate risk prone areas.

Good practice:

Bhubaneswar, under smart health Initiative, developed accessible urban health centres within 1 km radius in all wards, integrating GIS-based planning to serve slum and vulnerable communities. This model ensured universal health coverage under the Smart City Mission

Action 2: Develop and implement a citywide Heat Action Plan (HAP)

Action details

The HAP aims to safeguard residents from extreme heat by mapping heat-prone areas, issuing early warnings, and conducting outreach for vulnerable groups. It integrates urban cooling interventions such as cool roofs and shaded public spaces

Sub Actions:

- Map heat-prone areas using land surface temperature data from satellite imagery combined with perspective surveys with the residents.
- Establish early warning systems for extreme heat events, integrated with emergency response protocols.

- Design targeted outreach for high-risk groups such as elderly, outdoor workers, pregnant women, children and people in informal settlements.
- Promote cool roofs, green roofs, shaded public spaces as suggested in Built Environment sector **(Ongoing/Planned)**

Implementation agency

Lead: APCRDA

Supporting: APSDMA, Research Organizations

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide with focus on high temperature villages - Pichukalapalem, Dondapadu, Ananthavaram, Velagapudi, Venkatapalem

Monitoring indicators:

- Existence and periodic update of city Heat Action Plan
- Number of early warnings issued before heatwave events
- Percentage of high-risk areas mapped and targeted with awareness campaigns
- Number of citizens reached through awareness campaigns

Good practice:

Ahmedabad Heat Action Plan is the first city-level HAP in South Asia, successfully reducing heat-related mortality through early warnings, public awareness and targeted interventions in vulnerable areas

Action 3: Enhance heat, air quality and flood resilience of public health infrastructure

Action details

Retrofitting and designing healthcare facilities for climate resilience with cool roofs, passive ventilation, renewable energy backup, and flood-proofing measures.

Sub Actions:

- Retrofit all health facilities with cool roofs, passive ventilation, and climate appropriate shading.
- Ensure uninterrupted water supply, renewable-powered backup system, accessible toilets and safe waste management system
- Install vegetative barriers and shaded waiting areas in healthcare premises located in degraded air quality zones or near traffic corridors.

- Elevate new facilities above design flood levels and integrate waterproofing, raised electrical systems, and resilient drainage in flood-prone sites. **(Ongoing/Planned)**
- Create safe access routes to health facilities during floods, with priority to serving heat and flood-prone settlements or areas.
- Establish mobile medical units and telemedicine kiosks as backup service delivery modes during periods of disrupted physical access.
- Maintain pre-positioned emergency medical and sanitation supplies at facility and ward/ village levels before the start of heatwave or flood season.

Implementation agency

Lead: APCRDA, Medical and Family Welfare Department

Supporting: APG&BC

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide with focus on flood-prone and heat-impacted areas. Especially near to Pichukalapalem, Dondapadu, Ananthavaram, Velagapudi, Venkatapalem, Krishnayapalem, Sakamuru, Nowluru, Yerrabalem and Neerukonda

Monitoring indicators:

- Percentage of health facilities retrofitted with cool roofs, solar backup and passive ventilation
- Number of mobile health units operational during climate emergencies
- Number of service disruption days during flood events.

Good practice:

In Kerala, primary health centres were rebuilt with elevated plinths, solar backup, and improved sanitation systems after 2018 floods, ensuring uninterrupted services during monsoon emergencies

Action 4: Ensure sanitation and disease prevention in climate-sensitive areas.

Action details

Promotes climate-resilient sanitation, vector control, and hygiene measures to reduce disease outbreaks post heat and flood events.

Sub Actions:

- Install climate-resilient sanitation facilities in all public health centres and community shelters.

- Conduct seasonal vector control drives in heat and flood-prone areas.
- Promote safe water storage and community hygiene campaigns before and after flood season

Implementation agency

Lead: APCRDA, Medical and Family Welfare Department

Supporting: SHGs, NGOs

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide with focus on flood-prone and heat-impacted areas. Especially near to Pichukalapalem, Dondapadu, Ananthavaram, Velagapudi, Venkatapalem, Krishnayapalem, Sakamuru, Nowluru, Yerrabalem and Neerukonda

Monitoring indicators:

- Percentage of health facilities with climate-resilient sanitation systems
- Number of seasonal vector-control and water-quality campaigns conducted
- Percentage of households reached with hygiene and safe water awareness drives
- Incidence rate of water- and vector-borne diseases (yearly trend)
- Percentage of flood shelters equipped with sanitation facilities

Good practice:

Odisha's Community-Led Total Sanitation (CLTS) Model empowered SHGs and local communities to maintain hygiene and safe sanitation in flood-prone areas, reducing diarrheal and vector-borne diseases significantly during monsoon seasons.

Action 5: Monitor climate-sensitive diseases and pandemics

Action details

Establishes an integrated disease surveillance system to monitor vector-borne, water-borne, and climate-linked illnesses in real time, enabling early detection and rapid response.

Sub Actions:

- Establish a disease surveillance system integrating local clinics, hospitals and public health labs.
- Track water-borne, vector-borne, health-related illnesses in real time in the city, including village settlements.

- Develop rapid response protocols for outbreaks and pandemics with a dedicated health emergency team.

Implementation agency

Lead: APCRDA, Medical and Family Welfare Department

Supporting: Private Hospitals & Clinics, NGOs

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide with focus on flood-prone and heat-impacted areas. Especially near to Pichukalapalem, Dondapadu, Ananthavaram, Velagapudi, Venkatapalem, Krishnayapalem, Sakamuru, Nowluru, Yerrabalem and Neerukonda

Monitoring indicators:

- Percentage of clinics and hospitals integrated into the reporting network
- Number of alerts issued and response actions activated per year
- Response time between outbreak detection and intervention

Strategy 1 - Financing Modes/Sources

State budget, CSR funds

Strategy 2: Strengthen health governance and capacity for climate adaptation

Proposed Actions

Action 1: Integrate climate risk into health sector planning and regulation

Action details

Ensuring all new healthcare facilities meet climate-resilient design standards, including flood safety, renewable energy, and sanitation provisions

Sub Actions:

- Enforce regulations requiring all new healthcare facilities to meet climate-resilient design standards.
- Prioritise facility location in accessible areas served by public transport and safe from flooding.
- Include provisions for renewable backup power and sanitation.

Implementation agency

Lead: Medical and Family Welfare Department

Supporting: APCRDA

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of new health facilities meeting climate-resilient design standards

Action 2: Capacity building for health professionals

Action details

Focuses on training doctors, nurses, and sanitation workers on managing climate-induced health risks and emergency response for heatwaves, floods, and disease outbreaks.

Sub Actions:

- Train healthcare professionals to identify and manage climate-related health risks.
- Provide refresher courses on emergency response for heatwaves, floods, air pollution and disease outbreaks.
- Build capacity among sanitation workers for disease prevention and safe waste handling during climate emergencies.

Implementation agency

Lead: APCRDA

Supporting: APCRDA, NGOs/ CSOs, Academic Institutions

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Number of health professionals trained on climate-health linkages
- Frequency of emergency response refresher courses conducted annually
- Percentage of sanitation workers trained in safe waste management
- Percentage of hospitals conducting mock drills for heat/flood response

Action 3: Community engagement and awareness

Action details

Encourages citizen participation through awareness campaigns, evacuation drills, and volunteer networks for early reporting of disease outbreaks in high-risk areas.

Sub Actions:

- Establish climate health awareness programs in schools, urban villages and market areas.
- Conduct drills for emergency evacuation and medical response in high-risk zones.
- Encourage community-based volunteers to report early signs of disease outbreaks.

Implementation agency

Lead: Medical and Family Welfare Department

Supporting: APCRDA, NGOs/CSOs, RWAs, Fire Department, APSDMA

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Number of community awareness programs and school outreach sessions held annually
- Percentage of high-risk wards conducting emergency evacuation drills
- Number of active community health volunteers per 1,000 population.

Action 4: Monitoring, evaluation and reporting

Action details

Establish a Climate Health Dashboard to integrate disease data, air quality monitoring, and climate alerts, facilitating evidence-based health advisories and periodic reviews.

Sub Actions:

- Set up a centralised Climate Health Dashboard to track heat, flood and air pollution-related illnesses.
- Link continuous air quality monitoring stations with the command control centre and the health database.
- Issue health advisories during poor air quality episodes, focusing on sensitive groups.
- Release seasonal climate health bulletins for public and policy use.
- Review and update health and sanitation policies every 5 years

Implementation agency

Lead: APCRDA, Medical and Family Welfare Department

Supporting: NGOs/CSOs

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: High

Potential locations: Citywide

Monitoring indicators:

- Frequency of published climate-health bulletins (quarterly/seasonal)
- Number of health advisories issued for poor air quality or heat eventIncidence rate of water- and vector-borne diseases (yearly trend)

Good practice:

In **Tamil Nadu,** A state-of-the-art One Health and Climate Change centre is being set up at the State level, and this system will ensure real-time data collection, analysis, and reporting to track the incidents of diseases exacerbated by climate change, such as zoonotic diseases, vector-borne diseases, heat stress, and respiratory illnesses,etc. The integration of this data will inform resource allocation, healthcare infrastructure, and policymaking, enabling proactive interventions. Additionally, this data will support the development of predictive models and enhance district-level capacity for responding to climate-induced health risks.

Strategy 2 - Financing Modes/Sources

State budget, CSR funds

2.9 Air Quality Management

Baseline Status (2025)	**Key Statistics:** Annual concentration of PM 10 is 65.22 µg/m^3. Annual concentration of PM 2.5 is 32.15µg/m^3. AQI levels in Amaravati fall under satisfactory and good for about 82% of the days from 2020 to 2024.
Existing Policy, Plans and Initiatives	**National Policy/Programme/Targets:** • National Clean Air Programme. • Construction and Demolition Waste Management Rules, 2016. **State/Local Policy/Programme/Targets:** • NGT and EC guidelines for dust and emissions control during the construction phase
Opportunities and Gaps	• Only one AQQMS is installed at the AP secretariat for AQI monitoring. • Planned infrastructure construction activities in the city can increase the concentration of particulate matter. • The health of the existing villagers and construction labourers needs to be taken care of during the immediate construction phase.
SDGs	GOAL 3: Good Health and Well-being, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 15: Life on land.

Climate Strategies, Actions and Targets

Strategy 1: Dust and emissions control during construction and infrastructure development.

Proposed Targets

Action Area	Target Parameter	2028	2043	2058
Real-time air quality monitoring	Large construction sites (>20,000 sq.m) with live air quality monitoring.	100%	100%	100%

Action Area	Target Parameter	2028	2043	2058
Dust and emission control	Large sites using dust and emission control measures as per protocol.	100%	100%	100%

Proposed Actions

Action 1: Enforce robust dust suppression and containment protocols

Action details

Implement multiple measures to minimise the spread of particulate matter from source locations to adjacent areas and during material transportation. Precautionary and suppression measures are to be enforced to keep PM concentration within safe limits.

Sub Actions:

- Use of windshield of adequate height (minimum 3m height or 1/3rd of building height, maximum up to 10m) in all construction sites.
- Use green netting or dust-proof sheets on all scaffolding to control dust emissions during construction and demolition. **(Ongoing/Planned)**
- Deploy anti-smog guns/mist cannons at least three times daily, with continuous operation during periods of high wind. **(Ongoing/Planned)**
- Reuse treated wastewater from sewage treatment plants to operate anti-smog guns/mist cannons and minimize freshwater use.
- Cover excavated material using tarpaulin or green mesh, store fine materials indoors or under non-permeable covers.
- Enclose cutting, grinding, drilling and sawing in covered, ventilated enclosures.

Implementation agency

Lead: APCRDA

Supporting: APPCB

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of construction sites installed with windshields.
- Percentage of construction sites using treated wastewater for dust suppression.

Good practice:

The Commission for Air Quality Management in NCR Delhi has mandated sprinklers, anti-smog guns, and scaffolding netting for all registered C&D sites. Continuous mist cannons during windy periods reduced airborne dust, supporting the Graded Response Action Plan (GRAP) compliance.

Action 2: Deploy real-time air quality monitoring and site surveillance systems

Action details

Real-time monitoring of air quality through a continuous decentralised network of monitors helps collect localised data and identify when the air quality deteriorates, enabling alerts for immediate safety measures.

Sub Actions:

- Install real-time pollutants monitoring sensors (for PM1, PM2.5, PM10, PM100) for large sites (such as size >20,000 sq. m) and connect to Command & Control Centre dashboard.
- Maintain calibration logs and ensure uninterrupted data transmission at sub-hourly intervals (every 15 minutes)
- Reflect real-time air quality data on display boards at construction sites for transparency.

Implementation agency

Lead: APCRDA

Supporting: APPCB

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of construction sites installed with real-time pollutants monitoring sensors.
- Percentage of installed pollutants monitoring sensors integrated with CCC.
- Percentage of construction sites installed with display boards.

