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Net-Zero ClimateResilientCities

Methodology Toolkit

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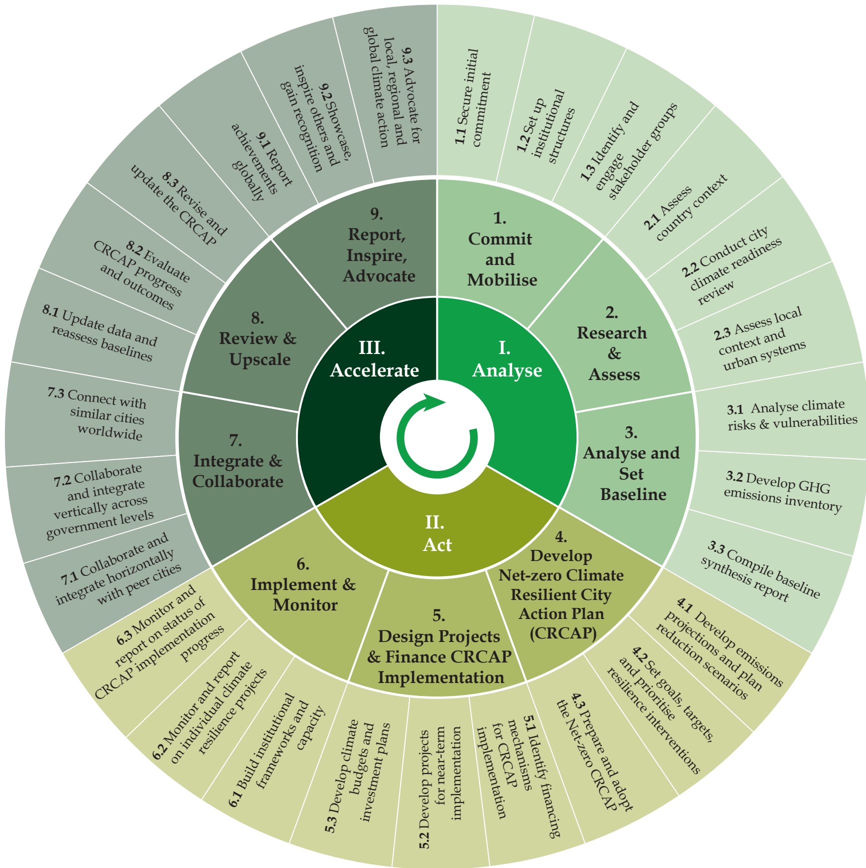
Guidance for Net-zero ClimateResilientCities Methodology Toolkit

The **Net-zero ClimateResilientCities (CRC) methodology**, a tailor-made climate action planning methodology for Local Governments (LGs), **provides step-by-step guidance to develop and implement a Net-zero Climate Resilient City Action Plan (CRCAP)**. The methodology is built on the premise that climate resilience encompasses both climate change mitigation and adaptation as well as the linkages between the two. Climate resilience addresses reducing GHG emissions and building resilience to climate change impacts, such as sea-level rise, shifting precipitation and temperature patterns, and extreme events.

The methodology equips LGs to estimate the GHG emission intensity of urban activities and to assess the climate risks of various urban systems and population groups within a city in the context of urbanisation and climate vulnerability. It also helps LGs identify climate resilience interventions to reduce GHG emissions, address existing and forecasted climate fragility, and develop a city-wide action plan. These capacities will help the city adapt to existing and impending climate change impacts and steer its focus toward climate change mitigation interventions.

The methodology builds on ICLEI's Cities for Climate Protection (CCP) Campaign, ICLEI's flagship GreenClimateCities (GCC) program, and ICLEI's adaptation toolkit - the ICLEI Asian Cities Climate Change Resilience Network (ACCCRN) Process or IAP toolkit. It also incorporates ICLEI's Net-zero emission modelling and scenario development methodologies, as well as the Intergovernmental Panel on Climate Change (IPCC) AR5 guidance on climate risk assessment.

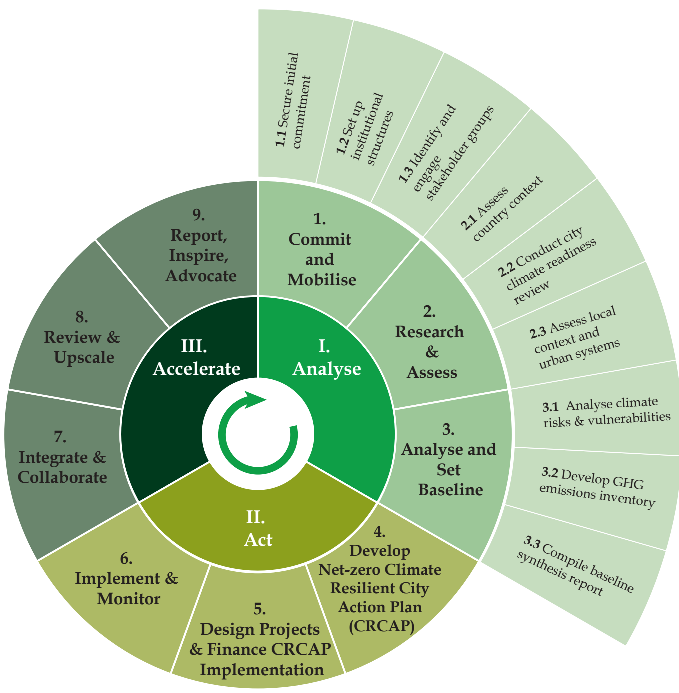


The Net-zero ClimateResilientCITIES methodology is a 9-step process comprising three phases, **Analyse**, **Act** and **Accelerate**, each unfolding into three steps. These steps can guide LGs in assessing their local context, GHG emissions levels, and climate risks; and identifying climate resilience interventions that can be integrated into urban development policies, plans, and processes to achieve low-carbon, climate-resilient development. The methodology is supported by a wide range of tools and guidance notes to help LGs deliver effective local climate action.

Guidance on the Net-zero ClimateResilientCITIES methodology and the toolkit

PHASE 1

Analyse



The “**Analyse**” Phase informs the policy and strategic decision-making at the start of the process. It includes setting up institutional structures to support implementation of the climate action planning process; and assessing the local context, gaps and opportunities in urban service systems, GHG emissions in the city, city level climate projections and scenarios, and climate risks and vulnerabilities.

PRIMARY OUTCOMES

- Declaration of LG’s commitment to achieve Net-zero emissions while prioritising climate resilient development for the local community
- Climate action planning using the Net-zero CRC methodology initiated by the LG
- Baseline synthesis report consolidating the findings from the baseline assessments, urban systems gap analysis, GHG emissions inventory, climate projections and scenarios statements, and the climate risks for the urban systems and population groups

Step 1: Commit and mobilise

Guidance Tools offered for Step 1:

- Tool 1.1: Mayoral Announcement
- Tool 1.2: Formation of City Climate Core Team
- Tool 1.3A: Stakeholder Engagement
- Tool 1.3B: Communications Plan

1.1 Secure initial commitment

This step is vital to ensure senior political and local government buy-in to kick-start the process for climate resilient development in the community and provide clear leadership. Consensus should be built within the LG on the various aspects of the climate action process. Political, executive and administrative support are required for successful planning and implementation of climate action plans. A Mayoral Announcement may be made, clearly stating the intent of the LG to address climate change through mitigation and adaptation measures, the ambition to achieve Net-zero emissions and—if already determined—the target year and city-wide vision for the Net-Zero CRCAP **(refer Tool 1.1: Mayoral Announcement)**.

1.2 Set up institutional structures

The formation of governance structures can ensure buy-in and effective decision-making, planning and implementation. At a minimum, a Climate Core Team should be setup, including representatives from all municipal departments (including Finance, all major municipal services and the communication/PR department), which will act as a task force to prepare and implement the Net-zero CRCAP **(refer Tool 1.2: Formation of City Climate Core Team)**.

1.3 Identify & engage stakeholder group(s):

This involves identifying and involving key individuals/community representatives and special focus groups, towards forming a Stakeholder Committee. The intention is to foster crucial partnerships, work with external groups and promote ownership of the Net-zero CRCAP within the LG as well as the community. Ideally, this committee, once nominated, is officially notified by either the administrative or political head of the LG **(refer Tool 1.3A: Stakeholder Engagement)**.

The core team should develop a Communications Plan to communicate with other LG departments, the external stakeholder committee and the city's local community. It is useful to prepare the plan in advance and update it regularly, as communication needs vary based on the stage of the CRCAP preparation or implementation **(refer Tool 1.3B: Communications Plan)**.

Step 2: Research & Assess

Guidance Tools offered for Step 2:

- Tool 2.1: Country Climate Profile
- Tool 2.2: City Climate Readiness Review
- Tool 2.3A: City Profile
- Tool 2.3B: Urban Systems Gap Analysis

2.1 Assess country context

It is valuable for an LG to understand external issues impacting local climate-resilient development. LGs, being the governance entity closest to action, are required to respond to and act on the different mandates from international agreements, regional directives, and national and sub-national laws (and rules). This step involves exploring the international/regional/national and sub-national contexts, including the policy/legal, economic, social and environmental contexts, and assessing their impacts on the LG unit, specifically in the context of climate-resilient development **(refer Tool 2.1: Country Climate Profile)**.

2.2 Conduct city climate readiness review

The impacts of climate change faced by the city's local community and the readiness of the city's LG readiness to implement the Net-zero CRCAP are assessed. The city's response to past events is noted to understand the efficacy of existing response mechanisms and further needs. A climate readiness review helps assess the city's capacities and readiness to tackle climate change **(refer Tool 2.2: City Climate Readiness Review)**. It is based on seven aspects:

- Political commitment and existing strategies, policies, and plans
- City's climate governance
- Information, data, tools, and processes
- Climate budgeting and financing processes
- Staff participation
- Existing climate initiatives
- Community engagement

2.3 Assess local context and urban systems

This step involves forming the evidence base for identifying climate risks, vulnerabilities and emission mitigation opportunities by building a comprehensive picture of the city's local context and the performance of its core urban systems. A City Profile is compiled covering the city's geography, connectivity, demography, institutional structure, local economy, land use and key environmental characteristics, drawing on data from local government departments, parastatal bodies, institutional databases and open-data sources **(refer Tool 2.3A: City Profile)**. Where data is not readily available, the gap is flagged along with the responsible department or agency, so such data gaps can be tracked and closed over time.

Building on the city profile, an Urban Systems Gap Analysis is conducted across key urban service sectors such as water supply, wastewater management, stormwater management, solid waste management, transportation, urban greening and biodiversity, and built environment and energy, using quantitative indicators and qualitative insights to assess coverage, reliability and service-level performance **(refer Tool 2.3B: Urban Systems Gap Analysis)**. This helps identify the fragility of urban systems, their inefficiencies, and their vulnerability to external disruptions, including extreme climate events. The outputs of this step feed directly into subsequent steps of the Net-zero CRC methodology, including Step 3.1 (Analyse Climate Risks & Vulnerabilities), Step 3.2 (Develop GHG Emissions Inventory), Step 4.1 (Develop Emissions Projections and Plan Reduction Scenarios), Step 4.2 (Set Goals, Targets, and Prioritise Resilience Interventions), and Step 4.3 (Prepare and Adopt the Net-zero CRCAP).

Step 3: Analyse and Set Baseline

Guidance Tools offered for Step 3:

- Tool 3.1A: Climate Trends and Past Events
- Tool 3.1B: Climate Change Projections and Scenarios
- Tool 3.1C: Climate Risk Assessment
- Tool 3.2A: Preparation and Management of GHG Emissions Inventory
- Tool 3.2B: GPC Standard
- Tool 3.2C: HEATplus Manual
- Tool 3.2D: GHG Emission Inventory Data Collection & Management
- Tool 3.2E: GHG Emissions Inventory Analysis and Synthesis
- Tool 3.2F: GHG Inventory Verification
- Tool 3.3: Preparation of Baseline Synthesis Report

3.1 Analyse climate risks & vulnerabilities

Basic historical weather data for the city including temperature, relative humidity, sea-level rise and precipitation, as relevant to the city's geography, is collected for the longest available period (a minimum of 30 years is recommended) to understand climate trends and patterns. Past climate events affecting the city are also documented over a comparable period, and local perceptions gathered through Shared Learning Dialogues (SLDs) are used to validate the trends derived from this analysis of secondary data **(refer Tool 3.1A: Climate Trends and Past Events)**.

Climate change projections are then collated for the city, using local data if available and regional or national assessments if not. Based on these projections, climate exposure scenarios, such as increased precipitation, heat stress, floods or other extreme weather events that increasingly affect people, infrastructure and urban systems are developed and documented as Climate Scenario Statements **(refer Tool 3.1B: Climate Change Projections and Scenarios)** which inform the climate risk assessment.

A Climate Risk Assessment (CRA) follows, based on the IPCC AR5 Working Group II conceptual framework, in which climate risk is assessed as a function of the interaction between climate hazards, exposure and vulnerability. This step draws on the fragile urban systems identified in Step 2.3 and generates ward-level climate risk statements for vulnerable population groups and urban systems, forming the analytical foundation for identifying and prioritising adaptation interventions **(refer Tool 3.1C: Climate Risk Assessment)**. For each climate hazard, the vulnerabilities of geographical areas, urban systems and population groups are assessed based on data such as geospatial, field level and grievance data, and by gathering insights from consultations with the Climate Core Team and the Stakeholder Committee through SLDs.

3.2 Develop GHG Emissions Inventory

A GHG emissions inventory is prepared to determine the sources and scale of GHG emissions from both LG operations and community-wide activities, providing evidence base for mitigation planning. Cities are guided to put in place a transparent, well-designed inventory management process covering data compilation, quality control and periodic updates, in accordance with the Global Protocol for Community-Scale GHG Emission Inventories (GPC), the standardised international framework for city-level carbon accounting **(refer Tool 3.2A: Preparation and Management of GHG Emissions Inventory and Tool 3.2B: GPC Standard)**.

Activity data such as electricity and fuel consumption, and waste generated and treated, are collected and organised across key sectors, including stationary energy, transportation, and waste, using a standard data inventory format that helps identify data gaps and validate entries with sector experts **(refer Tool 3.2D: GHG Emissions Inventory Data Collection and Management)**. Emissions are then calculated using ICLEI South Asia's HEATplus GHG inventory software or other tools as necessary **(refer Tool 3.2C: HEATplus Manual)**.

The findings are consolidated into a GHG Emissions Inventory Analysis and Synthesis Report that covers both community-scale and LG operations emissions, structured to align with GPC and Global Covenant of Mayors for Climate & Energy (GCoM) reporting formats **(refer to Tool 3.2E: GHG Emissions Inventory Analysis and Synthesis)**. The inventory is then verified against internationally accepted GPC standards—through city self-verification and/or third-party verification—to strengthen the credibility of the data and support access to climate finance and global reporting platforms **(refer Tool 3.2F: GHG Emission Inventory Verification)**.

3.3 Compile Baseline Synthesis Report

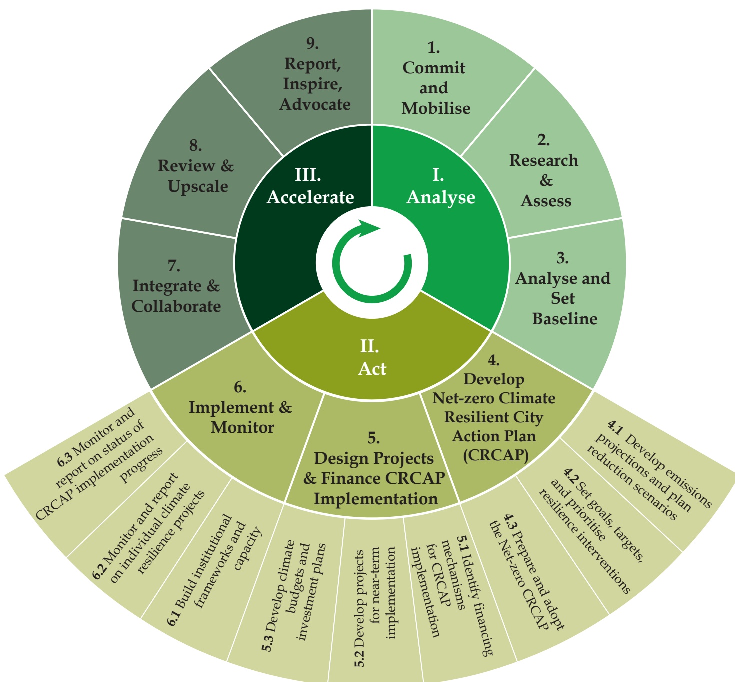
Findings from Step 2.1 (Country Climate Profile) through Step 3.2 (GHG Emissions Inventory) are consolidated into a Baseline Synthesis Report, bringing together the country and city profile, urban systems gaps, climate risks and vulnerabilities, and GHG emissions in a structured format **(refer Tool 3.3: Preparation of Baseline Synthesis Report)**. Against each identified climate risk statement, the specific locations, urban systems and population groups impacted are documented.

A summary of the carbon intensity of city activities is prepared from a mitigation perspective, and overlaps between high-emitting and climate-vulnerable sectors are noted to support integrated adaptation and mitigation planning. The report establishes the baseline against which future progress will be assessed and feeds directly into the identification and prioritisation of climate resilience interventions in Step 4.

PHASE 2

Act

The "**Act**" Phase translates the Net-zero CRCAP from a strategic plan into funded, on-the-ground climate action. It includes developing GHG emissions projections and net-zero reduction scenarios, setting sectoral goals, targets and prioritised resilience interventions, and preparing and ratifying the Net-zero CRCAP. It also covers designing and financing priority projects—including near-term implementation planning, climate investment plans and municipal climate budgeting—and establishing the institutional frameworks, capacities and monitoring systems needed to implement and track climate action.



PRIMARY OUTCOMES:

- Net-zero CRCAP prepared, ratified and adopted by the local municipal council
- Priority climate resilience projects identified, prepared for near-term implementation, and linked to financing mechanisms, climate investment plans and municipal climate budgets
- Institutional frameworks for Net-zero CRCAP implementation established within the LG and capacities enhanced through trainings based on findings from capacity building needs assessment
- Project and Net-zero CRCAP level monitoring, reporting and verification (MRV) systems and framework established, with key performance indicators to track implementation progress

Step 4: Develop Net-zero Climate Resilient City Action Plan

Guidance Tools offered for Step 4:

- Tool 4.1A: GHG Emissions Forecasting
- Tool 4.1B: GHG Emissions Reduction Scenario Planning
- Tool 4.2A: Net-zero Vision and Sectoral Goals, and Resilience Interventions
- Tool 4.2B: Prioritisation of Climate Resilience Interventions
- Tool 4.2C: Target setting for Climate Resilience Interventions
- Tool 4.3A: Detailing of Climate Resilience Interventions and Integration into City Plans/Schemes
- Tool 4.3B: CRCAP Document Template
- Tool 4.3C: Ratify and Adopt Net-zero CRCAP

4.1 Develop emissions projections and plan reduction scenarios

Building on the base-year GHG emissions inventory (Step 3.2), future emissions are projected under a Business-as-Usual (BAU) scenario, assuming no additional mitigation interventions are implemented and based on population and economic growth factors and other locally relevant, sector-specific drivers of urban activities linked to energy. The BAU projection establishes the baseline trajectory against which the scale of effort required to shift towards net-zero or low-carbon development can be measured **(refer Tool 4.1A: GHG Emissions Projections)**.

Cities then design long-term GHG emission-reduction scenarios including a net-zero pathway by modelling how combinations of interventions such as renewable energy (RE) generation or electric vehicle adoption can reduce emissions relative to the BAU trend under progressive action scenario[1.1] or an ambitious Net-zero pathway. This enables cities to compare the reduction potential and timelines of different scenarios and refine the interventions and targets accordingly **(refer Tool 4.1B: GHG Emissions Reduction Scenario Planning)**.

4.2 Set goals, targets, and prioritise resilience interventions

This step introduces climate resilience interventions and the process for identifying, prioritising and setting targets and goals for climate resilience interventions. Based on the findings from the baseline assessments, GHG emissions inventory and the climate risk assessment, cities can draw on a ready reference list of sector-wise resilience interventions and identify new interventions as required in line with their net-zero vision, sectoral goals, targets and strategies **(refer Tool 4.2A: Net-zero Vision and Sectoral Goals, and Resilience Interventions)**.

The initial list of proposed interventions is then assessed and prioritised based on their climate resilience potential, feasibility of implementation (technical, political and financial), and the time required to achieve impact, covering both adaptation and mitigation interventions across sectors **(refer Tool 4.2B: Prioritisation of Resilience Interventions)**.

Finally, ambitious yet practical sectoral mitigation targets (to reduce or avoid GHG emissions) and adaptation targets (to improve resilience to climate risks) are set, alongside city-wide targets and a climate vision statement, led by the Climate Core Team along with the Stakeholder Committee. Co-benefits such as improved public health, air quality and economic opportunity are also captured **(refer Tool 4.2C: Target Setting for Resilience Interventions)**.

4.3 Prepare and adopt the Net-zero CRCAP

Prioritised resilience interventions are linked to the city's existing, ongoing and planned initiatives to identify opportunities for leveraging existing funding and developed into sector-wise summaries with strategy-wise details on actions, sub-actions and other details. This can be undertaken in consultation with the Climate Core Team along with the Stakeholder Committee to ensure cross-departmental linkages and feasibility are captured in the Climate Actions and Goals chapter of the Net-zero CRCAP **(refer Tool 4.3A: Detailing of Climate Resilience Interventions and Integration into City Plans/Schemes)**.

The outputs and findings from Steps 1 to 4 are compiled into the Net-zero CRCAP document, using a chapter-wise structure covering the executive summary; national and local context baseline assessments; GHG emissions inventory; climate risk assessment; GHG emissions reduction scenario planning; and identification of climate resilience interventions, targets, and goals. The template is suggestive and should be adapted to the city's local context and requirements **(refer Tool 4.3B: CRCAP Document Template)**.

The completed Net-zero CRCAP is then formally presented to the Mayor, Commissioner and councillors and ratified by the municipal council, giving it official status as an approved policy and development planning framework. This political ratification builds ownership, strengthens accountability, and improves access to climate finance and implementation partnerships **(refer Tool 4.3C: Ratify and Adopt Net-zero CRCAP)**.

Step 5: Design Projects and Finance CRCAP Implementation

Guidance Tools offered for Step 5:
- Tool 5.1: Funding & Financing for CRCAP Implementation
- Tool 5.2: Near-term Project Prioritisation and Preparation
- Tool 5.3A: Preparation of Climate Investment Plans for Cities
- Tool 5.3B: Municipal Climate Budgeting

5.1 Identify financing mechanisms for CRCAP implementation

The Net-zero CRCAP identifies long-term pathways and priority actions for reducing GHG emissions and building climate resilience. A structured implementation approach is necessary to translate these into a pipeline of projects containing on-ground actions that can be funded through municipal budgets and external financing. The city can use one or both practical implementation pathways provided for the purpose **(refer Tool 5.1: Funding and Financing for CRCAP Implementation)**.

5.2 Develop projects for near-term implementation

Once the Net-zero CRCAP is ratified and adopted, cities develop a time-bound, near-term implementation plan—typically spanning 1 to 5 years—translating the CRCAP's long-term vision and sectoral goals into priority actions that are immediately feasible, and aligned with the city's development priorities and municipal capacities. The institutional structure established to coordinate CRCAP preparation continues to lead this near-term planning process **(refer Tool 5.2A: Near-term Project Prioritisation and Preparation)**. The tool provides guidance to cities on identifying, prioritising and preparing pilot demonstration projects as test-beds for new technologies or approaches, and developing a pipeline of bankable, investment-ready projects that include techno-economic assessments and Detailed Project Reports (DPRs) with clear rationale, detailed engineering design, cost estimates and climate impacts.

5.3 Develop climate budgets and investment plans

A Climate Investment Plan (CIP) translates the Net-zero CRCAP into a multi-year financial strategy, bridging climate ambition and financial reality by analysing the Urban Local Body's (ULB) financial health, allocating costs across stakeholders, and mapping funding sources for the additional investment required beyond BAU activities **(refer Tool 5.3A: Preparation of Climate Investment Plans for Cities)**.

The Net-zero CRCAP is embedded into routine municipal governance through municipal climate budgeting that includes tagging, tracking and prioritising municipal expenditure against defined mitigation and adaptation outcomes, so climate action is institutionalised within the annual budget cycle rather than treated as an off-budget or standalone initiative **(refer Tool 5.3B: Municipal Climate Budgeting)**. As a first step, regular municipal budgets and state, national and mission-linked grants are screened for potential financing opportunities, alongside external grant, donor and private-sector partner funding for specific projects.

Step 6: Implement and Monitor

Guidance Tools offered for Step 6:

- Tool 6.1A: Institutionalising Climate Action Planning and Implementation
- Tool 6.1B: Institutional Capacity Enhancement
- Tool 6.2: Climate Project Monitoring and Reporting
- Tool 6.3: Tracking CRCAP Implementation

6.1 Build institutional frameworks and capacity

Implementation of the Net-zero CRCAP requires the city's Climate Core Team, established in Step 1.2, to evolve into a permanent institutional structure, a Net-zero Climate Action Cell, with clearly defined roles, mandates, staffing and coordination mechanisms to guide annual planning, oversee pilot projects, and prepare bankable projects for scale-up **(refer Tool 6.1A: Institutionalizing Climate Action Planning and Implementation)**.

A Capacity Building Needs Assessment (CBNA) is then conducted to help the city self-assess its institutional, technical and human resource capacities for planning, implementing and monitoring climate actions under the Net-zero CRCAP; and identify strengths, gaps and priority capacity-building needs across technical assessment and planning, project conceptualisation, financing, data systems, coordination and monitoring. This is recommended after CRCAP adoption to strengthen institutional readiness for implementation **(refer Tool 6.1B: Institutional Capacity Enhancement)**.

6.2 Monitor and report on individual climate resilience projects

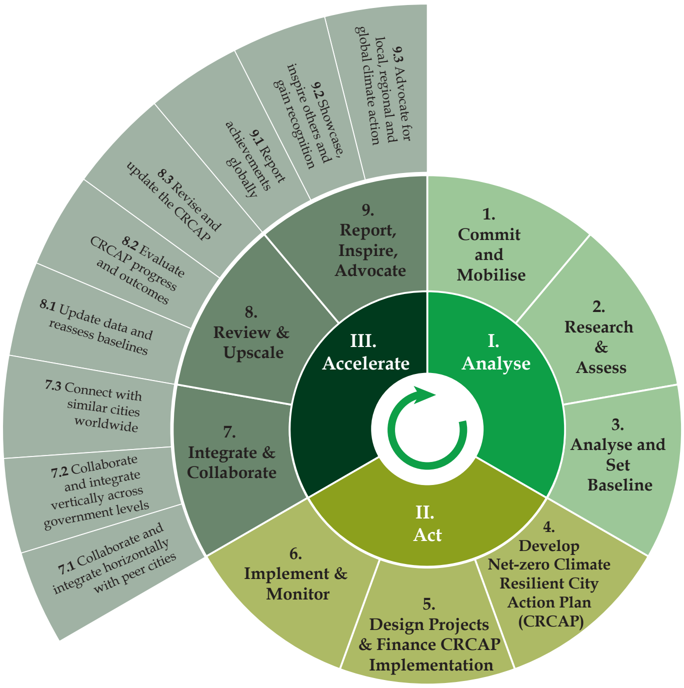
A project-level Monitoring, Reporting and Verification (MRV) system is developed to track the performance of individual climate adaptation and mitigation projects, ensuring implementation is consistently monitored against well-defined indicators and reported transparently for decision-making. This strengthens the credibility of climate interventions and supports compliance with national frameworks and international reporting platforms **(refer Tool 6.2: Climate Project Monitoring and Reporting)**. A robust project-level MRV system improves access to climate finance as many climate finance instruments, including grants, concessional loans, results-based finance and carbon market mechanisms require credible, quantifiable evidence of project impacts and outcomes.

6.3 Monitor and report on status of CRCAP implementation progress

The Net-zero Climate Action Cell (Tool 6.1A) and the point of contacts from the various departments in the LG can develop Key Performance Indicators (KPIs) to monitor and track implementation of the Net-zero CRCAP as a whole, covering both adaptation and mitigation interventions across sectors. A simple city-wide MRV framework defines measurable indicators, assigns responsibilities, and sets a schedule for periodic review of progress **(refer Tool 6.3: Tracking CRCAP Implementation)**. The sample KPIs and summary reporting template provided can be used to consistently track climate resilience interventions across sectors, complementing the project-level MRV systems developed in Step 6.2 for individual interventions. The data collected from project-level MRV systems with support from stakeholders and implementing agencies for different interventions can directly feed into the larger CRCAP implementation progress tracking.

PHASE 3

Accelerate



The "**Accelerate**" Phase focuses on sustaining, scaling up and showcasing climate action beyond the initial CRCAP cycle. It includes integrating and collaborating horizontally with peer cities, vertically with state and national governments, and globally through international networks and partnerships. It also covers periodically updating the baseline and evaluating and revising the Net-zero CRCAP based on implementation progress, and reporting, showcasing and advocating for the city's climate achievements at local, regional and global platforms.

PRIMARY OUTCOMES:

- Strengthened horizontal, vertical and global collaboration and partnerships that support implementation and scale-up of climate action
- Updated baseline and a revised, more ambitious Net-zero CRCAP reflecting implementation progress and emerging priorities
- Increased GHG emission reductions and climate adaptive capacities
- City's climate achievements reported, recognised and used to advocate for enabling policy, regulatory and financing conditions at regional, national and global levels

Step 7: Integrate & Collaborate

Guidance Tools offered for Step 7:

- Tool 7.1: Horizontal Collaboration with Other Similar Cities in the Country
- Tool 7.2: Vertical Collaboration with Provincial & National Governments
- Tool 7.3: Developing Global City Partnerships

7.1 Collaborate and integrate horizontally with peer cities

Horizontal integration refers to cooperation and coordination between different LGs within a province or region, and between city departments, through structured coordination strategies and peer exchanges that support planning, implementation and regional scale-up of climate actions. This can significantly improve the efficiency, coherence and sustainability of urban infrastructure that spans administrative borders, such as transportation, where coordinating interfaces, timetables, ticketing and operators helps expand public transport and non-motorised mobility. Horizontal collaboration with neighbouring municipalities can also help a city reach the scale needed for strategies that would not be viable alone, such as a regional waste management facility or a bulk RE purchasing consortium **(refer Tool 7.1: Horizontal Collaboration with Other Similar Cities in the Country)**.