Good practice:

Swati 18, an under-construction business centre in Ahmedabad, has installed PM1-PM10 sensors connected to a live dashboard with a public display. Triggered misting and rescheduled high-dust activities based on the sensors' data, maintaining compliance with Ahmedabad Municipal Corporation's construction dust control guidelines.

Action 3: Strengthen material handling, storage and transport regulations

Action details

Transporting C&D waste from the source to collection and treatment facilities must follow specific measures to suppress the spread of particulate matter. Once the material reaches the processing facility, it should be stored properly, with coverings or suppression measures in place to help maintain a better AQI around the facilities.

Sub Actions:

- Pave all internal haul roads, maintain dust-free surfaces.
- Cover all material transport vehicles with tarpaulin and enforce restrictions on overloading.
- Install wheel wash or tire wash systems at large sites, with use of treated wastewater where feasible.
- Dispose C&D waste at designated collection or processing facilities promptly (such as within 48 hours of generation).

Implementation agency

Lead: APCRDA

Supporting: APPCB

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of large construction sites installed with tire wash systems.

Good Practice

In **Chandigarh**, the municipal corporation established a Construction & Demolition Waste Recycling Plant at the Industrial Area to ensure regulated collection, covered transport, and scientific storage of debris. Internal haul roads were paved, vehicle washing was mandated, and processed material was reused in city works.

Action 4: Adopt low-emission construction machinery and power solutions.
Action details Adoption of the latest technology in construction activities, especially in non-preventive tasks that reduce fossil fuel consumption, can help improve air quality. Additionally, preventing increased vehicle pollution due to outdated technology and poor maintenance is a necessary step to avoid deterioration of air quality. **Sub Actions:** • Only allow Bharat stage complaint construction equipment on-site. • Fit all DG sets with particulate filters, acoustic enclosures and comply with noise and emissions norms prescribed by MoEF&CC in Environment (Protection) Rules. • Prioritise grid-based power supply for construction sites, incentivize battery or hybrid generator sets. • Maintain a preventive maintenance schedule for all machinery.
Implementation agency **Lead:** APCRDA **Supporting:** APPCB
Type of action: Climate Adaptation
Timeline: Short term
Climate resilience benefits: Medium
Potential locations: Citywide
Monitoring indicators: • Percentage of DG sets complies with noise and emissions norms.
Good Practice: In **Delhi**, for large scale projects, only Bharat Stage–VI compliant excavators, cranes and loaders were permitted on site. All DG sets were retrofitted with diesel particulate filters and acoustic enclosures per MoEF&CC norms, and the contractor employed hybrid gensets with priority to grid power.

Action 5: Implement specific measures for ready-mix concrete plants.
Action details The expected increase in both the number and scale of constructions will lead to the growth of ready-mix concrete plants. These plants, where construction materials will be stored and used in larger quantities,

need to implement measures to reduce particulate matter spread and maintain buffer zones from other public areas.

Sub Actions:

- Barricade or cover batching areas.
- Install dust collectors/ bag filters for silos, cover conveyor belts.
- Use sprinklers and windbreak walls around stockpiles.
- Pave all vehicle movement paths within the plants.

Implementation agency

Lead: APCRDA

Supporting: APPCB

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of plants that maintain barricades.
- Percentage of plants maintaining a green buffer on their boundaries.
- Percentage of plants where AQI falls below the acceptable levels in a month.

Good practice:

Nyati Group, a real estate developer based in Pune, has installed bag filters, covered conveyors, paved plant roads, and automated sprinklers for stockpiles. Additionally, the deployed advanced, weatherproof air quality monitors for real-time data monitoring. Fugitive dust fell by 28%, meeting MPCB standards.[88]

Action 6: Mandate comprehensive construction environmental management plans.

Action details

Construction sites are potential sources of particulate matter, air quality management plans should be included in building permission approval requirements, focusing on reducing pollutant levels and ensuring site owners and contractors take responsibility for effective enforcement.

[88] Transforming Air Quality at construction sites

Sub Actions:

- Mandate CEMP submission and approval as a precondition for all building permits of large sites (such as area >5,000 sq. m).
- CEMP shall include site-specific dust suppression measures, waste management and vehicle cleaning protocols, air quality monitoring, and contingency plans for high AQI days.
- Nominate a Site Air Quality Officer for each large construction project to oversee compliance and maintain daily logs.
- Submit monthly compliance reports to the concerned authority or department at APCRDA.

Implementation agency

Lead: APCRDA

Supporting: APPCB

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of construction sites implementing dust suppression measures.
- Percentage of construction sites submitting monthly compliance reports to APCRDA.

Good Practice:

Ahmedabad Municipal Corporation (AMC) has prepared the 'Policy on Good Construction Practices' to reduce the dust pollution from the construction sector. Policy developed based on information from RERA, around 450 sites were under construction during FY 2021-22, with more than 70% sites having built up area more than 5,000 m2. This policy includes good practices for construction sector, which needs to be followed for construction sites having more than 5,000 m2 built up area to reduce the air pollution from construction sector. This policy includes measures/ interventions including air quality monitoring, construction site surveillance and mitigation measures for dust generating sources (including demolition; cutting; crushing; drilling; excavation; operation of RMC plant; material handling, storage and transfer; use of mist machine etc.)

Strategy 1 - Financing Modes/Sources
State and APCRDA budget, NCAP funds

Strategy 2: Integrate air quality resilience into urban and building design

Proposed Actions

Action 1: Establish air filtration and ventilation standards for public buildings, schools and hospitals.

Action details

Adoption of air filters in public and other buildings where vulnerable groups are present during the daytime to reduce the impact, as air quality is often beyond permissible levels, especially during winter months, and with anticipated construction projects.

Sub Actions:

- Mandate Minimum Efficiency Reporting Value (MERV)-13/ High Efficiency Particulate Air (HEPA) filtration in all new public buildings, schools and hospitals.
- For naturally ventilated public buildings, install filtered fresh air inlets.

Implementation agency

Lead: APCRDA

Supporting: APPCB

Type of action: Climate Adaptation

Timeline: Short term

Climate resilience benefits: Medium

Potential locations: Citywide

Monitoring indicators:

- Percentage of public buildings, schools and hospitals installed with air filters.

Action 2: Implement worker and community protection measures.

Action details

On days with poor AQI, altogether avoiding activities can disrupt the livelihoods of daily wage workers. Implementing safety measures can help reduce the impact on health, and the APCRDA should monitor periodically on these days and property owners should be involved in enforcing safety precautions.

Sub Actions:

• Supply N95/ P2 masks to all outdoor municipal or construction workers on poor AQI days. **(Ongoing/Planned)** • Schedule work shifts to avoid peak dust hours, install shaded, ventilated rest shelters. • Ban biomass burning in worker camps, ensure LPG/PNG/ electric cooking facilities as feasible.
Implementation agency **Lead:** APCRDA **Supporting:** APPCB
Type of action: Climate Adaptation
Timeline: Short term
Climate resilience benefits: Medium
Potential locations: Citywide

Action 3: Design and maintain vegetative buffers and include provision for pollution-suppression infrastructure.
Action details Using the greenery as buffer space along the road network and special development zones helps in minimising the spread of particulate matter to the adjacent areas. **Sub Actions:** • Develop multi-row native tree buffers along highways, construction corridors and logistics hubs. • Use vegetated verges and permeable paving to reduce dust re-suspension and improve air quality.
Implementation agency **Lead:** APCRDA **Supporting:** APPCB
Type of action: Climate Adaptation
Timeline: Short term
Climate resilience benefits: High
Potential locations: Citywide

Monitoring indicators:

- Percentage of high traffic volume roads and logistic corridors with vegetative buffers.

Good practice:

Delhi - In the Delhi Metro Rail Corporation (DMRC) projects, vegetative buffers (grass verges, shrubs) were planted along excavated edges and combined with periodic water spraying / dust-cannon systems to suppress fugitive dust. This combined "green + mechanical" buffer reduced downwind PM_{10} exposures by 20–25 %.

Strategy 2 - Financing Modes/Sources

State and APCRDA budget, NCAP funds

Strategy 3: Establish strong governance, enforcement and adaptive management for air quality

Proposed Actions

Action 1: Setup and operationalize a Construction Air Quality Management Cell or Unit

Action details

Continuous monitoring of various activities and on-site inspections are crucial because enforcement failures often happen when construction workers are unaware of the long-term health effects of air quality. The efficacy of sensors installed at construction sites must be regularly verified through inspections.

Sub Actions:

- Establish a dedicated construction Air Quality Management Team/Cell under APCRDA.
- Deploy a trained inspection team with jurisdiction over all active construction zones, capable of issuing on-spot fines and blacklisting non-complaint contractors.
- Undertake periodic source apportionment studies using advanced receptor modelling techniques to identify and quantify key contributors to air pollution (e.g., transport, road dust, industry, construction, biomass burning)
- Integrate air quality data with command control centre for 24/7 data feed from dust sensors, CCTV, metrological station and air quality monitoring sensors.
- Maintain a dashboard showing live air quality data, inspection results, and enforcement actions, accessible to decision makers and the public.

Implementation agency

Lead: APCRDA

Supporting: APPCB
Financing Sources/ Modes APCRDA funds, NCAP funds.
Type of action: Climate Adaptation
Timeline: Short term
Climate resilience benefits: High
Potential locations: Citywide
Monitoring indicators: • Number of inspections carried out by the team/cell in a month. • Percentage of non-compliant construction sites identified out of total inspections in a month.

Action 2: Implement a city-wide AQI linked adaptive construction response protocol

Action details

Dissemination of information when the air quality is identified as moderate or lower, to prevent impacts on health. Depending on the information communicated to on-site personnel, they can immediately instruct the working groups to use safety precautions or schedule modifications.

Sub Actions:

- Maintain a graded AQI response system tailored to construction phase conditions.
    - **Moderate**: Maintain standard dust suppression, ensure covered storage and transport, and restrict biomass burning.
    - **Poor**: Increase misting frequency, limit material transfer during windy hours, and inspect all active sites for compliance
    - **Very Poor**: Halt earthworks and concrete batching in open areas, restrict truck movement to night hours and require all sites to operate only enclosed cutting/ drilling stations
    - **Severe**: Temporarily stop all non-essential construction, relocate school activities indoor, activate community clean air shelters.
- Deploy automated AQI-triggered alerts to contractors, site managers, APCRDA field teams, schools and health facilities via SMS/ social media.
- Integrate AQI response protocols into all public works tenders and private project environmental management plans.

• Maintain a multi-year compliance archive to track trends, inform mid-course policy adjustments and ensure accountability across construction project timelines.
Implementation agency **Lead:** APCRDA **Supporting:** APPCB
Type of action: Climate Adaptation
Timeline: Short term
Climate resilience benefits: High
Potential locations: Citywide
Monitoring indicators: • Percentage of days in a month that air quality records are monitored and recorded. • Percentage of moderate or below air quality days communicated to contractors and site managers. • Percentage of construction sites communicated for a poor air quality alert.
Good practice: Delhi, under the GRAP protocol, enforces graded AQI-based restrictions ranging from increasing the misting frequency to halting earthworks and activating clean-air shelters with automated alerts to contractors and schools.

Strategy 3 - Financing Modes/Sources
State and APCRDA budget, NCAP funds

3 Governance and Implementation of Climate Change Action Plan

Amaravati has set an ambitious vision to become a climate-resilient city and achieve low-emission development. To achieve this target, APCRDA needs to enhance collaboration among key stakeholders and develop a robust governance, monitoring, and verification framework to achieve the sectoral targets set in the CCAP, and sustain the benefits for the long term. This chapter outlines the key steps that APCRDA and stakeholders must take to enhance governance, monitoring, and verification, thereby facilitating the effective and timely implementation of proposed climate mitigation and adaptation actions.

3.1 Effective Governance for CCAP Implementation

Having enabling governance structures and coordination mechanisms in place to ensure effective implementation and monitoring of the climate actions of Amaravati's CCAP is important. APCRDA can establish an institutional structure such as a dedicated Climate Core Team[89] to oversee and ensure the strategic execution and implementation of its CCAP. It can be supported by a Stakeholder Committee that brings together multi-stakeholders to ensure inter-agency coordination, partnerships, and help incorporate local expertise to operationalise joint efforts on climate action and achieve intended objectives and targets of the CCAP.

The key responsibilities of the proposed Climate Core Team or Climate Cell include:

1. **Establish a Climate Core Team or Cell within APCRDA:**

A Climate Core Team or Cell can be established within APCRDA, with it being chaired and headed by the Commissioner and Additional Commissioner. It can include key departments handling Urban Services Infrastructure, Planning, Urban Greening and Environment, Economic Development, and Housing and infrastructure planning and development in the LPS zones from APCRDA and ADCL. The proposed Team or Cell shall be responsible for CCAP implementation, monitoring, and reporting, with strategic guidance from the Principal Secretary of MA&UD, the Commissioner & Director of Municipal Administration, to ensure the successful implementation of the CCAP and align with the state's target of net-zero emissions by 2047.