7.2 Collaborate and integrate vertically across government levels

Vertical integration, or multi-level governance, involves structured engagement between national, state and local government to enable regular information exchange, planning and coordination for climate action planning, implementation and reporting towards enhancing the effectiveness of policies and programs. This helps identify gaps in resources and capacity, address local needs, and build on local strengths, while positioning LGs to contribute to national low-emission development targets and commitments **(refer Tool 7.2: Vertical Collaboration with Provincial and National Governments)**. Since LGs operate within national and state policy and infrastructure frameworks, using or creating channels for vertical communication and coordination helps address enabling-framework gaps, improves access to state and national financing, and can provide additional technical, financial and political support for cities piloting innovative strategies that may be scaled up nationally.

7.3 Connect with similar cities worldwide

Joining city networks and platforms in the country, region, or internationally, including thematic groups such as the Global 100% Renewable Energy Cities and Regions Network connects cities with peers facing similar needs and challenges, enabling the exchange of knowledge, successful (and unsuccessful) approaches, and confidence in exploring new technologies. This can help identify pitfalls early and position the LG as a leader in its field. Participation in global networks also exposes cities to new ideas and innovative approaches, and emerging resources such as online marketplaces that centralise guidance on potential solutions and tools (**refer Tool 7.3: Developing Global City Partnerships**).

Step 8: Review & Upscale

Guidance Tools offered for Step 8:

- Tool 2.1 – Tool 3.3 (baseline assessment tools)
- Tool 6.2 – Tool 6.3 (monitoring and reporting tools)
- Tool 4.1 – Tool 4.3C (Net-zero CRCAP planning tools)

(No dedicated tools for this step; it draws on the overall set of tools in the toolkit)

8.1 Update data and reassess baselines

This step involves a systematic review of systems, processes, capacities, partners and actions, and an assessment of targets against results, in line with the Monitoring, Reporting and Verification (MRV) framework established in Step 6. It helps identify successes, challenges and barriers, and the extent to which the Net-zero CRCAP process has been institutionalised and integrated into city planning. A bi-annual review of the GHG emissions inventory and climate risk assessment can be conducted to improve data collection sources, scope of coverage, and identify further opportunities to improve impacts of the climate resilience interventions recommended by the Net-zero CRCAP. Using the same steps and tools to develop the original baseline, secure new information, update baselines, and assess emerging climate challenges (Step 2.1 [Assess country context] to Step 3.2 [Develop GHG Emissions Inventory]).

8.2 Evaluate CRCAP progress and outcomes

Building on the updated baseline and the project-level and CRCAP-level monitoring data from Step 6 (Tool 6.2: Climate Project Monitoring and Reporting and Tool 6.3: Tracking CRCAP Implementation), the city can evaluate the overall progress and outcomes of the Net-zero CRCAP, identifying new sector priorities as well as revised priorities and actions based on an assessment of needs, challenges and opportunities. This evaluation should reflect enhanced ambition for scaling up action towards emerging climate priorities and adaptation challenges.

8.3 Revise and update the CRCAP

Using the revised emissions projections, targets and prioritised interventions, the city should update the Net-zero CRCAP and ensure continued political commitment. This may include new priority sectors, revisions reflecting changes in national or state guidelines and programmes, and an increase in the scale, extent and number of projects, following the same preparation, target-setting and ratification process used to develop the original CRCAP (using Tool 4.1A: GHG Emissions Projections to Tool 4.3C: Ratify and Adopt the Net-zero CRCAP).

Step 9: Report, Inspire, Advocate

Guidance Tools offered for Step 9:

- Tool 9.1: Global Reporting of Climate Actions
- Tool 9.2: Communication for Visibility and Recognition
- Tool 9.3: Engagement in Local, Regional and Global Climate Advocacy

9.1 Report achievements globally

City leadership engages directly with international organisations, agencies and financial institutions to advocate for local action and improved enabling conditions for LGs, aligning with global processes such as the Paris Agreement and the Sustainable Development Goals (SDGs). Cities report their climate actions including the Net-zero CRCAP, GHG emissions inventory, climate risk assessments, targets, and mitigation and adaptation actions through global platforms such as the CDP-ICLEI Unified Reporting System, which allows simultaneous reporting to initiatives including the GCoM, ICLEI's GCC Program, and the Transformative Actions Program (TAP) **(refer Tool 9.1: Global Reporting of Climate Actions)**.

9.2 Showcase, inspire others and gain recognition

This step focuses on gaining national and international recognition for the city's Net-zero CRCAP achievements through award platforms, city networks and knowledge-sharing forums. Recognition acknowledges the work and climate impacts of the city and its "champions" and helps raise the community's public climate profile and sustain climate resilience as a political priority. By becoming better known, cities can attract national and global partnerships. Participation in city networks helps gain recognition through awards for member cities with rewards including technical or financial assistance **(refer Tool 9.2: Communication for Visibility and Recognition)**.

9.3 Advocate for local, regional and global climate action

Cities identify and engage with local, regional and global advocacy platforms to share learnings from CRCAP implementation; strengthen multilevel collaboration, and help shape enabling policy, regulatory and governance frameworks. The learning curve for cities is substantially shortened when they learn from peers, and sub-national and national climate goals are met faster when cities share knowledge within their region. Participation in sub-national, regional and national programs provides avenues for showcasing climate leadership locally, and for translating on-the-ground insights into strategic input for national policy discourses and global climate agendas **(refer Tool 9.3: Engagement in Local, Regional and Global Climate Advocacy)**.

The following is a list of the steps of the methodology along with the supporting tools and guidance documents. The tools are annexed to this document for guidance.

Net-zero Climate Resilient City Action Plan Process

Steps	New Sub-steps	Tools & Guidance Notes
1. Commit and Mobilise	1.1 Secure initial commitment	Tool 1.1: Mayoral Announcement
	1.2 Set up institutional structures	Tool 1.2: Formation of City Climate Core Team
	1.3 Identify & engage stakeholder groups	Tool 1.3A: Stakeholder Engagement
		Tool 1.3B: Communications Plan
2. Research and Assess	2.1 Assess country context	Tool 2.1: Country Climate Profile
	2.2 Conduct city climate readiness review	Tool 2.2: City Climate Readiness Review
	2.3 Assess local context and urban systems	Tool 2.3A: City Profile
		Tool 2.3B: Urban Systems Gap Analysis
3. Analyse and Set Baseline	3.1 Analyse climate risks & vulnerabilities	Tool 3.1A: Climate Trends and Past Events
		Tool 3.1B: Climate Change Projections and Scenarios
		Tool 3.1C: Climate Risk Assessment
	3.2 Develop GHG Emissions Inventory	Tool 3.2A: Preparation and Management of GHG Emissions Inventory
		Tool 3.2B: GPC Standard
		Tool 3.2C: HEATplus Manual
		Tool 3.2D: GHG Emissions Inventory Data Collection & Management
		Tool 3.2E: GHG Emissions Inventory Analysis and Synthesis
		Tool 3.2F: GHG Emissions Inventory Verification
	3.3 Compile Baseline Synthesis Report	Tool 3.3: Preparation of Baseline Synthesis Report
4. Develop Net-zero Climate Resilient City Action Plan (CRCAP)	4.1. Develop emissions projections and plan reduction scenarios	Tool 4.1A: GHG Emissions Projections
		Tool 4.1B: GHG Emissions Reduction Scenario Planning
	4.2 Set goals, targets, and prioritise resilience interventions	Tool 4.2A: Net-zero Vision and Sectoral Goals, and Resilience Interventions
		Tool 4.2B: Prioritisation of Climate Resilience Interventions
		Tool 4.2C: Target Setting for Climate Resilience Interventions
	4.3 Prepare and adopt the Net-zero CRCAP	Tool 4.3A: Detailing of Climate Resilience Interventions and Integration into City Plans/Schemes
		Tool 4.3B: CRCAP Document Template
		Tool 4.3C: Ratify and Adopt Net-zero CRCAP
5. Design Projects and Finance CRCAP Implementation	5.1 Identify financing mechanisms for CRCAP implementation	Tool 5.1: Funding & Financing for CRCAP implementation
	5.2 Develop projects for near-term implementation	Tool 5.2A: Near-term project prioritisation and preparation
	5.3 Develop climate budgets and investment plans	Tool 5.3A: Preparation of Climate Investment Plans for cities
		Tool 5.3B: Municipal Climate Budgeting

Net-zero Climate Resilient City Action Plan Process		
Steps	**New Sub-steps**	**Tools & Guidance Notes**
6. Implement & Monitor	6.1 Build institutional frameworks and capacity	Tool 6.1A: Institutionalising Climate Action Planning and Implementation
		Tool 6.1B: Institutional capacity enhancement
	6.2 Monitor and report on individual climate resilience projects	Tool 6.2: Climate Project Monitoring and Reporting
	6.3 Monitor and Report on status of CRCAP Implementation Progress	Tool 6.3: Tracking CRCAP Implementation
7. Integrate & Collaborate	7.1 Collaborate and integrate horizontally with peer cities	Tool 7.1: Horizontal Collaboration with Other Similar Cities in the Country
	7.2 Collaborate and integrate vertically across government levels	Tool 7.2: Vertical Collaboration with Provincial & National Governments
	7.3 Connect with similar cities worldwide	Tool 7.3: Developing Global City Partnerships
8. Review & Upscale	8.1 Update data and reassess baselines	Tool 2.1 – Tool 3.3
	8.2 Evaluate CRCAP progress and outcomes	Tool 6.2 – Tool 6.3
	8.3 Revise and update the CRCAP	Tool 4.1 – Tool 4.3C
9. Report, Inspire, Advocate	9.1 Report achievements globally	Tool 9.1: Global Reporting of Climate Actions
	9.2 Showcase, inspire others and gain recognition	Tool 9.2: Communication for Visibility and Recognition
	9.3 Advocate for local, regional and global climate action	Tool 9.3: Engagement in Local, Regional and Global Climate Advocacy

Tool 1.1

Mayoral Announcement

This tool is a template for a declaration of commitment by local governments or cities to climate-resilient development and to initiating the climate action planning process. The template may be used as a guidance to prepare an approval letter attuned to the city's local context, priorities and climate targets.

Insert city letter head with logo

[City] commits to develop and implement (net-zero) climate-resilient city action plan [horizon year]

Today, [NAME], Mayor of [CITY], reaffirmed the city's commitment to undertake ambitious and sustained climate action to steer the city towards a low-emission development pathway, enhance resilience to the impacts of climate change, and transparently report progress to the public.

The Mayor, [NAME], demonstrated this commitment to climate action by acknowledging the climate risks and vulnerabilities faced by the city, and by taking the necessary steps to develop a comprehensive greenhouse gas (GHG) inventory and a local climate action plan with ambitious climate change adaptation strategies and targeted GHG emission mitigation measures.

[CITY] further commits to institutionalizing a local climate governance framework that can support effective climate action planning, implementation and continuous monitoring and reporting of its climate actions.

With this pledge, the [NAME OF LOCAL GOVERNMENT] will continue to build a thriving, climate-resilient community for its residents and businesses. In doing so, [CITY] contributes directly to [COUNTRY's] progress on its Nationally Determined Contributions (NDC) and long-term net-zero ambitions.

We proudly stand with cities around the world in fostering global climate leadership and accelerating climate actions to successfully implement the 2015 Paris Agreement to limit global warming to well below 2°C.

Signed and endorsed by:

[NAME]

Mayor, [CITY]
On behalf of the [LOCAL GOVERNMENT NAME]

Date: ____________________

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Tool 1.2

Formation of Climate Core Team

This tool provides guidance to cities to establish a Climate Core Team that will lead, coordinate and oversee the development and implementation of the Net-zero Climate Resilient City Action Plan (CRCAP). The tool highlights the importance of identifying core team members from cross-functional divisions while ensuring gender balance and a diverse range of expertise. It also emphasizes the need to clearly define the Climate Core Team's activities and responsibilities for coordinating the Climate Action Planning process and establish clear terms of reference for the identified members.

Political and Senior Management Support

Securing mayoral, political and senior management support for climate action and participation in the Climate Core Team is critical to formalizing the team and granting it the authority required to function effectively.

Team Composition

Climate Action Planning extends beyond the environment sector; therefore, an effective Climate Core Team should draw on staff from a wide range of departments. Engaging staff from across local government operations, with diverse perspectives and expertise, is an important early step in the Climate Action Planning process.

The Climate Core Team may consist of representatives from local government departments responsible for development planning, energy use, pollution control, waste management, food security, water security, public health, local economic development, infrastructure, and transportation, while ensuring fair representation of both genders.

It is important to include senior decision-makers, such as heads of department and their administrative or political leader(s), so that the team's activities, undertaken as part of members' day-to-day responsibilities, and its recommendations receive direct institutional support from senior management in the local government. The team should also include specialist and operational personnel from relevant departments, ensuring gender balance.

A Project Nodal Officer should be identified to serve as the primary point of contact for the team and to coordinate and support the Climate Action Planning process in the city.

Where a similar committee or working group already exists within the local government, it may be designated as the Climate Core Team, provided it adopts the Terms of Reference (ToR) outlined in Exercise 2 below.

Team, Roles and Responsibilities

Identifying the Core Team members is a crucial step, as the team will be responsible for driving the Climate Action Planning process in your city. However, it should be noted that the Climate Core Team is not a fixed body, and additional members can be added as required. Suggested responsibilities of the Climate Core Team include:

- Serving as representatives of their respective city government divisions or sectors;
- Attending and participating in workshops to guide the Climate Action Planning process and its expected outputs (tools, materials, and reports);
- Leading the city government's participation in the program;
- Ensuring that the Climate Action Planning process is followed in its entirety;
- Ensuring that the deadlines for each step are met, including the delivery of workshops and stakeholder consultations at different stages of the project;
- Coordinating necessary communication and collaboration with all relevant departments of the city and other stakeholders;
- Supporting internal institutional capacity building to effectively fulfil long-term climate resilience planning requirements;
- Preparing a City Resilience Strategy and facilitating the effective integration of planned initiatives into the city's developmental plans; and
- Monitoring and reviewing progress towards reducing GHG emissions and climate vulnerability.

A Project Nodal Officer for the Climate Core Team will be identified to serve as the primary point of contact and to coordinate the Climate Action Planning process in the city. The main responsibility of the Project Nodal Officer will include ensuring effective coordination and smooth implementation of the tasks undertaken by the Climate Core Team. Responsibilities may include:

- Organizing Core Team meetings as per the agreed schedule;
- Facilitating communication and consultation with the stakeholder group;
- Tracking progress through the Climate Action Planning process and informing the Core Team of completed and upcoming tasks, as laid out in the toolkit; and
- Facilitating data collection from various departments and other sources.

It is envisaged that, after the development of the Climate Action Plan, the Climate Core Team will evolve into a Net-zero / Climate Action Cell institutionalized within the local government's governance framework. This Cell will support the implementation of the Climate Action Plan. Please refer to Tool 6.1A for the roles and responsibilities of the Cell.