Based on evolving urban governance institutional arrangements in Amaravati, the composition of the Climate Core Team or Climate Cell can be revisited to have representation of all relevant departments involved in day-to-day urban service delivery and governance in the city.

- **Strategic Alignment and Planning**
    - Oversee, guide, and coordinate the planning and implementation of the CCAP.
    - Periodically review state-level initiatives such as Swarna Andhra 2047 Vision and Master Plan for the larger capital region to identify strategic climate and sustainability interventions and projects.
    - Ensure alignment of CCAP actions with key national and state policies[90], programs, and schemes such as National Clean Air program (NCAP), Urban Challenge Fund, AMRUT, SBM, and EV policies.

[89] The Climate Core Team is responsible for overseeing the preparation, execution and implementation of the city's climate action plan
[90] Swarna Andhra@2047, AP Integrated Clean Energy Policy, AP Industrial Development Policy, AP Tourism Policy , AP Sustainable Electric Mobility Policy, AP Private Industrial Parks Policy, AP Electronics Manufacturing Policy, AP Data Center Policy

- Facilitate integration of climate initiatives into the city's development plans[91], policies and budgetary frameworks.
- Promote inclusive and gender-balanced approaches to climate planning and project design.

- **Institutional Coordination and Governance**
  - Ensure inter-departmental engagement, communication, and collaboration with the departments and stakeholders involved in the Climate Core Team and Stakeholder Committee for cross-sectoral coordination on climate action implementation.
  - Facilitate regular inter-departmental and stakeholder meetings on CCAP implementation
  - Coordinate with the State Climate Change Centre for Cities[92] to ensure alignment with state-wide climate initiatives and access to technical support.
  - Support relevant APCRDA and ADCL departments in preparing short-term departmental action plans under the CCAP and integrating them into regular planning and operations.
  - Conduct regular consultations with external experts, agencies, and institutions to gain insight on sectoral priorities and best practices.
  - Ensure representation of vulnerable & marginalized groups in planning and decision-making

- **Implementation and Action Delivery**
  - Develop and implement targeted strategies, programs, and projects to address climate risks and promote sustainability across sectors.
  - Conceptualize climate resilience projects, prepare feasibility analyses, and establish implementation frameworks to attract national, private sector and international funding.
  - Facilitate adoption of innovative and climate-sensitive financing mechanisms, including mobilization of local resources, i.e., CSR/CER funds.
  - Ensure timely and effective implementation of climate actions identified under the CCAP.

- **Monitoring, Evaluation, and Reporting**
  - Monitor and evaluate the progress of climate actions using relevant Key Performance Indicators (KPIs) as identified.
  - Compile periodic reports tracking KPIs for GHG reduction and resilience. Maintain a dashboard for CCAP progress transparency.
  - Review and update Amaravati's GHG emissions inventory and Climate Risk and Vulnerability Assessment once every three to five years.
  - Report on progress of CCAP implementation in adherence to national and state-level climate change frameworks and reporting mechanisms.
  - Participate in global climate action reporting platforms such as Global Covenant of Mayors (GCOM) and engage in peer-to-peer learning to adopt international best practices.
  - Apprise departments and stakeholders on CCAP progress and achievements.
  - Conduct periodic stakeholder perception surveys on CCAP effectiveness and inclusive governance
  - Review and update the CCAP, at least once every 5 years through engagement with departments and stakeholders.

[91] Capital City Master Plan, Zoning Regulations, Sectoral Master Plan, Urban greening policy, Streetscape guidelines, Disaster Management Plan, Mobility Plan, Flood mitigation plan

[92] Andhra Pradesh through the Municipal Administration & Urban Development (MA&UD) Department has established a 'State Climate Centre for Cities' under MoHUA's CITIIS 2.0 program (State Component 2)

- **Data and Knowledge Management**
    - Establish and maintain a centralized climate data portal to support decision-making and performance tracking.
    - Analyze city-wide data to identify trends, risks, and opportunities for course correction.
    - Conduct climate research and promote knowledge-sharing within and across departments and partner institutions.
    - The city may strengthen some additional socio-economic indicators including income distribution/levels across different sections, local migration and inequality aspects as possible.
- **Awareness, Capacity Building, and Partnerships**
    - Promote environmental education and awareness through sensitization programs and IEC (information, education, and communication) campaigns.
    - Identify capacity gaps among the implementation entities across sectors and partner with knowledge partners for training and building capacity among APCRDA staff and stakeholders for designing and implementing appropriate climate action projects.
    - Build strategic partnerships and mobilize support and funding from multiple sources to enable climate action.
    - Provide tools, resources, and guidance to internal departments and external stakeholders on sustainable and climate-resilient practices.
    - Set up recognition and reward mechanisms for CCAP champions and successful initiatives by APCRDA, public departments, and stakeholders.

2. Mainstream the 'Climate Resilient Infrastructure'[93] framework into Amaravati infrastructure planning processes.

Incorporate the 'Climate Resilient Infrastructure' framework into Amaravati's planning processes by embedding climate risk and GHG footprint considerations into project identification, design approval, tendering, and operations and maintenance (O&M) phases. This framework is essential to safeguard Amaravati from the anticipated impacts of climate change. The Climate Core Team can prioritize CCAP-listed actions in annual and project budgets, using climate-oriented benefits to rank investments for scale-up. The CCAP identifies sector-specific projects that align well with Amaravati's urban planning goals, offering significant potential for emission reduction. For example, in the context of civil works and infrastructure development, APCRDA can leverage enabling programs and capital subsidy schemes to ensure a portion of the budget is dedicated to supporting the installation of rooftop solar PV in upcoming residential buildings.

As a greenfield capital, Amaravati anticipates increases in built-up area and space cooling demand due to prevalent weather conditions. The planning department must strictly adhere to zoning regulations and promote all capital complexes, commercial, institutional, and large residential developments to be designed as green buildings that requires less energy and promote energy efficiency, optimal resource utilization, and the adoption of renewable energy, passive design measures, heat-resistant building materials, and high efficiency appliances. The CCAP outlines these targeted actions, while noting

[93] Infrastructure is considered climate-resilient when it is planned, designed, constructed, and operated to anticipate, respond to, and adapt to changing climatic conditions.

resulting climate resilience benefits and GHG emission reductions, thereby enabling decision-makers to prioritize effective climate actions in alignment with the Net-zero Swarna Andhra target.

3. **Empower the Stakeholder Committee to ensure inclusive and systematic implementation of the CCAP.**

   The successful implementation of the CCAP requires robust collaboration across several public institutions and parastatal agencies and local stakeholders. This includes the CDMA, AP TRANSCO, NREDCAP, APCPDCL, APSECM, APSRTC, APMRC, AP Water Resources, APG&BC, Swacch Andhra, APPCB, PH&MED, DTCP, academic institutions such as SRM University, SPA Vijayawada, Acharya Nagarjuna University, and residential welfare associations, among others. These stakeholders are already mapped and participated in one-to-one and joint consultations during the CCAP development, and thereby can be readily enrolled in the Stakeholder Committee.

   The Stakeholder Committee shall act as a central platform for inclusive, participatory, and coordinated action. The Committee will play a key role in: reviewing and analyzing CCAP strategies and sector-specific interventions; prioritizing projects and actions through consensus-based decision-making; and ensuring that the implementation of climate initiatives delivers reliable, affordable, and sustainable urban services while supporting the greenfield city's economic growth.

   The Climate Core Team shall promote active partnerships with think tanks, academic institutions, technical agencies, state nodal bodies, and city network organizations to explore emerging technologies, solution trends, and best practices that can be localized for Amaravati's context. A strong emphasis should be placed on community engagement, especially the involvement of vulnerable and climate-impacted communities. Enhancing the engagement of existing village communities will foster a sense of ownership and empower community members to implement climate-resilience solutions. Including vulnerable communities in the planning and execution stages ensures their insights and needs shape the outcomes, leading to more effective and sustainable resilience strategies. Moving forward, community engagement and participatory processes should be institutionalized as key components in the update and revision phases of Amaravati's CCAP.

4. **Mainstreaming Climate action into Policy and Zoning Regulations and creating an implementation framework**

   Amaravati should embed the climate-responsive strategies outlined in the CCAP into its Zoning Regulations and Urban Design and Architectural Guidelines. This integration will guide macro and micro level planning to be climate-resilient, with climate-adaptive neighborhood designs and sustainable buildings, through working towards maintaining blue and green cover of 30% in the city by increasing the green cover through avenue plantation and network of parks which help in reducing the solar radiation absorption, reducing UHI effect, and promoting NMT, enhancing better last mile connectivity. Additionally, promoting the installation of rainwater harvesting structures and groundwater recharge pits can make buildings more sustainable, and cool roofs help in reducing the dependency on mechanical cooling systems. Further measures include working on options to achieve 100% renewable target for Amaravati energy demands such as promoting rooftop solar PV at buildings, identifying potential off-site solar and wind energy systems at an early-stage for large developments, supporting collective aggregated procurement of renewable power.

3.2 Enable Data Collection and Management

The success of every city-wide project and policy is highly dependent on a robust institutional framework and governance practices. However, for designing such projects and policies, the availability of data and information that is grounded in science, validated by subject matter experts, and informed by local communities is crucial. In the Indian context, gaps exist in standardised processes and systems for city governments to collate up-to-date and accurate datasets of their infrastructure and operations.

Establishing an Integrated Command Control Centre (ICCC)[94] for Amaravati: The ICCC should be designed as a system-of-systems that integrates data from multiple sources (such as IoT sensors, GIS data, and city databases).

Amaravati should develop and implement a robust data governance policy that defines data management protocols, data sharing mechanisms, privacy controls, and ownership responsibilities for all stakeholders. The system should maintain geo-referenced data for all city assets, ensuring that building permissions and zoning regulations are spatially mapped and continuously monitored through GIS-enabled platforms. Various cells proposed under different sectors like SCADA system for monitoring water supply and wastewater networks, early flood warning system, real-time monitoring of Solid waste processing facilities, air quality monitoring, building permission approvals should be linked with ICCC for maintaining a centralized database and conduct analysis to identify cross-sectoral implications in early stages.

The ICCC should integrate platforms such as Building Permission Management Systems with real-time monitoring capabilities to ensure adherence to zoning regulations. The system should implement Standard Operating Procedures (SOPs) for building approval processes, incorporating business rules engines that automatically flag violations or non-compliance issues. Real-time integration with drone-based monitoring systems can provide surveillance of construction activities, ensuring that approved building plans are followed and unauthorized constructions are immediately identified. The installation and integration of environmental sensors at construction sites will enable the real-time monitoring of air quality, noise levels, temperature, and humidity. Predictive analytics capabilities of ICCC will help in forecasting energy demand patterns, optimizing renewable energy distribution, and identifying opportunities for energy efficiency improvements.

ICCC should be linked with Intelligent Traffic Management Systems (ITMS) with adaptive traffic control, public transport monitoring, and parking management systems. Real-time traffic flow analysis, congestion prediction, and dynamic route optimization should be core functionalities in coordination with traffic police department. The platform should integrate with Automatic Vehicle Location Systems (AVLS) for public transport monitoring and implement dynamic messaging systems for citizen communication during traffic disruptions.

For flood, heat, and disaster risk simulation, the ICCC should receive information from environmental sensors, automatic weather monitoring systems installed and maintained by stakeholders, and should have in-house expertise to perform predictive modeling analysis. Disaster Risk Simulation and Prediction functionalities should include flood modeling based on forecasting information, topographical

[94] The ICCC Maturity Assessment Framework (IMAF) will help Amaravati city to develop standardized, scalable, and resilient ICCC systems that can effectively monitor the utilities, manage crises, support smart infrastructure, and foster real time urban governance.

data, real-time water level monitoring, and emergency response coordination systems. The platform should maintain emergency response protocols with automated alert systems, evacuation route optimization, and coordination with emergency services including fire, police, and medical response teams.

Establishing the ICCC requires recruiting subject matter experts including ICCC managers, data officers, technology experts, GIS specialists, cybersecurity experts, and domain specialists. Training and capacity-building programs should be implemented with dedicated annual budgets for continuous skill development.

To address the high operational costs of ICCC operations, Amaravati should explore public-private partnership models for ICCC operations, potentially generating revenue through data insights for urban planning and traffic optimization services.

Chandigarh city has developed an ICCC platform to support environmental and urban sustainability through technology-driven governance. The core infrastructure integrates over 25 urban services through 2,000 IP-based CCTV cameras across 285 locations, IoT sensors for air and water quality monitoring, AI-powered traffic management at 45 junctions, GPS-enabled waste collection for 489 vehicles, and SCADA systems for utility monitoring. Key outcomes include improved air quality despite rapid urbanization, 70% waste segregation rate with 40% reduction in landfill overflow, 20% reduction in non-revenue water losses, 30% reduction in groundwater use, 875,000 public bike rides reducing CO_2 emissions by 875 tonnes, 15-minute reduction in peak hour travel times, and successful management of 2023 monsoon floods through real-time monitoring and coordinated emergency response. The ICCC project demonstrates how integrated command systems can transform urban environmental management by combining real-time data analytics with community engagement, serving as a replicable model for sustainable city development across India and beyond.[95]

3.3 Monitoring and Tracking Progress

Although Amaravati CCAP is aligned with the city's ongoing infrastructure plans and projects, specific strategies and actions require a robust institutional framework and capacity to design, implement, operate, and maintain the implemented climate actions for optimal performance. This section covers aspects for effective monitoring and reporting of climate actions to be implemented in Amaravati.

a. **Institutional Set-up:** APCRDA needs to monitor and maintain the implemented climate actions with appropriate monitoring and tracking measures through the concerned departments. For instance, developing a real-time SCADA system for the water supply and energy project to monitor supply and demand patterns and enhance service quality. Such initiatives would enhance revenue generation and reduce GHG emissions.

   The proposed Climate Core Team, comprising of Amaravati's decision makers and departments, shall plan, steer, and oversee the CCAP's implementation in Amaravati, monitor overall progress, and strive to achieve the set milestones and identify gaps in achieving the targets and resolve the same. The designated Nodal Officer, appointed by Climate Core Team, can supervise and monitor routine activities by collating progress reports from concerned departments. Individual departments must analyze reports from various monitoring systems and verify them against on-the-ground

[95] Asian Development Bank Institute. (2025). Integrated Command and Control Centre: A Holistic Approach to Tackling Environmental Challenges in Chandigarh.

information to improve system performance. The Core Team should conduct periodic meetings as needed with these departments to resolve inter-departmental and on-ground operational challenges, and apprise its members within the stipulated timeline. The Core Team can then review periodic progress (at least quarterly) and take any necessary actions. The Team should periodically apprise MA&UD and CDMA of the ongoing and planned climate actions for Amaravati and seek their inputs for better alignment and impact.

b. **Sectoral Key Performance Indicators (KPIs):** For the timely and successful implementation of the CCAP, it is crucial to adopt and utilise KPIs. APCRDA and the proposed Climate Core Team shall establish such qualitative and quantitative indicators to track performance progress and nominate the relevant committee members/departments for performance evaluation. The identified KPIs shall be dynamic, robust, and forward-looking in nature to ensure maximum positive impact on the ground. Suggested KPIs for all sectoral climate actions have been provided in section 2 of this report.

   Amaravati shall review progress through the KPIs at least annually and may opt for more regular monitoring and reporting, as necessary. The tracking of KPIs shall be aligned with national and state-level city performance monitoring cycles set by authorities such as MoHUA and MA&UD for integrating and highlighting climate-focused initiatives and success stories, thus establishing the need for climate-centric development.

   Amaravati can develop a monitoring, evaluation and reporting matrix based on the KPIs, aligned with international and national reporting platforms, such as GCoM and CSCAF. It can also consider establishing a reporting system or platform linked to its Integrated Command and Control Centre.

c. **Accountability and Transparency:** The proposed Climate Core Team can continue to update the city's baseline information and emissions inventories, monitor the benefits, and proactively report the analysis on public climate data platforms such as the Urban Outcomes Framework and the GCoM through the CDP-ICLEI Reporting Platform and other similar international climate platforms. This will help Amaravati gauge its performance compared to similar cities being reported on the platforms and explore potential partnership opportunities with the best-performing cities.

d. **Update and revise CCAP:** The CCAP is a dynamic document to be reviewed and updated regularly by APCRDA and relevant governing institutions, especially given Amaravati's greenfield context. To ensure alignment with evolving priorities, policies, technology and context, APCRDA can review and update its CCAP, at least every 5 years, with the aim to achieve net-zero emissions ahead of 2058.

Globally, leading cities have adopted pioneering approaches for monitoring and tracking climate action. For instance, with a vision to achieve carbon neutrality by 2050, the city of **Buenos Aires** launched its Climate Action platform in 2020. This digital portal provides real-time, open access to over 30 environmental datasets such as GHG emissions, air quality, waste management, and sustainable mobility statistics. The platform supports transparent reporting, citizen engagement, and open collaboration with experts and other cities. Open-source datasets, hackathons, and digital tools empower both officials and citizens to track the city's progress towards carbon neutrality, enhancing accountability and promoting data-informed governance frameworks.[96]

[96] Urban Agenda Platform. (2020). The Buenos Aires Climate Action platform: enabling citizen-driven urban climate action.

3.4 Strengthen Institutional Readiness for Fast-Tracking Climate Action

Amaravati's institutional readiness will be strengthened by embedding multidisciplinary capacity building and sustainable procurement reforms into core governance processes, enabling faster and higher-quality implementation of the CCAP and measurable GHG reductions.

Objectives:

- Build cross-functional skills, coordination, and incentives across technical, administrative, and political wings to implement climate projects at speed and scale.
- Institutionalize low-carbon, climate-resilient procurement to reduce lifecycle emissions in infrastructure works and city operations.

Capacity Building: APCRDA can partner with national and international academic institutions, professional training bodies, and industry experts to deliver targeted capability development across departments.

- Focus domains: NRW management, renewable energy with battery energy storage systems, energy saving operational performance of STP operations, EV and non-motorized transport systems, blue–green infrastructure, climate-resilient neighbourhood planning, climate risk mapping, climate finance structuring, and sustainable urban mobility planning, etc.
- Modalities: short and mid-term trainings, thematic workshops, field demonstrations, and exposure visits including study tours for hands-on learning of best practices.
- Integration: Trainings embedded in annual departmental action plans with KPIs, pre and post-training assessments, and application targets linked to project milestones and budget releases.
- Knowledge management: Create a climate action knowledge hub, standard operating procedures (SOPs), and a repository of case studies, toolkits, and model bid documents to ensure continuity despite staff transfers.
- Governance: Designate climate action contact points in each department, with quarterly cross-department meetings to resolve bottlenecks and accelerate decision-making.

Sustainable Procurement: Amaravati can achieve significant reductions in GHG emissions through the procurement and supply chain of products and services, particularly in infrastructure projects of various scales and typologies. For instance, procuring energy-efficient data servers and their cooling equipment for the city's Command and Control Centre, and powering them through clean energy sources, such as solar PV systems. Another example is procuring regionally manufactured certified green materials for external and internal building elements to reduce embodied energy and lifecycle emissions.

The APCRDA Commissioner and Additional Commissioner can authorise the dedicated nodal officer from concerned departments, in consultation with stakeholder committee members, to undertake market research for commercially available green certified products and materials in the region as well as assess newer technologies and construction techniques that are energy efficient with passive design specifications, to reduce space cooling demand of the buildings. APCRDA can maintain an approved list of green products with performance benchmarks.

Similarly, Amaravati can explore RE procurement options and other demand-side management practices, like green energy open access for energy-intensive facilities, such as water supply systems, for reducing peak demand charges and overall GHGs. The state has laid out guidelines and schemes for such RE procurement that APCRDA's concerned departments can examine and incorporate, as relevant. The Climate Core Team may propose amendments to public procurement bye-laws and standard bid documents to include minimum energy performance, lifecycle carbon assessment, and recyclability criteria and integrate these into evaluation bidding scoring with verifiable certifications in the market.

The Climate Core Team can oversee annual capacity plans, green procurement roadmaps, and performance targets, and conduct quarterly reviews to monitor implementation and resolve bottlenecks. Nodal point of the departments can translate CCAP targets into their departmental project-level specifications and tender documents, and report progress to the Core Team. Nodal officer designated for green procurement can maintain an approved products list and lead supplier engagement to ensure compliance and report progress to Core Team.

Through such an assessment, Amaravati can modify the public procurement bye-laws by apprising the state government agency. Such practices will enhance Amaravati's capacity and enable it to showcase best practices to other developing cities and private stakeholders, while also helping to achieve the state's net-zero targets.

Financing Climate Action:

Amaravati will require external financing to implement, scale (CAPEX), and sustain (OPEX) the climate-led projects identified under the CCAP. Amaravati should identify avenues and mechanisms to secure the necessary financial resources for the successful implementation of ongoing and planned climate actions of CCAP. APCRDA and the Climate Core Team can seek available grants or financing instruments through ongoing state-level missions such as the 'Integrated Clean Energy Policy 4.0' with a capital subsidy of 25% to a maximum of INR 3 lakhs per public charging station for the first 5,000 EV public charging stations in the state over five years and with a capital subsidy of 20% will be provided on the fixed capital investment for battery manufacturing units over 5 years until the state reaches 5,000 MWh of cumulative capacity. Other co-funding opportunities to realize deployment of climate projects should be explored.

The Climate Core Team can initiate frequent engagements with national as well as global networks and donor organisations that can assist Amaravati in securing grants and assistance for various climate-based projects through different financial instruments and models such as PPP, Green Bonds, and RESCO/ESCO, among others. Similarly, avenues such as ICLEI's Transformative Actions Program (TAP) and the World Bank's City Climate Gap Fund can be explored to access private sector investment. Amaravati should also assess Indian national government initiatives through apex agencies, such as the Ministry of New & Renewable Energy, the Ministry of Housing and Urban Affairs, and dedicated state nodal agencies that provide grants and incentives through various schemes, as well as recent CSR amendments to access funding for specific climate actions.

3.5 Way forward - Realizing Climate Ambitions

Amaravati, as the capital city of Andhra Pradesh, serves as a lighthouse for other cities in implementing model projects and policies, and the way forward for realizing its climate ambitions requires a systematic, phased approach that transforms the CCAP from strategic vision into tangible outcomes through robust institutional frameworks, supported with innovative financing mechanisms, and adaptive management systems.

Amaravati's unique advantage as a greenfield development presents an unprecedented opportunity to embed climate resilience and net-zero principles into every aspect of urban planning and infrastructure development, requiring the establishment of a dedicated Climate Core Team/Cell that coordinates across sectors, while ensuring seamless integration with existing governance structures, including APCRDA and state line departments. CCAP implementation requires sector-specific working groups comprising technical experts, policy makers, private sector representatives, academic institutions, and community representatives who can translate the CCAP's strategic interventions into detailed project designs, procurement specifications, and performance monitoring frameworks that track progress against the 2058 net-zero target through measurable indicators such as GHG emissions reductions, green building certifications, integration of RE with BESS, green cover expansion, EV readiness and climate vulnerability assessments etc.

The success of Amaravati's climate journey depends on mobilizing diverse funding streams, including green bonds, climate funds, public-private partnerships, and international development finance, while building local capacity through training programs, knowledge-sharing platforms, and community engagement initiatives. These initiatives embed climate action within the city's institutional framework, positioning Amaravati not merely as a planned capital but as a replicable model for climate-resilient, net-zero, and inclusive development that can inspire and guide cities across India and abroad.

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Annexure A. Feasibility Assessment of the Climate Resilient Interventions

The feasibility exercise also shows the period to realise the impact of the intervention.

- **Period to Realise Impact:** Actions that are based on readily available technology, that meet development/political priorities and are easily financed (readily available funds), can be implemented quickly with a short lead time for impact realisation. Based on these characteristics, the time required for implementing projects is categorised as short, medium, and long term.