EXERCISE 1

Identification of Climate Core Team Members

In Table 1 below, please list the members of the Climate Core Team, their position, and proposed responsibilities.

Table 1: Members of the Climate Core Team

Designation	Department	Responsibility
Chairperson		Supervising the working of the Core Team and providing overall management support
Project Nodal Officer		Coordinating all activities of the Core Team and ensuring its smooth functioning
Member		Coordinating activities with the XXYY department

EXERCISE 2

Terms of Reference

Once you have identified your Climate Core Team members, you will need to define an organizational framework for the team. The following are key elements to consider when developing the ToR.

Step 1: Vision and Statement

The Core Team should develop a clear vision and timeframe outlining the desired future of the city (for example, over a 5-, 10- or 20-year horizons). This vision may be guided by the city's existing vision statement. The team should identify and elaborate on climate change-related elements within this broader vision.

First, note the various elements of the desired vision in Table 2 below. Examples of potential elements of the vision are provided for reference. Please ensure that the focus remains on desired outcomes.

Table 2: Elements of the City Vision - Example

	Elements of the Vision Statement
1	e.g., The city government routinely considers climate impacts in project planning.
2	e.g., Basic services such as water, sanitation, and energy supply are provided equitably to all citizens.
3	
4	
5	

Now, based on the elements listed in Table 2, formulate a Vision Statement for your city. For example:

"By 2030, the City of ..XX… will have climate-resilient infrastructure and systems that ensure the equitable provision of basic services to all citizens."

The Climate Core Team will work toward achieving the city's vision and take the necessary steps to develop a Climate Action Plan that addresses short-, medium- and long-term climate actions.

Step 2 – Monitoring and Reporting

The Climate Core Team should define a clear monitoring and reporting process for executing the activities. The Project Nodal Officer may be designated as the lead person responsible for ensuring reporting and monitoring of progress.

Step 3 – Term of Office

The terms of office for the Climate Core Team members need to be discussed. When an official's tenure ends before the process concludes, the Core Team must be informed, and a replacement official should be appointed in a timely manner.

Step 4 – Frequency of Meetings

The frequency of meetings should be determined based on the process guide or the adopted project plan. Where possible, meeting schedules, including frequency, time, location, and maximum duration, should be decided in advance.

Step 5 – Decision-making process

It will be helpful to decide the decision-making process for the Climate Core Team in advance. This will ensure clarity and avoid last-minute confusion.

Tool 1.3A

Stakeholder Engagement

This tool helps local governments identify stakeholders and engage them in the development and implementation of the Climate Action Planning process. It guides local governments through a participatory approach to form a stakeholder group and develop a terms of reference (ToR) for stakeholder engagement.

Stakeholder engagement in the Net-zero Climate Resilient City Action Plan (CRCAP) development process should be a two-way dialogue between government teams leading the planning process (e.g., Climate Core Team) and different stakeholders, including government agencies, local NGOs, community groups, university partners and private sector organizations. Stakeholder engagement, through workshops and other tools, should be a participatory process that effectively involves different groups, especially in situations of controversy or complexity, to build consensus around possible solutions.

Local governments need to determine the form(s) of stakeholder engagement to be undertaken, such as inter-departmental coordination meetings, which can be used for the CRCAP development and implementation, provided they adhere to the ToR for stakeholder engagement.

There are two steps involved in setting up the City's stakeholder engagement system:

1. Forming a Stakeholder Group
2. Developing a ToR for Stakeholder Engagement

The following sections provide guidance on forming a Stakeholder Group and establishing a ToR for stakeholder engagement.

SECTION A

Forming a Stakeholder Group

The Climate Core Team may choose to involve other key individuals (from within or outside the local government), as required, to complete this task.

As with the Climate Core Team, stakeholders should be invited from a range of sectors and issues relevant to developing a comprehensive CRCAP, including energy use, pollution, waste management, food security, water security, public health, local economic development, infrastructure, transportation, and development planning.

Using this list of potential sectors, along with your understanding of the major groups and influential actors in your city, you can start identifying potential stakeholders for participation, ensuring fair participation of women.

1. Which groups can provide information that would contribute to the Climate Action Planning process? (e.g., para-statal departments responsible for groundwater, transport, and fuel supply, meteorological department, etc.)
2. Which groups would be involved in the implementation of the CRCAP? (e.g., local

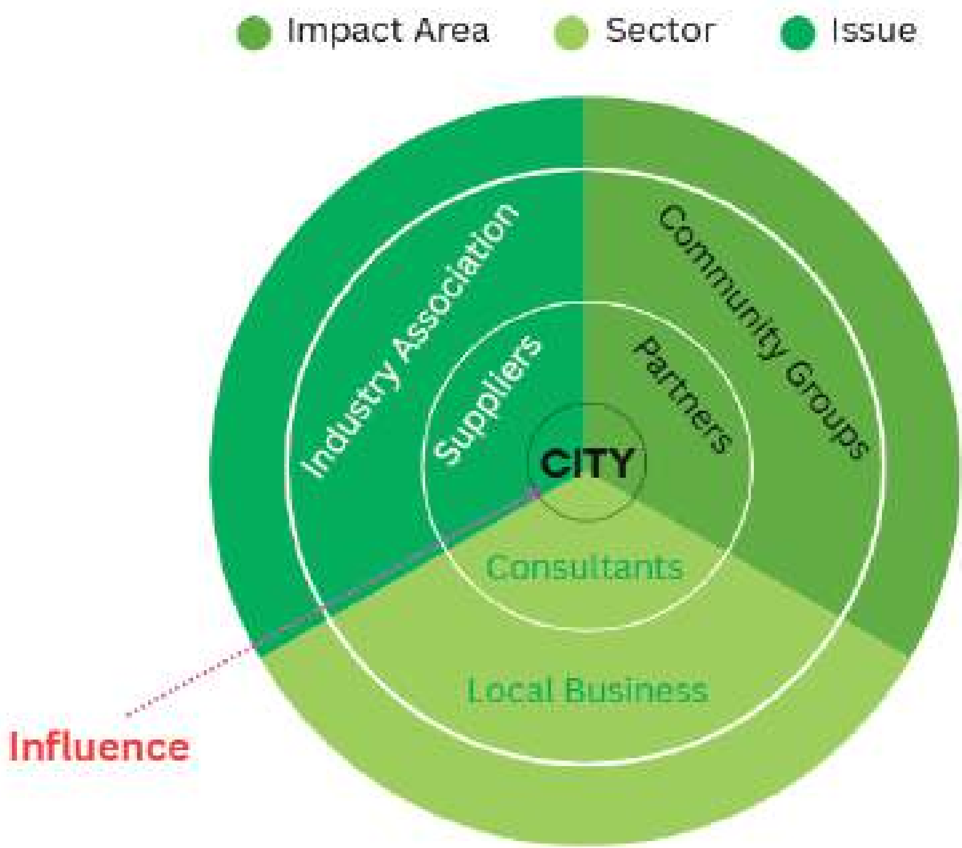
builders' associations, Resident Welfare Associations, para-statal departments, etc.)

3. Which groups would be able to support the implementation of the CAP? (e.g., local builders' associations, Resident Welfare Associations, para-statal entities, provincial government representatives, financial institutions, etc.)
4. Which groups are most likely to be affected by the implementation of the proposed CRCAP? (e.g., informal sector workers, low-income households living along surface water channels, residents of the city, intermediate public transport service providers, etc.)

Stakeholders may include individuals and organizations, different levels of government, NGOs, research institutions, the private sector, and community leaders.

Sphere of Influence

The diagram below can be used to identify all important groups.



The innermost circle represents your entity y (e.g., the local government, or a project team) where you have the maximum control, responsibility and authority.

The next circle represents people or organizations with whom you have close relationships or partnerships and common goals or a shared purpose, but over whom you do not have direct control.

The following circle includes those who may have some influence on the work you do, perhaps through indirect or ad hoc relationships, where you have even less control.

The outer circle represents the general macro environment in which you live, but over which you have minimal control.

	Government (local, national)	Local NGOs	Research Institutions	Community Representatives	Private Sector
Potentially provide information contributing to the development of the CRCAP					
Potentially be involved in the implementation of the CRCAP					
Whose support will be essential to implement the CRCAP					
Most affected by proposed CRCAP actions developed or supported by other groups					

Once the Stakeholder Committee is identified and finalized, it should be formally nominated or notified by either the administrative or political head of the local government.

SECTION B

Developing a Terms of Reference for Stakeholder Engagement

Developing a ToR for stakeholder engagement will help streamline the process and provide greater clarity on purpose, scope, approach and timing of stakeholder consultations. Provided below are indicative headings, questions and examples that can be used to develop a ToR for Stakeholder Consultations.

Vision

What will be the guiding vision for the consultations and engagement? This vision may be proposed by the Climate Core Team and adopted or amended during the first stakeholder meeting.

Composition

Who should attend each meeting? Should membership remain constant or vary depending on topics and tasks? Which representatives from the community should be included?

Rationale

Stakeholder concerns and feedback are valuable sources of information that can improve the design and outcomes of your City's Net-zero CRCAP and help your Climate Core Team identify appropriate actions. For stakeholders, consultations are an opportunity to:

- Learn about and contribute to the CCAP development process;
- Discover potential linkages to their own programs, planning and funding mechanisms; and
- Raise issues and concerns, potentially helping to shape the CCAP by making suggestions to the Climate Core Team.

Roles and Functions

Roles may evolve as the process progresses – from information sharing to problem-solving and strategy design. Define the roles and functions of stakeholder engagement.

Principles and Rules of Operation

It is very important to spell out the rules and expectations for stakeholder engagement.

Key Principles:

- Stakeholders will be identified through a systematic stakeholder analysis process.
- Meetings will be held in an open and transparent manner, giving all stakeholders an opportunity to participate.
- The scope of the process will be clearly communicated at the beginning.
- Unrealistic expectations will be avoided.
- Gender inclusiveness will be promoted, recognising that men and women may have different views, needs and levels of comfort in presenting their opinions in public.

Facilitation / Chairing of Stakeholder Engagement

Stakeholder meetings should be well-structured and, where possible, conducted by skilled independent facilitators. It may also be useful to have a formal Chairperson, whose role would include reporting back to the local government.

Key features of engagement:

- Information sharing is multi-dimensional, enabling all participants to contribute knowledge and experiences. This helps break down traditional boundaries between government, academic and community actors.
- The process is conducted openly and allows participants time to absorb and use climate-related information.
- The process is iterative, with several opportunities for members to engage, and progressively advance discussions.

Recording, Reporting and Communications

It is important to clearly define how stakeholder engagement outcomes are fed into the planning process. It should also be determined who is authorised to make public statements about meeting proceedings and outcomes.

Timing and Logistics of Meetings

Stakeholder meetings should be scheduled to align with the ongoing planning or implementation of the CRCAP. Where possible, determine in advance the meeting frequency, time, location, and expected duration. These should be designed to ensure maximum participation.

Finally, careful planning of stakeholder engagement is important. The example below provides an indicative checklist to ensure all necessary preparations have been made.

Preparation Checklist:

- Prepare a list of participants, based on Section A, and send invitations
- Determine the date and time
- Prepare the agenda and timetable
- Confirm whether a government institution will host the meeting and finalize the venue
- Ensure appropriate seating layout (e.g., round tables to facilitate discussion)
- Clearly assign responsibilities for organizing and conducting the engagement

Tool 1.3 B

Communications Plan

Effective communication and stakeholder engagement are crucial for the successful adoption and implementation of the Climate Resilient Cities (CRC) process and the Net-zero Climate Resilient City Action Plan (CRCAP).

Climate resilience and low-emission development can be complex and unfamiliar. Clear and coherent messaging helps build understanding, reduce resistance and facilitate coordinated action among communities, departments, and institutions.

This tool provides guidance on developing a comprehensive communications plan to support climate action planning and implementation. The plan helps engage stakeholders, build public awareness, and enable participatory decision-making across key stages of the CRCAP process, such as the greenhouse gas (GHG) emissions inventory, climate risk assessment (CRA), and target-setting.

The tool is to be used by the Climate Core Team (refer Tool 1.2: Formation of Climate Core Team) or other nodal entity already established in the city to prepare the Communications Plan for climate action planning and implementation in the city, with technical support and guidance from other stakeholders.

Purpose of the Communication Plan

A city-level communications plan for the CRCAP will strengthen cross-departmental, parastatal, and community-level engagement and collaboration through consistent internal and external messaging that supports coordinated climate action. The plan will support transparency and visibility of progress and results and help attract funding and partnerships by clearly communicating the impacts and benefits of the CRCAP.

Care should be taken to use simple, accessible language, avoiding technical terminology, where possible. The climate risks and recommendations should be communicated in a relatable manner, highlighting impacts on public health, livelihoods, and well-being. Effective communication supports participation, ownership, and sustained climate action across governments and society.

Components of the Communication Plan

Effective communication within the CRCAP process should adopt **the 5Ws and 1H** approach to ensure that:

1. **'WHY** climate action is needed' is clearly understood and communicated;
2. **'WHAT** actions are being proposed' is transparent;
3. **'WHO** needs to be engaged with' is clearly identified;
4. **'WHERE** information will be shared' is defined;
5. '**WHEN** messages are delivered' is structured and defined;
6. '**HOW** impact will be measured' is agreed upon.

Applying this approach helps translate technical assessments into accessible messages, engage diverse stakeholders, strengthen inter-departmental coordination, and maintain trust and accountability throughout their climate resilience journey. The key components of this communication plan are elaborated below.

1. Communication Goals (WHY)

Communication strengthens each stage of the CRCAP process by translating technical findings into messages people understand and implement. This component should ensure that the purpose of the CRCAP is communicated in a clear, relatable, and coherent manner, to build awareness, support behavioral change and anchor messaging around resilience, low-carbon development, and community preparedness.

2. Objectives (WHAT)

This component should convey the key sectoral issues, targets and actions and projected impacts, focusing on the role of city departments, citizens, NGOs, the private sector, academia and other stakeholders in implementation.

3. Target Audiences (WHO)

This component should identify the different stakeholder groups and define tailored communication approaches for each group. Audiences may include communities (including vulnerable groups) municipal departments, parastatals, NGOs, youth, and the private sector. Responsibilities should be shared across climate cells, sector nodal officers, project teams, and community representatives for preparation, validation and dissemination of communication materials.

4. Communication Channels (WHERE)

Communication channels should be selected based on the target audience. These may include community meetings, dashboards, social media, radio, workshops, messaging platforms and local networks. The climate action planning process and outcomes should be shared through appropriate channels in both English and local languages to ensure accessibility and inclusivity.

5. Frequency and Timing (WHEN)

Communication should be aligned with project milestones, seasonal cycles (e.g., heat or monsoon), and reporting requirements. Regular updates build continuity, trust, and visibility of actions.

6. Key Performance Indicators (HOW)

This component should set Key Performance Indicators (KPIs) to assess the effectiveness and reach of communication efforts. This will help the city identify operational challenges, the accuracy of alerts, and refine communication approaches. KPIs may include awareness levels, participation rates, behavior change, action uptake, and overall risk-reduction outcomes. Monitoring these indicators enables continuous improvement and accountability.

Note: The communication plan is not a one-time document; it should be periodically updated. For example, the key messages emerging from each phase of the process can be used to update the plan.

Financial and Manpower Requirements for Implementing the Plan

Financial support for a communications plan:

It is important to consider staff availability, financial resources and budget, and opportunities for in-kind support within the local government and community, while preparing the communication plan. Potential funding sources include:

- Municipal budget allocation for climate communication
- Designated communication budget under projects
- Dedicated climate action grants for outreach activities, public consultations, and community awareness drives
- Private sector collaboration linking climate communication to corporate social responsibility funding
- Donations from philanthropies and foundations
- Funds from national missions for awareness
- Innovation or challenge funds
- Support from startup ecosystems and voluntary initiatives

Governance and Institutional Coordination for Plan Implementation

Given the multiple stakeholders and components involved, responsibilities should be shared across a coordinated network of actors, including:

- **Communications Single Point of Contact (SPOC) within the Climate Core Team,** responsible for overall coordination and strategic alignment
- **Public Relations (PR) Officers within key city departments,** responsible for department-specific messaging, outreach, and media interactions.

Where feasible, additional support may include:

- **Designated Communications SPOCs in each city department** to facilitate two-way communication, provide updates, and tailor messaging for their respective sectoral spaces.
- **Media and Communications Interns** to support content development, social media management, documentation, and research. Institutional collaborations can also be developed through a periodic climate communication internship program.
- **Communication Fellows** to support project-level storytelling, visibility, and stakeholder engagement.

Embedding Communications into the CRCAP Process:

To develop a comprehensive communication plan, it is important to map where communication strategies – both internal and external - can be integrated throughout the CRCAP methodology across the various tools. This is a systematic way to compile a list of communication strategies that can be adopted across various stages of the CRCAP preparation and implementation process.

Cities may adapt and selectively use communication strategies most suited to their needs and stakeholder interests. By and large, when viewed from a communications perspective, the CRCAP methodology can be organized into three key action phases--Analyze, Act and Advocate--as outlined below:

Phase	Step	Sub steps	Communication focus	Strategies
Analyze	Commit and mobilize	1.1 Secure initial commitment	**Awareness and stakeholder engagement**	• Include a dedicated Communications Single Point of Contact (SPOC) within the Climate Core Team, reporting directly to the elected or executive members. This position should be staffed by someone proficient in both local/regional languages and English to ensure effective communication. • Formalize internal communication structures, develop a Terms of Reference (ToR) for the Communications SPOC. The SPOC should compile and analyze information from kickoff meetings, shared learning dialogues and stakeholder engagement workshops, and identify strategies for integration with the climate-resilient city action plan (CRCAP) process. The SPOC should use collaborative and structured platforms for providing communication updates. • Develop a communication plan detailing target audiences, channels, messages, timelines, and budget, and circulate it internally to secure buy-in from local government officials. Communicate objectives clearly through multilingual invitations, briefing notes, and feedback forms. For example, messaging may be developed for Focus Group Discussions (FGDs) to explain climate change concepts and the CRCAP process or initiate a discussion between city administrator / elected member and the community to identify grassroots-level climate challenges. • These activities will support effective engagement with the Stakeholder Committee (refer to Tool 1.3A: Stakeholder Engagement). • At the Research, Assess and Analyze stage, the communication plan should ensure that stakeholders understand: · the commitment of the local government to resilient development · key issues identified through Tool 2.3B Urban Systems Gap Analysis and the role of key stakeholders · the objectives and expected outcomes of the CRCAP · the process and results of key activities such as GHG emissions inventory, Climate Risk and Vulnerability Assessment (CRVA) and Urban Systems Gap Analysis. · opportunities for stakeholder engagement and support required for CRCAP implementation
		1.2 Set up institutional structures		
		1.3 Identify and engage stakeholder groups		
	Research and assess	2.1 Assess country context		
		2.2 Assess local context		
		2.3 Conduct a climate readiness review		
	Analyze and set baseline	3.1 Analyze climate fragilities, risks and vulnerabilities		
		3.2 Develop GHG emissions inventory		
		3.3 Compile a baseline synthesis report		

Phase	Step	Sub steps	Communication focus	Strategies
Act	Develop Net-zero Climate Resilient City Action Plan	4.1 Forecast BAU emissions	**Engagement and buy-in of CRCAP**	• At the Act stage, the communication plan should ensure that stakeholders understand: · the expected impacts of non-action (business-as-usual scenario) and the need for climate action and community-level behavioral change. · sectoral recommendations and impacts presented in a simplified manner · the financing mechanisms for action plan implementation and the role of different stakeholders in mobilizing finance (e.g., CSR from private sector) · the support needed from all stakeholders for implementation (finance, governance, monitoring) • The city should publish or launch the CRCAP on government websites and social media channels. • The city should communicate information on the Net-zero Cell formation, including its composition and roles. The minutes of meetings conducted by the cell should be regularly disseminated on the municipal website for the benefit of the public. • Campaigns, consultations and meetings on different urban sector actions such as water, waste, and transport can help identify resilience demonstration projects. For example, Cycle-to-Work Fridays—a behavior change campaign promoting non-motorized transport (NMT) for short trips, can be implemented in collaboration with resident welfare associations and local businesses. • Success stories from pilots should be highlighted through various channels such as videos, social media and print. • Pilot project implementation should be done in close coordination with local NGOs and public groups to identify challenges in implementation and strengthen monitoring. • The CRCAP Implementation and monitoring tracker should include the activities of the communication plan with clearly defined KPIs.
		4.2 Identify climate resilience goals, targets and interventions based on different Net-zero GHG Emission Scenarios.		
		4.3 Prepare and ratify Net-zero CRCAP		
	Details and finance projects	5.1 Identify and detail financing mechanisms for CRCAP implementation		
		5.2 Prepare short-term implementation plans for CRCAP		
		5.3 Prepare long-term implementation planning for CRCAP, including Climate Investment Planning (CIP) and Climate Budgeting		
	Implement and monitor locally	6.1 Establish institutional frameworks and develop capacity		
		6.2 Implement programs and projects		
		6.3 Monitor and report on the implementation status of climate resilience actions		

Phase	Step	Sub steps	Communication focus	Strategies
Accelerate	Integrate and Collaborate	7.1 Collaborate and integrate horizontally 7.2 Collaborate and integrate vertically 7.3 Connect with similar cities worldwide	**Partnership and Global Recognition**	Refer to the guidance document for points 7.1, 7.2, and 7.3 for an elaborate communication note. Refer to the guidance document for points 9.1, 9.2, and 9.3 for an elaborate communication note.
	Review and upscale	8.1 Update data, review assessment and analysis 8.2 Evaluate the CRCAP 8.3 Revise the CRCAP		
	Report, inspire, and advocate	9.1 Report achievements globally 9.2 Showcase actions, inspire others and gain recognition 9.3 Advocate for local and regional action		

CRCAP Communication Action Calendar (Suggestive Template)

Creating a communication calendar that lists key activities, objectives, preferred communication mediums, target audiences, and timelines is critical to the success of the plan. The calendar can help the city identify tailored approaches to different stakeholder groups. The following template is intended as a guide, and the examples provided are illustrative and meant for reference only.

Target Audience	Stakeholder	Activity	Objective	Communication Medium	When- Stage of involvement		Entity Responsible
					Timeline of activity	Duration of Activities	
Government	National/ State/Local Government Officials	Example: Climate Action Best Practices Workshop	Disseminate the CRCAP, its recommendations, and outcomes to local, state, and national government stakeholders to identify implementation support and clarify roles	Presentations during workshops and one-on-one consultations	April 2025	1 day	
Local Community	Residents Business owners Associations/ NGOs/SHGs	Example: Promote community participation in tree planting and protection	Conduct an awareness campaign targeting 50,000 citizens	Social media campaigns, radio and local FM, posters, banners, wall paintings, influencers and local environmental ambassadors	September 2025	1 month	
Investor Engagement	Partners Funders Private Sector engagement	Example: Climate-Resilient Infrastructure Investor Roundtable	Mobilize partnerships, funding, and private sector participation for implementation. Encourage innovation and advocacy	Roundtables, webinars, dialogues, progress dashboards, and quarterly updates	December 2025	6 months	
Global Audience (COP, Leadership Forums, Peer Learning and Capacity Building Forums)		Example: Showcase Session at COP - "City Resilience Lighthouse Practices"	Share success stories to promote peer-to-peer learning, enhance visibility, and attract funding Promote healthy competition through awards and recognition initiatives Encourage lighthouse cities to mentor other cities to achieve similar targets	Events, dashboards, newsletters, guidebooks, and peer-to-peer exchange visits	Post-CRCAP completion	3 months of promotion	

Tool 2.1

Country Climate Profile

This tool helps cities develop a country profile that provides the essential national context for local climate action, including broader climate policies, NDC commitments, and national regulatory frameworks. This context is critical for aligning city-level strategies and actions with national programs, funding opportunities, and sectoral priorities. The country profile also strengthens the climate action plan (CAP) by linking it to national and global climate goals, and by emphasizing the contribution of city-level interventions to national ambitions. The template below can serve as guidance for developing a country profile and a comprehensive understanding of existing policies and frameworks.

Country Context

This section helps in understanding the national context, including urbanization trends and patterns of city growth, and existing governance frameworks for local governments. Use the data template given in Table 1 below to develop the country context.

Table 1: Developing the Country Context

Country Context	Data	Remarks
Country Name		
Continent/Region		
Total Population		Year of Data
Percentage of Population Living in Urban Areas		Year of Data
Rate of Urbanisation		Annual average for last 10 years (if possible)
Human Development Index (HDI)		
GDP Per Capita (include currency)		Year of Data
Number of Cities / Local Governments		
National Governance Structure for Cities		Governance Structure and LG Mandates

National Climate Goals and Targets

This section gives an overview of the strategic impacts of climate change in the country and the national-level response against climate risks vis-a-vis its global peers. It also helps identify key climate goals, policies, and targets to consider when developing climate resilience action plans for local governments. Use the data template given in Table 2 and Table 3 below to understand the context of national climate ambitions, goals, targets and policies.

Table 2: National Climate Context

National Climate Context	Data	Remarks
Climate Zones		
Historic Climate Trends		
Key Climate Hazards		
Vulnerable Regions		
Loss and Damage from Climate Disasters (if available)		From recent years
Population Groups and Vulnerability		

Table 3: National Climate Policy and Targets

National Climate Policy and Targets	Data	Remarks
Status of UNFCCC Engagement		Party to UNFCCC frameworks and conventions (Yes/No and details)
Status of NDC / Updated NDC		Year of latest submission and key mitigation and adaptation goals committed
Net-zero Goal / Target		Target details and year
Existence of National GHG Emission Inventory and Climate Vulnerability Studies		Yes/No and details
Key Sectoral Targets and Priorities		Mitigation targets and adaptation priorities
Key National Climate Policies		Name(s) of policies and year
Urban-focused National Climate Policies		Name(s) of policies and year

Use Table 4 below to list key sectoral climate policies, strategies, and plans linked to climate change at the national level and to understand the goals and objectives with which city-level climate actions should be aligned.

Table 4: Sectoral policies, goals, and objectives

Sector	Existing Policy / Mission / Plan	Goals/Targets/ Objectives	Policy Type

Tool 2.2

City Climate Readiness Review

The City Climate Readiness Review tool is a self-assessment tool designed to help cities understand their capacity and readiness to tackle climate change challenges. It is structured around the following seven aspects:

Political Commitment and Existing Strategies, Policies, and Plans

City's Climate Governance

Information, Data, Tools, and Processes

Climate Budgeting and Financing Processes

Staff Participation

Existing Climate Initiatives

Community Engagement

The tool uses a questionnaire-based approach in each of these seven areas to highlight a city's strengths, identify gaps and encourage a culture of continuous improvement. The questions in this tool are not exhaustive and are intended to guide cities in developing an internal benchmark to assess and track improvements in climate actions and governance.

Instructions to the Climate Core Team: It is envisaged that the Climate Core Team established in the city will meet, discuss and collectively respond to the series of questions categorized into the seven areas mentioned above. Responses to each question should be recorded in the appropriate box, including supporting information in the Comments section, to enable a full understanding and assessment of your city's current situation.

This exercise should be undertaken in consultation with relevant staff, including senior management, and, where required, external parties, to ensure that the Climate Readiness Review provides the most accurate assessment possible.

Political Commitment and Existing Strategies, Policies and Plans:

The questionnaire in this section helps identify the city's long-term vision and political commitment to climate action, as well as existing and upcoming missions, policies, plans, and programs relevant to climate action. It also supports the identification of climate goals and policies at the city and regional levels, and their key targets, which can serve as reference points for developing climate action scenarios by building on existing policies and plans.

Strategies, Plans and Policies	Yes	No	Comments	Hints
Is there a long-term political commitment to climate action at the city level?				State when the commitment was issued.
What are the medium- to long-term strategic priorities or goals of your city?				Summarize the social, economic and environmental goals of the city. Refer to relevant Plan documents.
Are climate change issues (current and/or future) identified in the city's strategic priorities or goals?				List issues and concerns, such as conservation of natural resources, protection of natural environments, water conservation, extreme weather events such as floods, drought, and heat waves.
Which plans or policies integrate social, environmental, and economic elements?				Name the relevant policies.
Does your city have a notified Master Plan?				Name the policy and state when it was notified.
Has the city integrated state-level emission reduction policies, such as the electric vehicle policy or renewable energy policy, into its building bylaws?				Name the relevant sections of the building bylaws, if integrated.
Does your city have an environmental plan or policy?				Name the policy and state when it was established.
Does your city have a disaster management plan or policy?				Name the policy and state when it was established.
Does your city have a climate change policy or plan?				Name the policy and state when it was established.
Does your city have any policies, plans, guiding statements or directives aimed at reducing energy use and pollution?				Name the policy and state when it was established.
Please describe other ways in which your city could integrate climate change considerations into existing city policies and plans.				Consider energy use, pollution and emerging and future climate change issues.
Does your city apply environmental and/or disaster risk reduction (DRR) criteria in its decision-making? If yes, what types of projects typically assess environmental and/or DRR criteria?				List the environmental and/or DRR criteria. Has your city developed these criteria? For example, criteria for contracts with industries, building approvals, or other development activities.

Use Table 1 below to list existing policies and plans linked to climate action at the city and state/regional levels. The climate scenario development process during the preparation of the Net-zero Climate Action Plan (refer Tool 4.2D: GHG Emission Reduction Scenario Planning) builds on the goals and targets established through these policies, programs, and missions. This exercise also takes into consideration ongoing climate-linked initiatives and projects that have received administrative approval, as identified in this tool and in Tool 2.3B on Urban Systems Gap Analysis.

Table 1: Existing policies, goals and target at the local and regional level

Existing / Upcoming Policy / Mission	Goals and Targets/ Policy Objective	Policy Type

City's Climate Governance

Mapping the city's existing governance structure helps understand roles, functions, and capacities for implementing climate actions, and identifies challenges and opportunities for the effective implementation of the Net-zero Climate Action Plan.

This assessment of the city's current governance and monitoring structure should examine how departments interact, supported by an organogram or diagram, if available, and identify each department's core functions and specific roles in advancing climate mitigation, adaptation, and inclusivity goals. It should also evaluate existing capacities and effectiveness, highlight key challenges, and outline opportunities for improvement.