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
Energy and Building					
Prioritise energy efficiency and renewables in public buildings and city utilities	Build and operate certified green, energy-efficient public buildings	High	High	Medium	Short to Medium
	Establish enabling policies for government buildings and public procurement	High	Medium	High	Short
	Integrate energy efficiency & renewables into utility service infrastructure	High	High	Medium	Short to Medium
	Test innovative solutions & implementation models for further scale-up	Medium	High	Medium	Medium
	Notify enabling guidelines & conduct training of public officials	High	High	High	Short
	Central energy management system	High	High	Medium	Short to Medium
Reduce energy use by green, climate-responsive & energy-efficient buildings in all zones	Integrate green building norms into zoning regulations	High	Medium	Medium	Short
	Incentivise green building certification for private buildings	Medium	Medium	Low	Short to Medium
	Use passive cooling measures and sustainable building materials	Medium	Low	Low	Short to Medium
	Partner with green building agencies and implement pilot projects	Medium	Medium	Low	Short to Medium

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
	Promote enhanced building energy performance and reporting	High	Medium	Medium	Short to Medium
	Expand AGC Urban Design Committee & team into city-wide Green Building Promotion Department	High	High	Medium	Short
Integrate climate-resilient building design and thermal comfort	Deploy localized cooling interventions for vulnerable zones and public spaces	High	Medium	Low	Short to Medium
	Promote cool/green roofs and green facades in new and existing buildings	High	Medium	Low	Short to Medium
	Mandate passive cooling and thermal comfort standards in all new buildings	High	Medium	Low	Short to Medium
	Integrate flood-resilient design in building constructions	High	Medium	Low	Short
Integrate high level of clean energy and renewables to meet energy requirements	Develop Sustainable Energy Transition Roadmap for Amaravati	High	Medium	Medium	Short
	Wide-scale adoption of green renewable power using scalable mechanisms and financing models	High	Medium	Low	Medium
	Promote at-scale adoption of green renewable power	High	Low	Low	Short to Medium
	Pilot community-scale solar in existing settlement zones (such as R1)	High	Medium	Low	Short to Medium
	Solar rooftop in new EWS/LIG housing	High	Low	Low	Medium
	Solar water heaters in buildings with high hot water demand	High	Low	Medium	Medium
	Streamline procedures & facilitate financing support	High	Low	Medium	Short
	Encourage adoption of electric cooking	Medium	Low	Low	Medium
	Build local skills to boost job creation & support RE & EE deployment	High	Medium	Medium	Short
Adopt smart and reliable power	Plan & upgrade grid infrastructure to accommodate high levels of RE & meet future requirements	High	Medium	Low	Short

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
distribution systems for high renewable integration	Deploy smart systems, data management and advanced power management techniques	High	Medium	Low	Medium
	Adopt urban microgrids and demand management to support RE adoption and energy resilience	High	Medium	Medium	Medium
Undertake integrated spatial and energy planning with energy sector institutions	Advocate for faster integration of renewables in Amaravati's grid power supply	High	Medium	High	Short
	Involve APCPDCL, APTRANSCO, NREDCAP, APSECM in structures/ committees for master planning and urban infrastructure development	High	Medium	High	Short
	Coordinate with APCPDCL and APTRANSCO for effective integration of urban development and electricity planning	High	Medium	High	Short
Water Supply					
Sustainable water resource management for ensuring long term water security	Ensure protection of surface water sources	High	Medium	Medium	Short
	Conservation & management of groundwater resources by limiting extraction, promoting recharge, and continuous monitoring	High	Medium	Medium	Medium
	Reduce fresh water demand by replacing non-potable needs with alternative sources	High	Low	Low	Short
Provision of year-round supply of clean and adequate drinking water to all	Commission 24x7 water supply system of optimum quality and quantity	High	Medium	Low	Medium
	Ensure efficient management of bulk water users	High	Low	Medium	Short to Medium
	Ensure minimal extent of non-revenue water (NRW)	High	Medium	Medium	Short
Adopt high-efficiency water supply system powered by renewables	Implement energy efficiency in water pumping	High	Medium	Low	Short
	Utilise renewable energy in water supply facilities	High	Medium	Low	Short to Medium
Wastewater Management					

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
Commission efficient and adequate wastewater collection network	Deploy city-wide sewer network to prevent cross-contamination of water supply and stormwater during heavy rain and floods	High	Medium	Medium	Short
	Ensure optimum management and maintenance of sewer network	Medium	Medium	Medium	Short to Medium
	Provide facilities for safe containment, collection and treatment of wastewater during the first phase of construction	Low	Low	Medium	Short
Ensure sustainable and scientific wastewater treatment and reuse	Adopt well-managed, efficient treatment system & infrastructure able to sustain extreme climate events	Medium	Medium	Medium	Short
	Adopt decentralised wastewater management approaches	High	Medium	Low	Short to Medium
	Enable high level of safe reuse of tertiary treated wastewater	High	Low	Low	Short to Medium
Adopt low-carbon technologies, enhance energy and performance efficiency of treatment	Adopt anaerobic treatment technology with efficient methane gas capture and utilisation	Medium	Medium	Low	Short
	Enhance performance efficiency of wastewater treatment plants	High	Medium	Medium	Medium
	Reduce energy demand and integrate renewable energy sources	High	Medium	Low	Short to Medium
Adopt safe and sustainable faecal sludge treatment system	Ensure scientific management of faecal sludge from existing settlements in the near-term	Medium	Low	Medium	Short
Stormwater Management					
Adopt principles of Integrated Urban Water Management for	Conserve and optimise utilization of natural water bodies and drainage network for runoff management and flood control	High	Low	High	Medium

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
effective stormwater management	Establish unified real-time monitoring system for all urban water systems to enable comprehensive water management	High	Low	Medium	Medium
Integrate green spaces with blue infrastructure and adopt decentralised flood resilience measures	Mainstream nature-based solutions in land use planning and building regulations	High	Low	Low	Short
	Ensure city-wide adoption of rainwater harvesting and its sustained operation	Medium	Low	Medium	Medium
	Incorporate a river-centric approach in land use planning	Medium	Low	Medium	Short
Effective monitoring, forecasting and readiness to respond to extreme climate events	Implement Early Flood Warning System	High	Medium	High	Short to Medium
	Develop a comprehensive flood analysis system and mechanism to minimise urban flood risk	High	Low	Medium	Short to Medium
Solid Waste Management					
Adopt 3R principles and decentralised processing at source	Promote decentralised processing of wet waste through promotion of home-composting	High	Low	Medium	Short
	Establish compost pits in parks for on-site treatment of garden waste and implement processing of flower waste processing into incense sticks and cones	High	Medium	Medium	Short
	Conduct IEC and Behavior Change Communication (BCC) campaigns	High	Medium	Medium	Short
	Notify and implement green protocol guidelines for eco-friendly material use and waste management at community gatherings	High	Low	Medium	Short
	Efficient collection and recycling of E-Waste	High	High	Medium	Short
Ensure efficient waste collection and transportation	Ensure 100% collection across for in-house and third-party solid waste management operation (for both in-house and third-party services)	High	High	Low	Short
	Establish specialized waste collection mechanisms for non-routine and oversized residential waste	medium	Medium	Low	Short

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
Enforce extended bulk waste generators' responsibility practices for waste minimization and on-site processing	Establish a dedicated team to monitor and facilitate EBWGR implementation	High	Medium	Medium	Short
	Implement quantum-based fees for services to collect and transport dry waste from BWGs	High	Low	Medium	Short to Medium
Maintain cleanliness in public places and water courses	Impose spot-fine against littering and open dumping	High	Low	High	Short
	Enforce strict regulation on disposal of festival waste and ensure regular cleaning of watercourses	High	Low	Medium	Short
Efficient handling of Construction and Demolition Waste	Implement 100% C&D waste collection to achieve zero open dumping	High	Medium	Medium	Short
	Deploy processing infrastructure with flexibility to handle initial peak C&D generation volumes and meet long-term needs	High	Medium	Low	Short to Medium
	Ensure maximum reuse of treated C&D waste	High	Medium	Medium	Short
Decarbonise MSW value chain by integrating sustainable technologies appropriate to waste fractions	Conduct scientific techno-financial viability of various types of processing technologies	High	Medium	Medium	Short
	Explore the adoption of Bio-CNG facilities for wet waste processing	High	Medium	Low	Short
	Implement effective dry waste recycling and adopt market-driven secondary segregation for higher market value.	High	Medium	Medium	Short to Medium
	Commission sanitary landfill for scientific waste disposal and equipped with integrated methane capture system	High	Low	Medium	Short
	Deploy integrated digital monitoring systems in all MSW operations for real-time tracking of quality, quantity & environmental compliance	High	Medium	Medium	Short to Medium
	Electrify solid waste vehicle fleet and integrate renewable energy into SWM operations	High	Medium	Low	Short
Transportation					

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
Develop an integrated public transit system	Deploy a city-wide electric public bus system in near to mid-term	High	Medium	Low	Short to Medium
	Expand to develop an integrated, high-capacity and scalable public transit system	High	Medium	Low	Medium to Long
	Strengthen first and last mile connectivity	High	Medium	Medium	Short
	Implement an integrated fare and ticketing system	Medium	Medium	Medium	Short to Medium
	Promote low-carbon public transit technologies	Medium	Medium	Low	Short to Medium
Enable and prioritize Non-Motorized Transport (NMT)	Establish city-wide NMT infrastructure	High	High	Low	Short
	Improve NMT safety and accessibility	High	High	Medium	Short
	Promote behavioral shift to active mobility	High	Medium	Low	Short to Medium
Promote Clean, Electric Mobility for Public and Private Transport	Mandate electrification of government and institutional fleet	High	Low	Low	Short
	Develop city-wide charging infrastructure	High	Low	Low	Short to Medium
	Integrate renewable energy in EV charging infrastructure	High	Medium	Low	Short to Medium
	Incentivize electric vehicle uptake and phase out ICE vehicles	Low	Medium	Medium	Short to Medium
	Mandate EV-ready development regulations	High	Low	Low	Short
Enable Sustainable, Low-Carbon Freight	Implement immediate controls on construction-related freight movement	High	Low	Medium	Short
	Electrify last-mile freight and introduce e-logistics mandates	Medium	Low	Medium	Short to Medium
	Establish integrated urban freight and logistics management zones and implement freight routing	High	Low	Low	Short to Medium
Develop Climate-Resilient and Low-Emission Transport Infrastructure	Adopt climate-resilient transport infrastructure design	High	Medium	Medium	Short
	Incorporate nature-based and water-sensitive design elements	High	High	Medium	Short
	Implement adaptive traffic and smart parking management system	Medium	Medium	Low	Short

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
Integrated transport governance and smart mobility planning	Operationalize Unified Metropolitan Transport Authority (UMTA) and build institutional capacity	High	Medium	Medium	Short
	Deploy smart mobility platforms and real-time passenger tools	High	Medium	Medium	Short to Medium
Biodiversity and Urban Greening					
Conserve and restore ecosystems to enhance climate and ecological resilience	Protect and conserve natural water bodies, hills and eco-sensitive zones	Medium	Medium	Medium	Short
	Restore degraded and ecologically sensitive areas using nature-based solutions	Medium	High	Medium	Stort to Medium
	Safeguard culturally and ecologically sensitive zones	High	High	Medium	Short
Expand and diversify green spaces for ecological, recreational and climate co-benefits	Develop a city-wide green space network	High	High	Medium	Short to Medium
	Develop biodiversity parks	Medium	Medium	Medium	Medium
	Scale urban afforestation and native forest clusters	Medium	Medium	Medium	Medium
Integrate blue-green infrastructure into urban planning and infrastructure development	Embed blue-green infrastructure in city planning and development regulations	High	Medium	Medium	Medium
	Develop shaded and green mobility corridors	High	High	Medium	Medium
	Promote urban agriculture	Medium	Medium	Low	Medium
	Promote green roofs and facades in buildings	Medium	Low	Low	Short to Medium
Strengthen governance and community stewardship	Institutionalize biodiversity planning and legal frameworks	High	Medium	Medium	Short
	Establish monitoring systems using City Biodiversity Index (CBI) and technology	High	Medium	Medium	Short
	Promote public participation, education and stewardship	High	Medium	Medium	Short to Medium
Health					
Strengthen health sector to withstand climate hazards	Accessibility of health services for all communities	High	High	Medium	Short
	Develop and implement a citywide Heat Action Plan (HAP)	Medium	High	Medium	Short

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
	Integrate climate risk into health sector planning and regulation	Medium	Medium	Medium	Short
	Enhance heat, air quality and flood resilience of public health infrastructure	Medium	Medium	Medium	Short
	Ensure sanitation and disease prevention in climate-sensitive areas	Medium	High	Medium	Short
	Monitor climate-sensitive diseases and pandemics	Medium	Medium	Medium	Short
Strengthen health governance and capacity for climate adaptation.	Capacity building for health professionals	Medium	Medium	Medium	Short
	Community engagement and awareness	High	Medium	Medium	Short
	Monitoring, evaluation and reporting	High	High	Low	Short
Air Quality Management					
Dust and emissions control during construction and infrastructure development	Enforce robust dust suppression and containment protocols	Medium	Low	Low	Short
	Deploy real-time air quality monitoring and site surveillance systems	High	Low	Medium	Short
	Strengthen material handling, storage and transport regulations	Low	Low	Low	Short
	Adopt low-emission construction machinery and power solutions	Low	Low	Low	Short
	Implement specific measures for ready-mix concrete plants	Medium	Low	Medium	Short
	Mandate comprehensive construction environmental management plans	High	Low	Medium	Short
Integrate air quality resilience into urban and building design	Establish air filtration and ventilation standards for public buildings, schools and hospitals	High	Low	Medium	Short to Medium
	Implement worker and community protection measures	Low	Medium	Low	Short
	Design and maintain vegetative buffers and include provision for pollution-suppression infrastructure.	Low	Medium	High	short

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention			Period to Realize Impact
		Technical	Political	Financial	
		High/ Medium/ Low	High/ Medium/ Low	High/ Medium/ Low	Short/ Medium/ Long
Establish strong governance, enforcement and adaptive management for air quality	Setup and operationalize a Construction Air Quality Management Cell or Unit	High	Medium	Medium	Short
	Implement a city-wide AQI linked adaptive construction response protocol	High	Medium	Medium	Short

Annexure B. Prioritisation of Resilience Actions

The prioritisation exercise uses five key criteria/characteristics:

- Redundancy: A resilient system can function and achieve results through multiple paths or nodes when one fails and when performance is critical. In contrast, a "single best solution" is not resilient because if it fails, the system collapses. Back-up systems, or decentralised nodes for service delivery in a linked network, are preferable.
- Flexibility and diversity: Essential systems should be able to work under a variety of conditions; they should not be rigid or designed only for a specific situation. Any system will fail if overloaded beyond its capacity, but it should be designed to fail under stress in a safe and predictable way, rather than suddenly and catastrophically.
- Re-organisation and responsiveness: Under extreme conditions, systems should be able to respond and change to meet unexpected shocks. This requires flexible organisations and access to different kinds of resources (information, skills, equipment, knowledge and experience). It also requires a high level of coordination and flexible organisational structures capable of adjusting to new conditions.
- Access to information: Resilient systems have mechanisms to learn from and build on experience, so that past mistakes are not repeated and lessons from other cities can be integrated into planning. This requires procedures for monitoring and evaluating performance under stress, and multiple sources of knowledge and documentation (strengthening "institutional memory").
- Energy saving and GHG emissions mitigation potential: Resilient systems have potential to reduce energy consumption and mitigate GHG emissions, which may be integrated into their regular planning. This requires procedures for periodic monitoring and evaluating performance, which requires multiple sources of knowledge and documentation.

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
Energy and Building							
Prioritise energy efficiency and renewables in public buildings and city utilities	Build and operate certified green, energy-efficient public buildings	Yes	Yes	Yes	Yes	Yes	Very High
	Establish enabling policies for government buildings and public procurement	No	Yes	Yes	Yes	Yes	High
	Integrate energy efficiency & renewables into utility service infrastructure	Yes	Yes	Yes	Yes	Yes	Very High
	Test innovative solutions & implementation models for further scale-up	Yes	Yes	Yes	Yes	Yes	Very High
	Notify enabling guidelines & conduct training of public officials	Yes	Yes	No	Yes	No	Medium
	Central energy management system	Yes	Yes	No	Yes	No	Medium
Reduce energy use by green, climate-responsive & energy-efficient buildings in all zones	Integrate green building norms into zoning regulations	Yes	Yes	No	Yes	Yes	High
	Incentivise green building certification for private buildings	Yes	Yes	No	No	Yes	Medium
	Use passive cooling measures and sustainable building materials	Yes	Yes	No	Yes	Yes	High
	Partner with green building agencies and implement pilot projects	Yes	Yes	No	No	Yes	Medium
	Promote enhanced building energy performance and reporting	Yes	Yes	No	No	Yes	Medium
	Expand AGC Urban Design Committee & team into city-wide Green Building Promotion Department	Yes	Yes	Yes	Yes	No	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
Integrate climate-resilient building design and thermal comfort	Deploy localized cooling interventions for vulnerable zones and public spaces	Yes	Yes	No	Yes	Yes	High
	Promote cool/green roofs and green facades in new and existing buildings	Yes	Yes	No	No	Yes	Medium
	Mandate passive cooling and thermal comfort standards in all new buildings	Yes	Yes	No	Yes	Yes	High
	Integrate flood-resilient design in building constructions	Yes	Yes	No	Yes	No	Medium
Integrate high level of clean energy and renewables to meet energy requirements	Develop Sustainable Energy Transition Roadmap for Amaravati	Yes	Yes	Yes	Yes	No	High
	Wide-scale adoption of green renewable power using scalable mechanisms and financing models	Yes	Yes	Yes	No	Yes	High
	Promote at-scale adoption of green renewable power	Yes	Yes	No	Yes	Yes	High
	Pilot community-scale solar in existing settlement zones (such as R1)	Yes	Yes	No	Yes	Yes	High
	Solar rooftop in new EWS/LIG housing	Yes	Yes	No	Yes	Yes	High
	Solar water heaters in buildings with high hot water demand	Yes	Yes	No	Yes	Yes	High
	Streamline procedures & facilitate financing support	Yes	Yes	No	Yes	No	Medium
	Encourage adoption of electric cooking	Yes	Yes	No	No	Yes	Medium
	Build local skills to boost job creation & support RE & EE deployment	Yes	Yes	Yes	Yes	No	High
Adopt smart and reliable power	Plan & upgrade grid infrastructure to accommodate high levels of RE & meet future requirements	Yes	Yes	Yes	Yes	Yes	Very High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
distribution systems for high renewable integration	Deploy smart systems, data management and advanced power management techniques	No	Yes	Yes	Yes	No	Medium
	Adopt urban microgrids and demand management to support RE adoption and energy resilience	Yes	Yes	Yes	Yes	Yes	Very High
Undertake integrated spatial and energy planning with energy sector institutions	Advocate for faster integration of renewables in Amaravati's grid power supply	No	Yes	Yes	Yes	No	Medium
	Involve APCPDCL, APTRANSCO, NREDCAP, APSECM in structures/ committees for master planning and urban infrastructure development	No	Yes	Yes	Yes	No	Medium
	Coordinate with APCPDCL and APTRANSCO for effective integration of urban development and electricity planning	Yes	Yes	Yes	Yes	No	High
Water Supply							
Sustainable water resource management for ensuring long term water security	Ensure protection of surface water sources	Yes	Yes	Yes	Yes	No	High
	Conservation & management of groundwater resources by limiting extraction, promoting recharge, and continuous monitoring	Yes	Yes	Yes	Yes	No	High
	Reduce fresh water demand by replacing non-potable needs with alternative sources	Yes	Yes	Yes	Yes	No	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
Provision of year-round supply of clean and adequate drinking water to all	Commission 24x7 water supply system of optimum quality and quantity	Yes	Yes	Yes	Yes	No	High
	Ensure efficient management of bulk water users	Yes	Yes	No	Yes	No	Medium
	Ensure minimal extent of non-revenue water (NRW)	Yes	Yes	No	Yes	No	Medium
Adopt high-efficiency water supply system powered by renewables	Implement energy efficiency in water pumping	Yes	Yes	Yes	Yes	Yes	Very High
	Utilise renewable energy in water supply facilities	Yes	Yes	No	Yes	Yes	High
Wastewater Management							
Commission efficient and adequate wastewater collection network	Deploy city-wide sewer network to prevent cross-contamination of water supply and stormwater during heavy rain and floods	Yes	No	Yes	Yes	No	Medium
	Ensure optimum management and maintenance of sewer network	Yes	Yes	Yes	Yes	No	High
	Provide facilities for safe containment, collection and treatment of wastewater during the first phase of construction	Yes	No	Yes	Yes	No	Medium
Ensure sustainable and scientific wastewater	Adopt well-managed, efficient treatment system & infrastructure able to sustain extreme climate events	Yes	Yes	Yes	Yes	No	High
	Adopt decentralised wastewater management approaches	Yes	Yes	Yes	Yes	Yes	Very High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
treatment and reuse	Enable high level of safe reuse of tertiary treated wastewater	Yes	Yes	Yes	Yes	Yes	Very High
Adopt low-carbon technologies, enhance energy and performance efficiency of treatment	Adopt anaerobic treatment technology with efficient methane gas capture and utilisation	Yes	Yes	Yes	Yes	Yes	Very High
	Enhance performance efficiency of wastewater treatment plants	Yes	Yes	Yes	Yes	Yes	Very High
	Reduce energy demand and integrate renewable energy sources	Yes	Yes	Yes	Yes	Yes	Very High
Adopt safe and sustainable faecal sludge treatment system	Ensure scientific management of faecal sludge from existing settlements in the near-term	Yes	No	Yes	Yes	Yes	High
Stormwater Management							
Adopt principles of Integrated Urban Water Management for effective stormwater management	Conserve and optimise utilization of natural water bodies and drainage network for runoff management and flood control	Yes	Yes	Yes	Yes	No	High
	Establish unified real-time monitoring system for all urban water systems to enable comprehensive water management	Yes	Yes	No	yes	No	Medium
Integrate green spaces with blue	Mainstream nature-based solutions in land use planning and building regulations	Yes	Yes	Yes	Yes	No	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
infrastructure and adopt decentralised flood resilience measures	Ensure city-wide adoption of rainwater harvesting and its sustained operation	Yes	Yes	Yes	Yes	No	High
	Incorporate a river-centric approach in land use planning	Yes	Yes	Yes	Yes	No	High
Effective monitoring, forecasting and readiness to respond to extreme climate events	Implement Early Flood Warning System	Yes	Yes	No	Yes	No	Medium
	Develop a comprehensive flood analysis system and mechanism to minimise urban flood risk	Yes	Yes	No	Yes	No	Medium
Solid Waste Management							
Adopt 3R principles and decentralised processing at source	Promote decentralised processing of wet waste through promotion of home-composting	Yes	No	Yes	Yes	Yes	High
	Establish compost pits in parks for on-site treatment of garden waste and implement processing of flower waste processing into incense sticks and cones	Yes	No	Yes	Yes	Yes	High
	Conduct IEC and Behavior Change Communication (BCC) campaigns	Yes	Yes	Yes	Yes	No	High
	Notify and implement green protocol guidelines for eco-friendly material use and waste management at community gatherings	Yes	Yes	Yes	Yes	No	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
	Efficient collection and recycling of E-Waste	Yes	Yes	Yes	Yes	No	High
Ensure efficient waste collection and transportation	Ensure 100% collection across for in-house and third-party solid waste management operation (for both in-house and third-party services)	Yes	No	Yes	Yes	No	Medium
	Establish specialized waste collection mechanisms for non-routine and oversized residential waste	Yes	Yes	Yes	Yes	No	High
Enforce extended bulk waste generators' responsibility practices for waste minimization and on-site processing	Establish a dedicated team to monitor and facilitate EBWGR implementation	Yes	No	Yes	Yes	No	Medium
	Implement quantum-based fees for services to collect and transport dry waste from BWGs	Yes	No	Yes	Yes	No	Medium
Maintain cleanliness in public places and water courses	Impose spot-fine against littering and open dumping	Yes	No	Yes	Yes	No	Medium
	Enforce strict regulation on disposal of festival waste and ensure regular cleaning of watercourses	Yes	No	Yes	Yes	No	Medium
Efficient handling of Construction and	Implement 100% C&D waste collection to achieve zero open dumping	Yes	No	Yes	Yes	Yes	High
	Deploy processing infrastructure with flexibility to handle initial peak C&D	Yes	No	Yes	Yes	No	Medium