Climate Governance Structure(s) and Monitoring of Climate Action in the City	Yes	No	Comments	Hints
Is there an institutional setup for coordinating climate action?				Examples include climate cells, dedicated climate project units, interdepartmental committees, nodal officers, or any formal coordination platforms responsible for driving climate initiatives.
Does this setup have sufficient capacity and administrative backing, to function effectively?				Show the organogram to understand the capacity and power allocation of the institutional setup.
Which department oversees the institutional setup and leads climate action in the city?				Mention the department leading climate actions - like Town Planning, Environment, Disaster Management, and Urban Development.
Does the city have mechanisms for stakeholder engagement in data collection and in the planning and implementation of climate-related projects?				Refer to directives issued by senior officials for conducting inter-departmental and stakeholder meetings at regular intervals.
Which stakeholder groups are engaged, including government agencies, businesses, NGOs, academic institutions, and civil society organizations?				Look for official orders and communications that identify participating agencies or organizations.
Does the city have an existing monitoring, evaluation and reporting (MER) system to track progress on the reduction of climate risk and emissions?				Review the functions of climate cells, or dedicated climate units.

Information, Data, Tools, and Processes

Climate- and energy-related information and systems that process and manage it are crucial for enabling city staff to make better, more informed decisions in implementing the city's environment and climate-related policies and in tracking progress.

Information, data, tools and processes	Yes	No	Comments	Hints
Does the city have GIS-based Master Plans and a mapped physical infrastructure network under national, regional or local missions or initiatives?				Refer to recently developed Master Plans using GIS and outputs from infrastructure-mapping initiatives.
Does your city use any information-based geographical tools (e.g. maps, GIS)?				If yes, list the tools and describe their use (e.g., institutional maps, zoning maps, socio-economic profile maps, hazard maps, future growth maps, GIS-based planning tools).
Does your city have access to local or regional climate projections or impact scenarios? If not, which national or state agencies are responsible for holding weather and climate-related information?				National agencies are using global climate change projections to inform local projections of long-term environmental changes.
Please detail other ways in which your city may improve access to environmental and climate information.				

Climate Budgeting and Financing Processes

Adequate financial resources are essential for implementing climate change, DRR and environmental actions. City governments can, and do, implement innovative climate change projects with very limited financial and human resources, for example, energy-saving measures. These actions are commonly referred to as 'low-hanging fruit'. However, city governments commonly encounter problems in accessing the financial resources necessary to move beyond the 'low-hanging fruit'. They are encouraged to develop dedicated budgets and to explore external funding opportunities to supplement municipal resources.

Climate budgeting and financing process	Yes	No	Comments	Hints
Does your city issue green bonds?				List the projects for which green bonds have been issued.
Does your city have a specific budget allocation for DRR, environmental or climate change projects?				Describe the projects covered by specific budgets.
Please describe other funding mechanisms.				

Staff Participation, Training and Support

Building staff awareness helps strengthen institutional capacity and integrate climate change considerations into decision-making processes, both in their roles within the city government and as citizens. This, in turn, can improve organizational performance and build internal support for climate change initiatives.

Staff Participation, Training and Support	Yes	No	Comments	Hints
Does the city offer staff training on DRR, and environmental /energy / climate-related initiatives?				Training may be part of specific projects or other training events.

Existing Initiatives for Climate Change

This section covers specific climate change-related initiatives that the city has implemented. City staff must identify larger initiatives that have helped the city to manage current issues (e.g., energy conservation, and improved access to clean water) as well as those that prepare the city for emerging and future risks (such as extreme weather events, rising temperatures, intense storms and rainfall, flooding, and sea-level rise).

This section highlights broader strategic climate-linked initiatives the city is part of, including DRR initiatives, climate change programs funded by multilateral and bilateral organizations, and CSO- and CSR-led programs that enhance climate resilience. Existing sectoral projects linked to climate change will be identified under Tool 2.3B (Urban Systems Gap Analysis).

Ongoing Projects					
Sector	Project	Project		Duration of the project	Achievements
		Benefits	Costs		
Disaster Risk Reduction	Description of intended and unintended actions	Benefits (e.g., cost savings, reduced energy use)	Costs (e.g., higher capital costs)	Start and end dates	
Is your city a member of UNISDR's "Making My City Disaster Resilient" Campaign?					
Any other DRR initiatives?					

Stakeholder Engagement

City-led programs play a key role in educating the community and raising awareness of environmental issues. In this section, the city must identify programs and initiatives that demonstrate engagement with communities on climate change, DRR, and environmental matters, including energy and water conservation, and pollution.

Community	Yes	No	Comments	Hints
Does your city engage the community in DRR, environmental protection or climate initiatives? If so, which sectors of the community are engaged and through which projects?				Describe the initiatives and sectors involved.
Please describe other ways in which your city could engage the community on climate change issues.				Consider current, emerging and future climate risks.

Next Steps

Following completion of the Climate Readiness Review, your city should write a 2 to 3 page summary report covering key findings. The summary should identify areas where the city is performing well in climate action readiness, identify gaps and opportunities for improvement, and reaffirm the city's commitment to strengthening climate action and improving overall performance across the dimensions assessed in this tool.

Tool 2.3A

City Profile

A City Profile is essential for understanding a city's unique characteristics and its capacity to address climate change challenges. It gives a comprehensive snapshot of the city's geography, connectivity, demography, institutional structure, local economy, land use, and key environmental characteristics. This information helps undertake baseline assessments, identify key challenges and opportunities, and enable evidence-based climate action planning and policy decisions. City profile data can be sourced from local government departments, parastatal bodies, institutional databases, and open-data sources.

Assessing the availability of relevant data is the first step in developing a city profile and will help identify data is already available from various sources to support the climate change resilience analysis. Wherever possible, you should provide actual datasets at this stage. Where information is unavailable, it should be clearly marked as "Not Readily Available" and mention the name of the relevant department or agency responsible for the data. The following sections provide guidance on the collection and analysis of data for each characteristic of a city:

Brief Introduction

Collecting data on the city's description, nature, and location helps establish its geographic, administrative, and spatial context. This information supports baseline assessments, mapping, and comparative studies. Data can be sourced from urban local bodies and urban development authorities.

City Description	
Nature of the city (city classification, population size, economic role, cultural significance, and historical context)	
Location (geographic location in India, proximity to major rivers, and the significance of its location)	

Connectivity

Information on a city's access and connectivity helps in understanding regional linkages and growth centers that can directly impact socio-economic development. This section identifies major transport hubs such as highways, railways, airports, and ports that influence trade, mobility, and urban growth. Data on regional connectivity can be sourced from Urban Development Authorities and notified regional plans, Master Plans and development plans.

Access to the City		Transport Hubs/ National Highways, State Highways, major nodes
Port/ Harbour, etc.	Yes/No	
Airport	Yes/No	
Road network	Yes/No	
Rail	Yes/No	

Category	Unit	Data/ information/ file name (please mention NA for data that is not available)	Source of Data / Relevant department	Time period for which data is available
Demographics				
Population				
Total population	Number			
Sex Ratio	Number			
Population by age group	Number (by age categories)			
Average population density	Persons per sq. km (ward/zone level)			
Population distribution (ward/zone/area-wise)	Persons per sq. km			
Number of households	EWS, LIG, MIG, HIG			
Average household size	Number			
Floating/itinerant population	Number			
Annual inward migration rate (optional)	Persons per year			
Annual outbound migration rate (optional)	Persons per year			
Literacy				
Literacy rate	Percentage			
Literacy distribution (male/ female)	Percentage			
Vulnerable groups				
Population living in slums / informal settlements / EWS housing	Number (Gender-wise)			
Population of minority groups	Number			
Floating Population (applicable to cities whose economy is mainly driven by tourism)				
Number of tourist places within or around city limits	List, location			
Number of tourists/ floating population per year	Peak season and off-peak season			
Number of hotels and guest houses within city limits	Numbers, cumulative accommodation capacity			

Demography

Gathering demographic data provides insights into the city's population structure, growth and density, which are key indicators for planning physical and social infrastructure, housing, and other urban services. Understanding gender composition and ward-wise population density helps plan inclusive and equitable urban development policies and programs. Analyzing the correlation between historical population growth trends, socio-economic factors and GHG emissions inventoried over a period can inform population and emission projections. This enables evidence-based planning for sector-wise GHG emission mitigation strategies. Population data can be sourced from District Census handbooks, Census of India 2011, municipal records, State Statistical Departments and the National Sample Survey of India.

Institutional Structure and Municipal Budget

Understanding the local government structure, including ward divisions, institutional roles and administrative responsibilities, is essential for assessing governance capacity and coordination mechanisms. Assessing municipal finances, such as budget size, revenue sources, and expenditures, helps evaluate the city's capacity to plan, implement and sustainably manage effective urban development and climate action projects. Relevant data can be sourced from municipal records and annual budget documents, State Urban Development and Town Planning Departments, municipal finance audits, State Finance Commission reports, and notified Master Plans.

Institutional Structure and Municipal Budget	
City Name	
City Municipal Area (sq.km)	
City Planning Area (sq.km)	
Baseline Year	
Local Government Name	
Annual Government Operational Budget	
Revenue Sources	
Annual Expenditure (sector-wise)	
Number of Government Employees	
Number of Zones	
Number of Wards	
Municipal Corporation Structure (administrative divisions, governance structure, main responsibilities)	
Other	

Economic Activities

Employment and economic data help understand a city's livelihood patterns, major economic drivers, and the roles of both formal and informal sectors. They provide insights into income opportunities, workforce distribution, and economic resilience. This data is used to calculate growth patterns, which in turn support GHG emissions projections and target setting. Data can be sourced from the Census of India 2011, Industrial Corporations, ULB surveys, Economic Development Cells, and MSME portals.

Category	Unit	Data/information / file name (please mention NA for data that is not available)	Source of data / relevant department	Time period for which data is available
Employment and Economy				
Employment rate (%)	Percentage			
Main economic activities	List most to least important			
Primary occupation/ economic activity	Percentage from listed activities			
Secondary occupation/ economic activity	Percentage from listed activities			
Informal sector: numbers, categories				

Land Use

Land-use data provide the spatial foundation for understanding how land is utilized across the city. Analyzing land-use data helps identify areas vulnerable to environmental risks. Data can be sourced from Urban Development Authorities, Revenue Departments, Urban Local Bodies, and State Town Planning Departments.

Category	Unit	Data/information / file name (please mention NA for data that is not available)	Source of data / relevant department	Time period for which data is available
Land Use				
Total city area	Sq. km			
Availability of Master Plan	Yes/No			
Year of notification of latest Master Plan	Year			
Zoning / land use	Area by land use category with maps of existing and proposed land use			

Housing

Data on housing provides insights into living conditions, and how land allocated for housing is being utilized. It helps identify formal and informal settlements, housing conditions, and areas vulnerable to environmental risks. Data can be sourced from State Town Planning Departments, Slum Development or Urban Housing Boards, and State- or District-level Disaster Management Authorities.

Category	Unit	Data/information / file name (please mention NA for data that is not available)	Source of data / relevant department	Time period for which data is available
Housing				
Number of housing units	City-level Ward-level (optional)			
Apartments (optional)	Number of properties; ward/zone/ area-wise distribution			
Number of affordable housing units in the city (optional)	Number of dwelling units; ward/ zone/area-wise distribution			
Number of affordable housing units in the planning stage (optional)	Number of dwelling units; ward/ zone/area-wise distribution			
Single-family dwelling (optional)	Number of properties; ward/zone/ area-wise distribution			
Slum areas (both officially recognized / classified and not officially recognized / classified)	Number and area			
Huts, temporary houses and slums (optional)	Number of properties; ward/zone/ area-wise distribution			
Informal or unauthorized settlements	Number and area			
Housing units considered at risk of flooding or storm damage (optional)	Number of properties, locations			
Disaster (if applicable)				
Flood-prone areas	Sq .km			
Earthquake-prone areas	Sq. km			
Other disaster-prone areas				
Does the city have a disaster management plan or similar response mechanisms?	If yes, collect a copy			

Climate

Climate data is usually available as daily datasets covering parameters such as minimum and maximum temperatures, humidity, and precipitation. These datasets can be used to calculate annual and monthly averages for temperature and precipitation to establish a city's baseline climate profile. Seasonal variations in temperature and rainfall can be understood by analyzing monthly averages for a representative year. Climate datasets can typically be sourced from the Indian Meteorological Department, open-source datasets, or other relevant national and international meteorological agencies.

To assess long-term trends and emerging climate patterns, datasets spanning at least 30 years should be plotted with trendlines. Detailed climate trend analysis is part of Climate Risk Assessment (refer Tool 3.1A).

Table 1: Monthly Average Temperature Data (most recent year available)

Month	Monthly Minimum Temperature	Monthly Maximum Temperature	Monthly Average Temperature
Source: Please insert the source of the information			

Table 2: Annual Average Temperature Data

Year	Annual Minimum Temperature	Annual Maximum Temperature	Annual Average Temperature
Source: Please insert the source of the information			

Table 3: Average Monthly Rainfall Data (most recent year available)

Month	Average Monthly Rainfall	Number of Rainfall Days
Source: Please insert the source of the information		

Table 4: Average Annual Rainfall Data

Years	Average Annual Rainfall (mm)	Seasons (please define the seasons for your region/country)			
		Example: January-March	April-June	July-September	October-November
Source: Please insert the source of information					

Physiography

Data on soil type, topography and agricultural resources help in understanding the city's natural environment and ecological productivity. Data can be sourced from satellite imagery and geospatial platforms such as ISRO Bhuvan and Survey of India maps.

Category	Unit	Data/information / file name (please mention NA for data that is not available)	Source of data/ relevant department	Time period for which data is available
Ecosystems/ Biodiversity				
Category and type of soil	Type, with soil map (if available)			
Topography	Contour topographic map (ward/zone/area)			
Agricultural resources (optional)				
Total area under agriculture	Sq. km			
Regional crop seasons	Months			
Primary crop(s)	Names			
Secondary crop(s)	Names			
Contribution to local economy	Percentage of total GDP			
Contribution to the local food requirement	Percentage			

Tool 2.3B

Urban System Gap Analysis

This tool supports cities in undertaking an urban system gap analysis across key urban sectors to assess infrastructure and service delivery using quantitative indicators and qualitative insights. The analysis involves collecting data and assessing the service-level performance of each sector to identify gaps, inefficiencies, and fragility to external disturbances such as climate hazards.

The tool provides a structured approach to analyze the performance, coverage, reliability, and efficiency of key systems in a city, including water supply, wastewater management, stormwater management, solid waste management, transportation, urban greening and biodiversity, and the built environment and energy. The outputs from this tool directly inform subsequent steps in the Net-zero ClimatResilientCities (CRC) methodology and relevant tools such as Tool 3.1C: Climate Risk Assessment, Tool 4.1: GHG Emissions Forecasting, and Tool 4.3A: Detailing of Climate Resilience Actions and Integration into City Plans / Schemes.

Section A

Approach to Urban System Gap Analysis

Rapid urbanization, growing service demand and increasing climate variability have significantly increased the stress on urban service infrastructure and delivery systems. As these systems are complex and interdependent, an integrated urban system analysis is required to plan for climate resilience in cities, rather than siloed sectoral assessments.