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
Demolition Waste	generation volumes and meet long-term needs						
	Ensure maximum reuse of treated C&D waste	Yes	Yes	Yes	Yes	No	High
Decarbonise MSW value chain by integrating sustainable technologies appropriate to waste fractions	Conduct scientific techno-financial viability of various types of processing technologies	Yes	Yes	No	Yes	No	Medium
	Explore the adoption of Bio-CNG facilities for wet waste processing	Yes	Yes	No	Yes	Yes	High
	Implement effective dry waste recycling and adopt market-driven secondary segregation for higher market value.	Yes	No	Yes	Yes	Yes	High
	Commission sanitary landfill for scientific waste disposal and equipped with integrated methane capture system	Yes	Yes	Yes	Yes	Yes	Very High
	Deploy integrated digital monitoring systems in all MSW operations for real-time tracking of quality, quantity & environmental compliance	Yes	Yes	Yes	Yes	No	High
	Electrify solid waste vehicle fleet and integrate renewable energy into SWM operations	Yes	Yes	Yes	Yes	Yes	Very High
Transportation							
Develop an integrated public transit system	Deploy a city-wide electric public bus system in near to mid-term	Yes	Yes	No	Yes	Yes	High
	Expand to develop an integrated, high-capacity and scalable public transit system	Yes	Yes	Yes	Yes	Yes	Very High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
	Strengthen first and last mile connectivity	Yes	Yes	No	Yes	Yes	High
	Implement an integrated fare and ticketing system	Yes	Yes	No	Yes	No	Medium
	Promote low-carbon public transit technologies	Yes	Yes	No	No	Yes	Medium
Enable and prioritize Non-Motorized Transport (NMT)	Establish city-wide NMT infrastructure	Yes	No	No	Yes	Yes	Medium
	Improve NMT safety and accessibility	Yes	No	No	Yes	No	Average
	Promote behavioral shift to active mobility	Yes	Yes	No	Yes	No	Medium
Promote Clean, Electric Mobility for Public and Private Transport	Mandate electrification of government and institutional fleet	Yes	Yes	No	Yes	Yes	High
	Develop city-wide charging infrastructure	Yes	Yes	No	Yes	No	Medium
	Integrate renewable energy in EV charging infrastructure	Yes	Yes	Yes	No	Yes	High
	Incentivize electric vehicle uptake and phase out ICE vehicles	Yes	Yes	Yes	No	No	Medium
	Mandate EV-ready development regulations	Yes	No	Yes	Yes	No	Medium
Enable Sustainable, Low-Carbon Freight	Implement immediate controls on construction-related freight movement	Yes	No	Yes	Yes	Yes	High
	Electrify last-mile freight and introduce e-logistics mandates	Yes	Yes	No	Yes	Yes	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
	Establish integrated urban freight and logistics management zones and implement freight routing	Yes	No	Yes	Yes	No	Medium
Develop Climate-Resilient and Low-Emission Transport Infrastructure	Adopt climate-resilient transport infrastructure design	Yes	Yes	Yes	Yes	No	High
	Incorporate nature-based and water-sensitive design elements	Yes	Yes	Yes	Yes	No	High
	Implement adaptive traffic and smart parking management system	Yes	Yes	No	Yes	No	Medium
Integrated transport governance and smart mobility planning	Operationalize Unified Metropolitan Transport Authority (UMTA) and build institutional capacity	Yes	No	Yes	Yes	No	Medium
	Deploy smart mobility platforms and real-time passenger tools	Yes	No	Yes	Yes	No	Medium
Biodiversity and Urban Greening							
Conserve and restore ecosystems to enhance climate and ecological resilience	Protect and conserve natural water bodies, hills and eco-sensitive zones	Yes	Yes	No	Yes	No	Medium
	Restore degraded and ecologically sensitive areas using nature-based solutions	Yes	Yes	No	Yes	No	Medium
	Safeguard culturally and ecologically sensitive zones	Yes	Yes	Yes	No	No	Medium
Expand and diversify green spaces for ecological, recreational	Develop a city-wide green space network	Yes	Yes	Yes	Yes	Yes	Very High
	Develop biodiversity parks	Yes	Yes	Yes	Yes	No	High
	Scale urban afforestation and native forest clusters	Yes	Yes	Yes	Yes	Yes	Very High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
and climate co-benefits							
Integrate blue-green infrastructure into urban planning and infrastructure development	Embed blue-green infrastructure in city planning and development regulations	Yes	Yes	Yes	Yes	No	High
	Develop shaded and green mobility corridors	Yes	Yes	No	Yes	Yes	High
	Promote urban agriculture	Yes	No	No	No	Yes	Average
	Promote green roofs and facades in buildings	Yes	No	No	Yes	Yes	Medium
Strengthen governance and community stewardship	Institutionalize biodiversity planning and legal frameworks	Yes	Yes	Yes	Yes	No	High
	Establish monitoring systems using City Biodiversity Index (CBI) and technology	Yes	Yes	Yes	Yes	No	High
	Promote public participation, education and stewardship	Yes	Yes	Yes	Yes	No	High
Health							
Strengthen health sector to withstand climate hazards	Accessibility of health services for all communities	Yes	Yes	Yes	Yes	No	High
	Develop and implement a citywide Heat Action Plan (HAP)	Yes	Yes	Yes	Yes	No	High
	Integrate climate risk into health sector planning and regulation	Yes	Yes	Yes	No	No	Medium
	Enhance heat, air quality and flood resilience of public health infrastructure	Yes	Yes	Yes	Yes	No	High
	Ensure sanitation and disease prevention in climate-sensitive areas	Yes	Yes	Yes	Yes	No	High
	Monitor climate-sensitive diseases and pandemics	Yes	Yes	Yes	Yes	No	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
Strengthen health governance and capacity for climate adaptation.	Capacity building for health professionals	Yes	Yes	No	Yes	No	Medium
	Community engagement and awareness	Yes	No	Yes	Yes	No	Medium
	Monitoring, evaluation and reporting	Yes	Yes	Yes	Yes	No	High
Air Quality Management							
Dust and emissions control during construction and infrastructure development	Enforce robust dust suppression and containment protocols	Yes	Yes	No	Yes	No	Medium
	Deploy real-time air quality monitoring and site surveillance systems	Yes	No	Yes	Yes	No	Medium
	Strengthen material handling, storage and transport regulations	Yes	Yes	Yes	No	No	Medium
	Adopt low-emission construction machinery and power solutions	No	Yes	Yes	Yes	No	Medium
	Implement specific measures for ready-mix concrete plants	Yes	Yes	Yes	No	No	Medium
	Mandate comprehensive construction environmental management plans	Yes	No	Yes	Yes	No	Medium
Integrate air quality resilience into urban and building design	Establish air filtration and ventilation standards for public buildings, schools and hospitals	Yes	Yes	No	Yes	No	Medium
	Implement worker and community protection measures	Yes	No	Yes	Yes	No	Medium
	Design and maintain vegetative buffers and include provision for pollution-suppression infrastructure.	Yes	Yes	Yes	Yes	No	High

Strategy	Potential Climate Resilience Interventions	Feasibility of the intervention					Overall Resilience
		Redundancy	Flexibility	Responsiveness/ re-organisation	Access to Information	Energy saving and GHG emission mitigation potential	
		(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	
Establish strong governance, enforcement and adaptive management for air quality	Setup and operationalize a Construction Air Quality Management Cell or Unit	Yes	Yes	Yes	Yes	No	High
	Implement a city-wide AQI linked adaptive construction response protocol	Yes	Yes	Yes	Yes	No	High

Annexure C. Power Demand of Amaravati in 2058

Classification	Estimated Power Demand (MW)
Residential	1076.6
Commercial	521.4
Government / Institutional	21.3
Industrial	498.9
AGC (Excluding DC)	169.3
Startup Area	202.4
Residential area in commercial & Industrial Zones	36.5
Utilities (Including District Cooling System)	123.2
Line losses @2.84%	77.5
Total Demand	**2726.9**

Annexure D. Renewable Energy (Solar PV) Integration Target for Amaravati

The table below illustrates the percentage of projected electricity consumption in the city targeted from renewable energy sources in the planning period in Amaravati; in both BAU and Climate Action Scenarios.

Parameter	Climate Action Scenario			BAU Scenario		
	2028	2043	2058	2028	2043	2058
Percentage of electricity consumption targeted from renewable energy (%)	15%	75%	100%	3.88%	19.60%	44.44%

Annexure E. Electric Cooking Target for Amaravati

The table below presents the targeted share of cooking energy demand expected to be met through electricity (powered by renewable energy sources) during the planning period in Amaravati, under both the BAU and Climate Action Scenarios.

Residential Sub-sector

Parameter	Climate Action Scenario			BAU Scenario		
	2028	2043	2058	2028	2043	2058
Percentage of energy demand for cooking met by electricity (%)	-	5%	10%	-	-	-
Percentage of electricity for cooking sourced from renewable energy (%)	100%	100%	100%	-	-	-

Commercial and institutional buildings/facilities sub-sector

Parameter	Climate Action Scenario			BAU Scenario		
	2028	2043	2058	2028	2043	2058
Percentage of energy demand for cooking met by electricity (%)	-	10%	15%	-	-	-
Percentage of electricity for cooking sourced from renewable energy (%)	100%	100%	100%	-	-	-

Annexure F. Estimated Modal Share of Transportation and Trip Generation Rates

The table below highlights the estimated modal share distribution across different transport modes, including private vehicles, public transport, and NMT, in both the BAU and Climate Action Scenarios.

Mobility Profile	Climate Action Scenario			BAU Scenario		
	2028	2043	2058	2028	2043	2058
Non-Motorised Transport (Walk + Cycle)	20%	24%	25%	20%	20%	20%
Private Vehicles	56%	30%	29%	58%	58%	58%
Public Transport	24%	46%	46%	22%	22%	22%

Note:

- *In the BAU scenario, the modal share is assumed to remain largely consistent across the planning period.*
- *Only bus-based public transport systems are assumed for 2028 and 2043, while by 2058, metro services are expected to be established, accounting for 45% of the total public transport share.*

Parameter	Units	Value
Average trip generation	trips/person/day	1.5

Note: The trip generation rate has been assumed to be constant throughout the planning period in both the Climate Action and BAU scenarios.

Annexure G. Estimated Fuel-Mix of the Vehicles/Transport Modes in Amaravati – Climate Action Scenario

Fleet mix by fuel	2028				2043				2058			
	Petrol	Diesel	CNG	Electric	Petrol	Diesel	CNG	Electric	Petrol	Diesel	CNG	Electric
2-Wheeler	64%	-	-	36%	10.5%	-	-	89.5%	4%	-	-	96%
Car	38%	48%	7%	7%	12%	15%	2%	71%	3%	4%	1%	92%
Bus	-	-	-	100%	-	-	-	100%	-	-	-	100%
Metro	-	-	-	100%	-	-	-	100%	-	-	-	100%
Rail	-	-	-	100%	-	-	-	100%	-	-	-	100%
Taxi/Cabs	-	-	-	100%	-	-	-	100%	-	-	-	100%

Annexure H. Estimated Fuel-Mix of the Vehicles/Transport Modes in Amaravati – BAU Scenario

Fleet mix by fuel	2028				2043				2058			
	Petrol	Diesel	CNG	Electric	Petrol	Diesel	CNG	Electric	Petrol	Diesel	CNG	Electric
2-Wheeler	96%	-	-	4%	79.2%	-	-	20.8%	62%	-	-	38%
Car	40%	51%	6%	2%	37.7%	48.7%	3.7%	9.4%	35%	46%	1%	17%
Auto-Rickshaw	-	-	97%	3%	-	-	82.7%	17.3%	-	-	68%	32%
Bus	-	-	-	100%	-	-	-	100%	-	-	-	100%
Metro	-	-	-	100%	-	-	-	100%	-	-	-	100%
Rail	-	-	-	100%	-	-	-	100%	-	-	-	100%
Taxi/Cabs	40%	51%	6%	2%	-	-	90%	9%	-	-	82%	17%

Annexure I. Renewable Energy (Solar PV) Integration Target for Transportation in Amaravati (2028-2058)

The table below presents the estimated share of renewable energy in meeting the electricity demand of the transport sector in Amaravati under both the BAU and Climate Action scenarios.

Parameter	Climate Action Scenario			BAU Scenario		
	2028	2043	2058	2028	2043	2058
Percentage of electricity consumption targeted from renewable energy (%)	20%	40%	60%	0%	0%	0%

Annexure J. Solid Waste Processing in Amaravati (2028-2058) -Climate Action Scenario

Type	2028		2043		2058	
	Tonnes	Percentage	Tonnes	Percentage	Tonnes	Percentage
Waste to Energy (WtE)	462	88%	998	60%	2,354	60%
Waste to Recycling	-	-	89	5%	210	5%
Composting Plant	-	-	212	13%	500	13%
Biomethanation/Bio-CNG	-	-	170	10%	400	10%
Sanitary Landfill	66	12%	208	12%	491	12%

BAU Scenario

Type	2028		2043		2058	
	Tonnes	Percentage	Tonnes	Percentage	Tonnes	Percentage
Waste to Energy (WtE)	462	88%	718	43%	1,692	43%
Waste to Recycling	-	-	89	5%	211	5%
Composting Plant	-	-	621	37%	1,464	37%
Biomethanation/Bio-CNG	-	-	41	2%	98	2%
Sanitary Landfill	66	12%	208	12%	491	12%

Note:

- *In 2028, all waste is assumed to be processed through Waste-to-Energy (WtE) facilities as per the city's initial waste management plan.*
- *Approximately 10% of rejects from the treatment facilities are estimated to be sent to the sanitary landfill, in addition to the inert waste.*

Annexure K. Emission Factors

Emission factors have been maintained consistently across the planning period, both BAU and Climate Action Scenario, to ensure methodological uniformity and facilitate accurate comparison with the baseline year.

Emission Factors for Fuels and Grid-Electricity			
Fuel	**Emission factor per unit of fuel**	**Unit**	**Source**
LPG	2.98	tCO_2e/tonne	IPCC
PNG	0.00189	tCO_2e/cubic metre	IPCC
Petrol	2.30	tCO_2e/kilolitre	IPCC
Diesel	2.85	tCO_2e/kilolitre	IPCC
CNG (cubic m)	0.0021	tCO_2e/cubic metre	IPCC
Grid – Electricity (2023-24)	727.00	tCO_2e/million kWh	Central Electricity Authority (CEA) - CO_2 Baseline Database for the Indian Power Sector, version 20.0, 2024 Available at: https://cea.nic.in/wp-content/uploads/2021/03/User_Guide_Version_20.0.pdf

Emission Factors for Biological Treatment of Waste (IPCC Default)				
Type of Biological Treatment	CH4 Emission Factors (g CH4/kg waste treated)		N2O Emission Factors (g N2O/kg waste treated)	
	on a dry weight basis	on a wet weight basis	on a dry weight basis	on a wet weight basis
Composting	10.00	4.00	0.60	0.24
Anaerobic digestion at biogas facilities	2.00	0.80	Assumed negligible	Assumed negligible

Methane Correction Factor (MCF) for Landfill (IPCC Default)	
Type of Site	**(MCF) Default Values**
Managed – anaerobic	1

Annexure L. Meeting Minutes of Stakeholder consultations

MAU61-EE0ENV(OTH)/2/2025-CZLE I/4354756/2025

Minutes of Meeting on Online Stakeholder Consultation on Climate Change Action Plan for Amaravati

Date : 08.09.2025, 03.00 P.M – 4: 30 PM IST
Location : Virtual Meeting
Participants:

1. K Kanna Babu, I.A.S., Commissioner, APCRDA
2. G.Surya Sai Praveenchand, I.A.S, Additional Commissioner, APCRDA
3. Nitin Kumar Sharma, Director, Environment, APCRDA
4. Officials from APCRDA
5. Dhyanachandra H M, IAS, Commissioner, Vijayawada Municipal Corporation
6. P. Sreenivasulu, IAS, Commissioner, Guntur Municipal Corporation
7. Mr. Emani Kumar, Executive Director, ICLEI South Asia
8. Representatives from ICLEI South Asia team
9. Vijay Kumar, Chairman, AP State Biodiversity Board
10. Ravindra Babu, Joint Director, CDMA office
11. D. Chandra Sekhar, Additional Commissioner, Vijayawada Municipal Corporation
12. VS Dharmateja, Joint Director, Urban Greening and Forest, ADCL
13. D Srinivasa Reddy, Senior Infrastructure planner, ADCL
14. P Suryachandram, Chief Engineer (Vijayawada Zone), APTRANSCO
15. Smt M Padma Sujatha, Chief Engineer/Generation, APGENCO
16. Hima Sailaja, District Forest Officer, Guntur
17. Maqbool Ahmed, Deputy Director, DTCP
18. Deputy Director, AP Water Resources Department, Guntur
19. Zonal manager, Andhra Pradesh Industrial Infrastructure Corporation (APIIC), Guntur
20. District Public Transport Officer, Guntur, APSRTC
21. Deputy Transport Commissioner, Guntur, AP Transport
22. Hima Bindu, Deputy Director, Horticulture, AP Urban Greening and Beautification Corporation
23. Prasad, Project Manager, AP State Disaster Management Authority
24. Md. Nazeena Begum, Environmental Engineer, Guntur Regional office, APPCB
25. Stella Samuel, Head, Indian Meteorological Centre Amaravati
26. Dr Shoji D. Thottathil, Assistant Professor, Department of Environmental Science and Engineering, SRM University
27. Dr. P. Brahmaji Rao, Associate Professor, Head, Dept. of Environmental Sciences, Acharya Nagarjuna University
28. Representative from the AP State Energy Conservation Mission office
29. Representative from the Swachh Andhra Corporation
30. Representative from the New & Renewable Energy Development Corporation of Andhra Pradesh Ltd.
31. Representative from the School of Planning and Architecture, Vijayawada
32. Representative from APCPDCL, CRDA Circle
33. Boja Raju, Project Manager, Bapuji Rural Enlightenment and Development Society

pg. 1

Opening Remarks:

- The Additional commissioner, APCRDA, set the context for the meeting and explained the importance of preparation of the Amaravati Climate Change Action Plan, being prepared with the assistance of M/S ICLEI, as per the directives of NGT orders and EC conditions. Explained that this online meeting would kick-start the consultation process, leading to more detailed in-person meetings in the future.
- The Commissioner APCRDA gave his opening remarks on the importance of the change action plan, not only for regulatory compliance but also for ensuring Amaravati develops as a net-zero, climate-resilient capital city. He urged all departments to participate in the process actively and explained to them how sector-wise inputs could make the climate action plan robust and actionable.
- Mr. Emani Kumar from ICLEI South Asia outlined the purpose of the meeting, which is to ensure that all departments contribute to the Amaravati City climate action plan.

Discussion:

1. The project team from ICLEI South Asia explained the overall activities and progress on the Climate Change Action Plan (CCAP) for the Amaravati project. The plan involves assessing current and future greenhouse gas emissions and climate vulnerabilities, with a focus on both mitigation and adaptation strategies.
2. The following are the brief points about the presentation made:

- Trends in temperature and rainfall changes in Amaravati:
  - Explained methods used for Land Surface Temperature (LST) future projections for Amaravati, along with the respective data.
  - Flooding data analysis presented for Amaravati, along with flood-affected areas and flood mitigation measures proposed by APCRDA and ADCL
- Climate risk impact on infrastructure was discussed, highlighting that the rising temperatures may increase water demand and energy usage. This will lead to health risks due to heat stress, flooding threats to infrastructure through inundation and accessibility challenges.
- The notified master plan of Amaravati has 30% of green and blue land use allocation to reduce greenhouse gas emissions from the buildings. The current GHG emission baseline (2024) and draft future emission projections (2028, 2043, 2058), considering planned interventions and targets, were discussed.
- The Additional Commissioner, APCRDA highlighted Amaravati's commitment to achieving 100% electricity consumption through renewable energy sources. Achieving this target will require active input and coordination with the Energy Department, and further discussions will be held at various government levels.
- ICLEI presented the future GHG emissions analysis done for Amaravati and the methods adopted.

- The approach adopted for setting climate action targets across the sectors was explained, referencing alignment with relevant national and state policies and targets, local plans and regulations, ongoing consultations with APCRDA officials, and key findings from the GHG emissions inventory as well as the Climate Risk and Vulnerability Assessment.
- Stella Samuel from IMD recommended that the project team use data from SRRG and DRMS stations, which offer rain gauge measurements, to support rainfall trend analysis. She also advised including data from the Bapatla IMD station.
- Prasad from APSDMA mentioned that, in addition to ongoing work on flood analysis, NRSC has completed a flood atlas report for Andhra Pradesh, which is available with APSDMA and can be shared for reference.
- Dr. Shoji D. Thottathil from SRM University pointed out the significant GHG emission i.e. methane emissions from small aquatic systems in the Amaravati region, which are often overlooked. He has been monitoring water quality and emissions and suggested that this data should be integrated into the climate action plan.
- Vijay Kumar Neelayapalem, Chairman, AP State Biodiversity Board highlighted the necessity of land for biodiversity activities and mentioned previous communications with the commissioners regarding this issue. Additional Commissioner, APCRDA assured that they would coordinate with ADCL to address land allocations to the extent required for the same.

In conclusion, the Additional Commissioner and Commissioner thanked the ICLEI team for presenting sectoral action plans and to all participants for their engagement. Attendees were encouraged to review the shared materials, consult within their departments, and share best practices or suggestions for Amaravati's climate action plan.

__ Commissioner
APCRDA

To
All the Participants for the necessary action.
Copy to:

The Additional Commissioner (Planning), APCRDA for information
The Additional Commissioner (Admin), APCRDA, for information
The Chairperson & Managing Director, ADCL, for information
The ESMU wing for necessary action

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KUNNAPAREDDY KANNABABU
Date: 22-09-2025 12:56:03

Minutes of Meeting on Climate Change Action Plan for Amaravati

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Date : 25.09.2025, 03.00 P.M – 5.00 PM IST
Location : Auditorium, Ground floor, APCRDA office, Lenin centre, Vijayawada.

Participants:

- M.K.V Sreenivasulu, Managing Director, Andhra Pradesh Greening and Beautification Corporation
- R. Hima Bindu, General Manager, Andhra Pradesh Greening and Beautification Corporation
- BN Prabhakar, Executive Engineer, Andhra Pradesh Solar Power Corporation Pvt Ltd
- D Sarath Chandra, Consultant, Electrical Engineer, Andhra Pradesh Solar Power Corporation Pvt Ltd
- V Ramesh Babu, Deputy Executive Engineer, AP State Energy Conservation Mission
- G. Sreenivasulu, Deputy Executive Engineer, AP State Energy Conservation Mission
- G Sumanth, Engineer, AP State Energy Conservation Mission
- G. Sekhar, Assistant Director, Commissioner & Director of Municipal Administration
- G. Brahmaiah, Consultant, Commissioner & Director of Municipal Administration
- Md. Javeed, SWM Expert, Commissioner & Director of Municipal Administration
- D Rambabu, City Planner, Guntur Municipal Corporation (GMC)
- J Suraj Kumar, Deputy City Planner, Guntur Municipal Corporation (GMC)
- Chandra Bose, Deputy City Planner, Vijayawada Municipal Corporation
- M. Hari Prasad, Additional Director, LSE, APCRDA
- B John Benny, Deputy Director, LSE, APCRDA
- Nitin Kumar Sharma, Director Environment, APCRDA
- P Bhagavan Narayana Kumar, Assistant Conservator Of Forest, LSE, APCRDA
- G Praman Kumar, Senior Planner, LSE, APCRDA
- M Sri Gowri Shanthi, Senior Planner, USI, APCRDA
- G Raghavendra, Sustainability Specialist, APCRDA
- K Ravi, Environment Specialist, APCRDA
- A Siva Ramakrishna, Horticulture Officer, APCRDA

- Mr. Emani Kumar, Executive Director, ICLEI South Asia
- Representatives from ICLEI South Asia team

Online Participants

- Venu Prasad, Deputy Executive Engineer, APGENCO
- D Srinivasa Reddy, Senior Infrastructure planner, ADCL
- Prasad, Project Manager, AP State Disaster Management Authority
- Md. Nazeena Begum, Environmental Engineer, Guntur Regional office, APPCB
- Bhanu, UNICEF Consultant, Swachh Andhra Corporation
- Representative from the School of Planning and Architecture, Vijayawada

Opening Remarks:

- The Senior Planner (USI/ESMU), APCRDA, welcomed all participants and acknowledged their continued engagement in the consultation process. Referring to the earlier online meeting held on 08 September 2025, the planner informed attendees that the ICLEI team is now seeking more detailed, sector-specific feedback to support the finalization of the Amaravati Climate Change Action Plan (CCAP). This collaborative input is expected to strengthen the plan's relevance and effectiveness across key thematic areas.

Discussion:

- The Project team from ICLEI South Asia explained the overall activities and progress on the Climate Change Action Plan (CCAP) for the Amaravati project.
- The following are the brief points that were presented:
  - Review and synthesis of Amaravati's Master Plan, regional/infrastructure plans, zoning regulations, draft urban design guidelines
  - Analysis of baseline infrastructure, climate risk, and urban system impacts.
  - Identification of strategic mitigation and adaptation actions and target setting across nine urban sectors: energy and buildings, water supply, wastewater, stormwater, solid waste management, transportation, urban greening/biodiversity, health, and air quality.
  - Key goals include building Amaravati as an eco-friendly, low-carbon city with extensive green spaces, renewable energy integration, robust disaster resilience,

and efficient resource management.

1. **Key Points Highlighted in the Presentation**
   - Urban Design: The notified master plan of Amaravati has 30% of green and blue land use allocation planned on compact, mixed-use principles with high walkability.
   - Climate Risk Analysis: Data shows rising average and surface temperatures, increased frequency/intensity of rainfall events causing flooding, and the need for climate-resilient design and infrastructure.
   - GHG Emissions: Amaravati's per capita emissions are going to increase in the future due to higher electricity consumption with the growing population, and future interventions such as renewables, NMT, efficient buildings, and sustainable waste management can drastically reduce the emissions.
   - Sectoral Targets and Strategies for 100% Renewable Energy for city utilities, rainwater harvesting in all buildings, 50% reuse of treated water, and Nature-based solutions for storm management, decentralized waste management, EV transport, 30% blue green network, and readiness for heat impacts, early warning community awareness, and construction pollution protocols discussed.

2. **Stakeholder Input & Sectoral Discussions**
   - DEE, APGENCO suggested focusing on renewable energy. He flagged the proximity of the NTTPS power plant and compliance with pollution norms. As the power plant is close to Amaravati city.
   - DEE, APSECM highlighted the need to fast-track the adoption of the new Energy Conservation Building Code (2024), statutory enforcement, and inclusion of green building standards. Recommended AP Housing Corporation involvement for EWS solar appliance installations.
   - Additionally, the DEE, APSECM underscored the importance of establishing energy management centers, promoting efficient appliance standards, and implementing decentralized monitoring mechanisms. A phased approach was suggested for the adoption of these measures across both private and public buildings to ensure effective and scalable implementation.
   - Project Manager, APSDMA suggested including the NDMA heatwave mitigation guidelines (cool roof tech, green corridors/bus shelters), ward-level contingency plans for future flood events, robust early warning/sensor systems, and aligned city zoning to avoid high-risk development
   - DCP, GMC raised concerns about the ecological impacts of massive construction on agricultural/marshy land, suggested preparing robust

construction waste/social management plans, and habitat/ecosystem protection studies.

- EE, APPCB stressed the need for separate demarcation for industrial zones in Amaravati city to avoid future pollution conflicts and legal issues; recommended stringent guidelines to be adopted for the oil spills and chemical disposals.

Closing Remarks:

In conclusion, the Director (Environment), APCRDA, extended sincere appreciation to the ICLEI team for their comprehensive presentation of sectoral action plans. The session reflected a collaborative spirit and a shared commitment to advancing sustainable development goals.

The Director also thanked all participants for their active engagement and valuable contributions throughout the consultation. Their insights and feedback are instrumental in shaping a robust and inclusive final document.

The final version of the action plan is expected to undergo review around mid-October 2025. During this period, additional suggestions from stakeholders will be carefully considered and incorporated to ensure the document reflects a broad consensus and aligns with regulatory and developmental priorities.

Director (Environment)
APCRDA

To
All the Participants for the necessary action.

Copy to:
The Commissioner, APCRDA, for information
The Additional Commissioner (Planning), APCRDA, for information
The Additional Commissioner (Admin), APCRDA for information
The Chairperson & Managing Director, ADCL for information
The ESMU wing for necessary action