A structured approach for urban system gap analysis is necessary to understand the performance, interconnections, and challenges across key urban sectors. The approach involves collecting both quantitative and qualitative data from local government departments, parastatal agencies, institutional databases, primary surveys, and open data sources. These datasets are organized by indicators such as sectoral infrastructure, coverage, cost efficiency, environmental quality, and energy use, and compared against service-level benchmarks to identify sector-specific gaps and issues.

Comparing current performance with service-level standards helps identify the gaps related to infrastructure deficiencies, service delivery and quality shortfalls, limited coverage in certain areas, governance or institutional challenges, capacity constraints, or financial limitations affecting operations and maintenance.

The sector-wise gap analysis helps identify key weaknesses and informs the development of fragility statements for each sector. These statements link resilient system characteristics, including flexibility and diversity, energy consumption and greenhouse gas (GHG) emissions, redundancy, and safe failure (see Section B). The analysis also supports the estimation of future municipal emission projections based on service demand trends and the identification of climate resilience interventions.

This evidence-based approach enables cities to understand the limits and challenges in urban system performance, assess climate risks, estimate future municipal GHG emissions, inform policy decisions, and identify targeted interventions and strategies for climate-resilient urban development.

Section B

Analysis of Sector-wise Fragility to External Disturbances

Urban resilience refers to the capacity of systems—whether social, ecological, or infrastructural—to withstand disturbances without losing their essential functions. A resilient system can self-organize, adapt to stress, and continue operating when exposed to climate-related hazards. Fragility assessment focuses on whether these systems have the following characteristics:

- **Flexibility and Diversity:**

  Systems include multiple options, and key assets and functions are distributed or decentralized so they are not all affected by a single event. *Example: A network of hospitals rather than a single centralized hospital.*

- **Energy Consumption and GHG Emissions:**

  Systems consume less energy and contribute to lower GHG emissions. *Example: Hospitals using energy-efficient fixtures and renewable energy backup.*

- **Redundancy:**

  Systems include backup options, alternative pathways, and contingency plans to maintain service delivery during disruptions. *Example: Hospitals and emergency communication facilities sharing backup generators; water systems using both grid electricity and renewable energy sources.*

- **Safe Failure:** Systems can absorb shocks or stress without catastrophic collapse, and are designed to fail in predictable, manageable ways. *Example: Dikes designed to fail in controlled directions, diverting floodwaters away from populated areas.*

A fragility statement provides clear justification as to why a system is rated as vulnerable. It clearly explains underlying weaknesses and links them to missing resilience characteristics such as flexibility, energy consumption, redundancy, or safe-failure capacity. This helps ensure consistent assessment, evidence-based scoring, and targeted interventions for strengthening the system. The fragility statements identified for each sector feed into the preparation of climate fragility statements, linking changing climate scenarios with the characteristics of a resilient urban system (see Tool 3.1C: Climate Risk Assessment).

Section C

Template for Urban System Gap Analysis and Identifying Fragility Statements

The sector-wise data template tables help identify available data and its collection for a comprehensive urban system gap analysis. Cities should provide actual data wherever possible at this stage and indicate gaps where information is not readily available, along with details of the relevant departments.

The collected data is analyzed against service-level benchmarks, as specified in the service-level information table. The identified gaps and issues can be presented through lists, tables, or graphical summaries, depending on the type of issue and available data. Visual tools such as GIS maps, spatial overlays, charts, and infographics clearly communicate spatial patterns, underserved areas, critical hotspots, and priority issues.

The gap analysis is followed by fragility assessment, where the template helps identify the anticipated risks arising from system weaknesses. Fragility statements are prepared based on the four resilience characteristics described in Section B.

1. Water Supply

Collecting data on the city's water supply system helps establish its source, infrastructure, coverage, and operational context. This information supports baseline assessment, system mapping, and performance evaluation. Data can be sourced from the Urban Local Body (ULB), Water Supply Department, and relevant parastatal or utility agencies.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Water Supply					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: All data in this data sheet pertains to water supply facilities and infrastructure supplying water to the city only. Please add additional data fields based on the number of water supply/treatment stations, as applicable. Please provide supporting data sheets as and where available.					
Water sources					
Surface Water					
Major surface water sources (names of rivers, canals, lakes, reservoirs supplying water)	Name, number, map				
Contribution of each source to total city water supply	%				
Total quantity of surface water supplied (overall and per capita)	MLD (million litres per day)				
Number of water bodies (lakes, reservoirs, canals) used or available in city	Number				
Total area of water bodies	Sq. km or hectares (ha)				
Distance of external sources from city (e.g., canal head, reservoir)	km				
Storage or carrying capacity of each major source	MLD or cubic meters (m^3)				
Water quality status (as per the Central Pollution Control Board (CPCB) classification or water quality parameters like biological oxygen demand (BOD), total dissolved solids (TDS), coliform)	mg/L or CPCB Category (A–E)				
Water use type (domestic, industrial, irrigation, non-potable)	—				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Groundwater					
Share of total water requirement met through groundwater	%				
Number of tube wells / bore wells (installed, operational, defunct)	Numbers				
Average operational hours of bore wells (normal and emergency conditions)	Hours per day (h/day)				
Groundwater table depth (range and zone-wise variation)	meters (m), map				
Groundwater use type (domestic, industrial, tanker, emergency)	—				
Rainwater harvesting structures (number and capacity/potential)	Number / cubic meters (m^3)				
Groundwater quality (CPCB/ Central Ground Water Board (CGWB) classification, parameter values)	mg/L or category				
Groundwater pollution sources (agriculture, sewage, industry, etc.)	Description				
Land subsidence or over-extraction effects (if any)	mm/year				
High and low groundwater zones (spatial variation)	Map / qualitative				
Flood or waterlogging-prone areas due to high groundwater table	sq. km / qualitative/ map				
Monitoring and data sources (agencies responsible)	Description				
Water treatment and distribution					
Water treatment and pumping infrastructure					
Water treatment plant capacity and operations					
Total installed capacity of existing water treatment plants	MLD (million litres per day)				
Total operational treatment capacity	MLD				
Average daily water treated	MLD				
Treatment process type (e.g., sedimentation, filtration, chlorination)	Description				
Source of water treated (surface or groundwater)	Qualitative				
Infrastructure inventory					
Water treatment plans	Number, location, map				
Capacity of overhead tanks	Number, KL				
Booster stations	Number, MLD				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Pumping system performance					
Number of pumping stations	Number				
Pumping capacity (installed and operational)	MLD				
Number of pumps (installed/ working/ standby)	Number				
Average discharge	MLD				
Total pump rating	kW				
Water Distribution					
Water supply distribution network	Maps to scale, with ward-/ zone-/area-wise breakup; % coverage of network				
Water supply zone	Name, boundary, map, area covered, number of zones				
Water pumping stations	Number, name, capacity, map, ward/zone/area covered				
Number of water distribution stations	Number				
Trunk main line	Km, map				
Distribution network	Km, map				
Number of service connections by diameter and category	Number per zone/area				
Number of authorized connections	Categories, Number of ward-/ zone-/area-wise distribution				
Household coverage with piped water supply	Number, per cent				
Slum area coverage with piped supply	% of slum households				
Households with water meters	Number / %				
Number of service connections by diameters	Number per water supply zone/ category/ area-wise				
Public taps, hand pumps, tube wells, tankers	Number				
Continuity of water supply	Time				
Supply pattern (time slots)	Hours (morning/evening)				
Per capita water supply	Liters per capita per day (lpcd)				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Total amount of water supply	MLD				
Total amount of water demand	MLD				
Total non-revenue water (NRW) / unaccounted for water (UFW)	MLD				
Quality of water supplied	As per Pollution Control Board category / mg/L				
Cost recovery in water supply services	Number (INR) or percentage per year				
Efficiency in the collection of water supply-related charges	Number (INR) or percentage per year				
Supervisory Control and Data Acquisition (SCADA)					
Number of water distribution systems with SCADA	Number				
Number of water treatment plants with SCADA	Number				
Type of parameters monitored	List (e.g., water flow, pressure, quality, energy use)				
Data monitoring and control locations	Number/names/maps (e.g., ICCC, zonal stations)				
Availability of real-time monitoring	Yes/No				
Purpose of SCADA system	Qualitative (e.g., fault detection, efficiency improvement)				
Quantitative energy efficiency benefit					
Energy consumption	kWh				
Energy Savings	kWh, %				
Renewable energy generation	kWh, MWp				
Cost savings	Currency (₹)				
Carbon emissions reduction	Tonnes CO2				
Peak load reduction	kW				
Qualitative energy efficiency benefit					
Operational improvement					

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Comfort & User experience					
Process efficiency					
Sustainability					
Service Level Information					
Particulars			Benchmark	Years	Unit
Coverage of water supply connections			100%		
Per capita supply of water			135 lpcd		
Extent of metering of water connections			100%		
Extent of non-revenue water (NRW)			20%		
Continuity of water supply			24 hours		
Quality of water supplied			100%		
Efficiency in redressal of customer complaints			80%		
Cost recovery in water supply services			100%		
Efficiency in collection of water supply-related charges			90%		
Description of Future Plans for the next five years (if any)					
Details of project	**Budget allocation**	**Capacity and cost**	**Current status**	**Starting and ending dates**	**Comments/ Sources**
For e.g.,- Rejuvenation of 22 Lakes and lake development	*INR 1,529 million*	*22 lakes; de-silting, aeration systems, Sewage Treatment Plant-linked polishing*	*Tendering in progress*	*2025-2029*	*As per Municipal Environment Cell*
Projected service demand assessment					
The projected service demand for the water supply sector will be assessed by analyzing current consumption patterns, applying population growth projections, and comparing future demand against normative standards. This step will help estimate the additional supply, infrastructure, and system capacities required to meet future needs and identify potential demand–supply gaps.					

Gap Analysis

By comparing the existing performance of the water supply system with these standards, gaps will be identified to highlight key issues related to infrastructure deficiencies such as inadequate distribution networks or aging pipelines, service delivery and quality shortfalls such as intermittent supply or poor water quality, limited water distribution network coverage in certain areas, and the governance or institutional challenges impacting operations and maintenance of the water supply and distribution system in the city.

For example:

- **Problems in feeder main systems-inequitable distribution and intermittent water supply:** Pipe networks are not laid in certain areas within the corporation boundary, especially in the added area of the city. There are many uncovered areas in the city, and they depend on water supply from tankers. While the average rate of water supply in the city is 90 LPCD, distribution is not equitable. In the added areas, public standposts serve water supply needs, leading to high non-revenue water (NRW).
- **Inadequate service coverage in added areas:** About 65% of the households have house service connections (HSC). The number of house connections is low compared to the total number of properties.

Fragility Statements for Water Supply Sector

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement
e.g., Water supply	Flexibility and Diversity: Traditional water sources have been lost due to urbanization and the city depends on centralized pumping systems that transport water over long distances. Supply does not meet the growing demand. Energy consumption and GHG emissions: Transporting water over long distances through old pumping stations consumes approximately 143 million kWh of electricity, resulting in 117,540 tCO_2e of GHG emissions in the city. Redundancy: Alternatives usually include water supplied by tankers (trucks). In mountainous regions, access for these trucks is limited, and they are an expensive and polluting fallback option. Safe failure: In the event of a disruption in water supply, individual households have to fend for themselves. Parts of the system is over 100 years old.	Disruption of water supply to citizens Additional financial burden on households to purchase water from water tankers Water shortages adversely impact the tourism industry Increased pollution and emissions from tanker operations	Shared with the Irrigation and Public Health Department	The water supply system is old and largely dependent on long-distance water transport, resulting in significant energy consumption and GHG emissions. Even minor disruptions in the distribution network can lead to significant shortages, and alternative options are neither cost-effective nor sustainable.

2. Wastewater Management

Collecting data on the city's wastewater management system helps evaluate treatment capacity, infrastructure condition, and reuse potential. Information on sewage treatment plants (STPs), wastewater inflow, reuse practices, and sludge management supports performance assessment and future planning. Data can be sourced from the Urban Local Body (ULB), Pollution Control Board, and relevant utility departments.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Wastewater management					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: All data in this data sheet pertains to wastewater treatment facilities and infrastructure for the city only. Please add additional data fields based on the number of wastewater treatment stations, as applicable. Please provide supporting data sheets as and where available.					
Sanitation Access / Toilet Coverage					
Households with individual toilets (IHHL coverage) (IHHL = *Individual Household Latrine)*	%				
Public/community toilets	Number, %, location, map				
Community toilet/public toilet seat availability	Number (men, women, persons with disabilities)				
Toilets connected to the sewer network	%				
Functional toilets (household and public)	%				
Water availability in toilets	Hours/day				
Sewer connectivity coverage	%				
Non-sewer-connected household using septic tanks/pits	%				
Fecal sludge management coverage for non-sewer-connected households	% households receiving desludging services				
Open defecation spots	Location (if any)				
Complaint redressal efficiency	% of complaints resolved in time				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Wastewater Treatment					
Total wastewater generated	MLD (million liters per day)				
Total wastewater collected (sewer network coverage)	% of total wastewater generated				
Number and capacity of operational Sewage Treatment Plants (STPs)	Number, MLD, map				
Operational capacity vs installed capacity	MLD, % utilization				
Number and location of sewage pumping stations	Number, map				
Sewerage network coverage	Map, %				
Wastewater inflow at STPs	MLD				
Influent and effluent quality parameters: • Biochemical oxygen demand • Chemical oxygen demand • Total suspended solids • Total nitrogen • Total phosphorus	mg/L				
Compliance of STPs with CPCB discharge standards	Yes/No; name of non-compliant STPs				
Upgradation plan and funding support	Program name / Source				
SCADA (supervisory control and date acquisition) system installation for sewage and pumping stations	Yes/No				
Biogas generation at Pirana STP	m^3/day				
Annual biogas captured and utilized	million m^3/year				
Biogas utilization and sale details	INR/m^3, INR/kg				
Status and technology of digesters	Number, type, condition				
Causes of reduced biogas generation	Description				
Electricity consumption of STPs	kWh/day				
Specific energy consumption of STPs	kWh/day treated				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Diesel usage for generator sets (backup)	Liters/day				
Wastewater Recycle & Reuse					
Total treated wastewater generated	MLD				
Year of preparation of the Treated Sewage Reuse and Recycle Action Plan	Year				
Purpose of treated wastewater reuse	Description (Industrial, Irrigation, power plants, plantation)				
Treated wastewater discharged into water bodies	MLD				
Percentage of total sewage reused	%				
Quantity of treated wastewater reused	MLD				
Type of treated wastewater reused	Treatment level (e.g., secondary treatment)				
Purpose of current reuse (e.g., irrigation)	Description				
Proposed capacity of Tertiary Treatment Plants (TTPs)	MLD				
Objective of proposed TTPs	Description (industrial reuse)				
Sludge & Septage Management					
Quantity and source of sludge generated	Tonnes per day (TPD)				
Details of sludge treatment (hygienization) plant	TPD, Year, Agency				
Function and utilization of sludge treatment plant	Description, % utilization				
Moisture content in sludge (input vs design)	%				
Use and management of manure	Description				
Households using septic tanks and their spatial distribution	Number, location				
Quantity of septage generated annually	Cubic meters per year (m^3/year)				
Septage collection and disposal mechanism	Description				
Septage treated at STPs	MLD, location				
Issues in septage management	Description				
Environmental and health risks from unsafe disposal	Description				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Service Level Information					
Particulars			Benchmark	Years	Unit
Coverage of toilets			100%		
Coverage of sewerage network services			100%		
Collection efficiency of sewerage network			100%		
Adequacy of sewage treatment capacity			100%		
Quality of sewage treatment			100%		
Extent of reuse and recycling of sewage			20%		
Extent of cost recovery in sewage management			100%		
Efficiency in redressal of customer complaints			80%		
Efficiency in collection of sewerage charges			90%		
Description of Future Plans for the next five years (if any)					
Details of project	Budget allocation	Capacity and cost	Current status	Starting and ending dates	Comments/ Sources
For e.g., Construction of 150 MLD tertiary treatment plant under Gujarat Resilient Cities Project (GRCP)	INR 1,530 million	150 MLD tertiary treatment capacity; Cost = approx. INR 10.2 million/ MLD	DPR approved	2025-2029	Urban local body / water supply and sewerage board
Projected service demand assessment					
The projected service demand assessment for wastewater management will estimate future wastewater generation based on population growth and wastewater trends. By comparing this demand with existing and planned capacities, the analysis will highlight gaps in sewer coverage, pumping, and treatment needs for the coming years.					

Gap Analysis

By comparing the existing performance of wastewater management against these standards, gaps will be identified, highlighting key issues within wastewater collection, conveyance, treatment, reuse, and financial performance. These gaps may relate to inadequate sewer network coverage, low collection efficiency, insufficient STP capacity, poor treatment quality, limited reuse of treated wastewater, governance and O&M challenges, capacity constraints, or weak cost recovery and charge collection.

For example:

- **Treatment capacity:** Currently, 21% of the wastewater generated in XX city is being treated, and the rest of the untreated water is disposed of in the Noyyal River, causing increased pollution levels.
- **Less coverage of sewer network:** Only 45% households are connected to the sewer network, which largely exists in the core city. Greywater in areas not connected to the sewer network is disposed of into surface drains.

Fragility Statements for Wastewater Management Sector

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement
e.g., Wastewater management	**Flexibility and Diversity:** The city relies mainly on a few centralized STPs, many of which operate below capacity or receive highly variable influent quality. Limited decentralized or nature-based treatment options increase dependence on a single system. **Energy consumption and GHG emissions:** Old aeration systems and outdated pumping infrastructure consume high energy, contributing significantly to operational emissions. **Redundancy:** Backup arrangements for pump failures, STP downtime, or network blockages are limited. Overflow points and alternative treatment routes are either absent or insufficient. **Safe failure:** During heavy rains or system overloads, wastewater frequently bypasses treatment, leading to untreated discharge into drains and water bodies, and causing severe ecological and public health risks.	Untreated sewage entering rivers, lakes and stormwater drains Groundwater contamination in low-lying and unsewered areas Public health risks due to exposure to pathogens Foul odor, mosquito breeding and degraded urban environment	Shared (Municipality + State Pollution Control Board / Line Departments)	The city's wastewater management system is fragile due to its dependence on aging, centralized treatment plants, limited backup capacity, and energy-intensive pumping infrastructure. Frequent overflows, inadequate redundancy, and the absence of safe-failure pathways lead to untreated sewage entering the environment, creating persistent health risks and operational challenges—especially as population growth and climate-induced flooding increase system stress.

3. Stormwater Management

Collecting data on the city's stormwater management system helps assess drainage coverage, pumping capacity, and flood vulnerability. Information on network length, pumping stations, outfalls, and flood-prone zones supports evaluation of system efficiency and risk management. Data can be sourced from the Urban Local Body (ULB), Stormwater or Drainage Department, and Disaster Management Cell.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Stormwater management					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: All data in this datasheet pertains to stormwater management infrastructure and facilities for the city only. Please add additional data fields based on the number of stormwater pumping stations, drainage networks, and lakes/nalas as applicable Please provide supporting data sheets, maps, or design documents wherever available.					
Drainage distribution network	Map with ward/zone/area				
Total length of stormwater drainage network	km				
Average age of water network	Years				
% coverage of stormwater network over total road network	%				
Number of stormwater pumping stations with capacity	Number, location, map, cu.m./hr				
SCADA coverage of stormwater stations	Number / %				
Number of stormwater outfalls	Number				
Disposal of stormwater	Location and quantity				
Number of main and auxiliary pumps for stormwater management	Location, number				
Number of catch pits (zone-wise distribution)	Number				
Identified flood-prone / waterlogging points	Number/map location				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Major flood-prone zones or areas	Names / qualitative				
Key causes of flooding (siltation, waste, illegal sewage connections)	Qualitative				
Drainage-linked health or hygiene impacts	Qualitative				
Source augmentation and Rainwater harvesting/ GW recharge is being practiced by city. If yes, provide relevant details	Qualitative				
Total electricity consumption in stormwater sector	Million kWh				
Total fuel consumption in stormwater supply sector	KL				
Monsoon Action Plan	Yes/no, if yes – provide year and details				
Service Level Information					
Particulars			Benchmark	Years	Unit
Coverage of stormwater drainage network			100%		
Incidence of waterlogging/flooding			0		
Description of Future Plans in the next five years(if any)					
Details of project	Budget allocation	Capacity and cost	Current status	Starting and ending dates	Comments/ Sources
For e.g.- Protect & rejuvenate natural drains.- -Kharicut Canal development- -Gota Godhavi natural drain	*INR 1486 million*	*Improvement of approx. 89 km of natural drain length*	*DPR under preparation*	*2026-2030*	*As per ULB stormwater management plan*
Projected service demand assessment					
The projected service demand assessment for stormwater management will estimate future runoff volumes based on land-use changes, rainfall trends, and urban growth. Comparing these projections with the existing drainage capacity will help identify gaps in network coverage, conveyance, and flood-mitigation needs for the coming years.					

Gap Analysis

By comparing the current state of stormwater management in the city with established benchmarks, gaps can be identified to highlight key issues in drainage network coverage, conveyance efficiency, flood risk management, maintenance practices, and the overall system performance. These gaps may relate to inadequate stormwater drainage coverage, undersized or silted drains, poor outfall conditions, high incidence of waterlogging or urban flooding, limited maintenance capacity, weak enforcement of encroachment regulations, or insufficient funding for upkeep and upgrades.

For example:

- Encroachment of major and minor drains within the network
- Most of the city's drains also convey sewage, which is a significant health hazard.

Fragility Statements for Stormwater Management Sector:

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement
e.g., Stormwater management	Flexibility & Diversity: The city depends mainly on an aging, linear network of drains and natural channels, many of which are encroached, silted, or narrowed. There is limited use of green infrastructure or permeable surfaces that could diversify drainage pathways. Energy Consumption & GHG Emission: Pumping stations used in low-lying areas often run inefficiently, consuming high energy during the monsoon due to outdated equipment and poor maintenance. Redundancy: The system lacks sufficient overflow routes, detention ponds, and alternative corridors. When the primary drains choke, the absence of secondary pathways results in immediate surface flooding. Safe failure: During intense rainfall, drains overflow unpredictably, flooding streets, homes, and commercial areas. Instead of failing in controlled ways, water spreads to critical urban functions, disrupting mobility, damaging infrastructure, and creating safety hazards.	Frequent urban flooding during moderate to heavy rainfall Waterlogging affects mobility, emergency response, and economic activities Damage to roads and public infrastructure due to prolonged standing water Mixing of stormwater with sewage in areas with combined or leaking systems Increased vector-borne diseases and public health risks	Shared (Municipality + Urban Development/ Drainage Departments)	The stormwater management system is fragile due to its dependence on undersized, encroached, and silted drainage channels, limited redundancy, and the absence of green or permeable infrastructure. Inefficient pumping systems and uncontrolled overflow patterns lead to widespread flooding, mobility disruptions, infrastructure damage, and growing climate-related risks as rainfall intensity increases.

4. Solid Waste Management

Collecting data on solid waste management infrastructure provides a comprehensive overview of the city's waste generation, collection efficiency, processing capacity, and disposal practices. Information such as total waste generation, segregation levels, transfer station capacity, and legacy waste treatment helps assess performance and identify infrastructure gaps. Data should be collected from the Solid Waste Management Department, Ahmedabad Municipal Corporation (AMC), and relevant project implementing agencies. Supporting maps, datasets, and reports from facilities such as MRFs, composting plants, and landfill sites should also be included to ensure data accuracy and completeness.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Solid Waste Management					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: All data in this data sheet pertains to solid waste management facilities and infrastructure for the city only. Please add data fields for additional disposal sites, composting plants, and waste-to-energy facilities, as applicable. Please provide supporting data sheets as and where available.					
Waste Collection					
Total waste generation	Metric Tonnes per day (MT/day)				
Waste quantity by source/type	Metric Tonnes per day (MT/day)				
Door-to-door collection coverage and infrastructure	%, Number				
Waste collection methods in dense settlements	Description				
No. of waste collection vehicles (type-wise: autos, tippers, compactors, e-rickshaws)	Number				
Collection frequency	Times/day				
Source segregation performance	%				
Community-level and roadside waste collection system	MT/day, Number				
Special waste streams (holy, flower, biodegradable, green, carcass)	MT/day, Number, Description				
Biomedical waste management	MT/day, Number, Agency				
Waste processing and recovery facilities (MRFs)	MT/day, Area, Model, Operator				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Employment generation through waste management	Number				
Street cleaning operations	Number, km/day				
Waste Composition					
Categorization/ physical composition of solid waste • Food waste • Gardens and parks • Paper/cardboard • Wood and straw • Textiles • Disposable nappies • Rubber • Industrial • C&D waste • Inert waste • Other recyclables	Waste component-wise percentage of total solid waste generated				
Seasonal variation in waste composition	% variation summer/monsoon/winter				
Density of waste (bulk density)	kg/m^3				
Refuse Transfer Stations (RTS)					
Number and capacity of Refuse Transfer Stations (RTS)	Number, Metric Tonnes (MT)				
Distance between RTS and disposal site	Km				
Average turnaround time for vehicles	Minutes/trip				
Total handling capacity of all RTS	Metric Tonnes (MT)				
Infrastructure and equipment at each RTS	Number, Capacity (MT)				
Material Recovery Facilities (MRFs) at RTS premises	Number, Capacity (TPD)				
Type and source of waste handled	Description				
Spatial distribution of RTS	Description / Map Reference				
Construction and Demolition Waste					
Daily C&D waste generation	Metric Tonnes per Day (MT/day)				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Number of C&D waste collection centers	Number, map				
Collection request modes (citizen interface)	Description				
Daily waste processed vs capacity utilization	MT/day, %				
Transport fleet for C&D waste	Number of vehicles				
Implementing/Managing agency	Name				
C&D waste processing plant capacity	Metric Tonnes (MT)				
Financial model of plant operation	Description				
Plant operating agency	Name				
Final products from processed C&D waste	Type / Description				
Mandatory procurement clause for recycled materials	Description				
Royalty/revenue earned by the authority from recycled product sales	Percentage (%) or Amount (INR)				
C&D waste collection charge – Less than 1 MT	INR per Trip				
C&D waste collection charge – 1–5 MT	INR per MT and INR per Trip				
C&D waste collection charge – More than 5 MT	INR per MT and INR per Trip				
Municipal Waste Treatment and Processing					
Waste-to-composting facility capacity	TPD				
Material Recovery Facilities (MRFs) capacity	TPD, location map				
Construction & Demolition (C&D) waste treatment facility capacity	TPD				
Total solid waste generated per day	MT/day				
Untreated waste reaching dumpsite	MT/day				
Proposed waste-to-energy plant capacity	TPD				
Proposed waste to bio-CNG plant capacity	TPD				
Proposed plastic waste management plant capacity	TPD				
Proposed waste to composting plant capacity	TPD				
Electricity generation from proposed waste-to-energy plant	MW				
Implementation model for proposed plants	Type/Description				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Leachate generated at processing sites	Liters/day				
Leachate treatment facility available	Yes/No, Capacity (Liters/day)				
Odor control and air quality measures at plants	Yes/No, type				
Rejection rate (waste not processed at MRFs/composting)	MT/day, %				
Disposal					
Name of waste disposal sites	Name, map				
Capacity of scientific landfill site	MT				
Landfill liner type (HDPE, soil, composite)	Description				
Leachate collection system	Yes/No, Capacity				
Gas extraction wells installed	Number				
Landfill gas flare system/energy generation	Yes/No, MW				
Daily cover applied	Type(Soil/geotextile)				
Year of operation commencement	Year				
Type of waste disposed of (residuals post-treatment and inert waste)	Description				
Number of landfill cells planned	Count				
Location of scientific landfill site	Map				
Planned operational lifespan of landfill	Years				
Legacy Waste					
Location and year of operation commencement of dumpsites	Text, Year				
Quantity and area of legacy waste	Million Metric Tonnes (MT), Acres				
Height range of waste heaps	Meters (m)				
Year and details of biomining initiative (including number of machines and daily treatment capacity)	Year, Count, MT/day				
Total legacy waste treated and land reclaimed	Million Metric Tonnes (MT), Acres				
Revenue generated and reuse of inert material	INR (million), Description				
Proposed redevelopment/use of reclaimed site	Description				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Administrative & Financial Indicators					
ULB annual expenditure on SWM	INR/year				
ULB annual revenue from SWM user charges	INR/year				
Cost per tonne of waste handled	INR/MT				
Staff strength for SWM (sanitation workers, drivers, supervisors)	Number				
Service Level Information					
Particulars			Benchmark	Years	Unit
Household-level coverage of Solid waste management services			100%		
Efficiency of collection of municipal solid waste			100%		
Extent of segregation of municipal solid waste			100%		
Extent of municipal solid waste recovered			80%		
Extent of scientific disposal of municipal solid waste			100%		
Extent of cost recovery in SWM services			100%		
Efficiency in redressal of customer complaints			80%		
Efficiency in collection of SWM charges			90%		
Description of Future Plans in next five years(if any)					
Details of project	Budget allocation	Capacity and cost	Current status	Starting and ending dates	Comments/ Sources
For e.g.- 500 TPD waste to bio-CNG PPP	*PPP*	*500 TPD*	*Proposal stage*	*2027-2030*	*Source: ULB / SWM Department /*
Projected service demand assessment					
The projected service demand assessment for solid waste management will estimate future waste generation based on population growth, land-use changes, consumption patterns, and economic activity. By comparing these projections with existing collection, processing, and disposal capacities, the assessment will highlight gaps in waste-handling efficiency, treatment infrastructure, transportation logistics, and landfill requirements. This will help identify the system upgrades and policy interventions needed to ensure sustainable and compliant waste management in the coming years.					

Gap Analysis

Comparing the current solid waste management performance with service-level benchmarks will help identify gaps in waste collection, segregation, transportation, processing, and disposal. These gaps may include low collection coverage, poor segregation, inadequate processing capacity, operational inefficiencies, or weak financial performance.

For example:

- 3 waste transfer stations were constructed by Coimbatore City Municipal Corporation (CCMC) in 2010 at Ukkadam, Peelamedu and Sathy Road; the Sathy Road transfer station is currently non-functional, and CCMC transports its waste directly to the dump yard.
- Daily evacuation of waste from the two transfer stations at Ukkadam and Peelamedu is hampered due to an insufficient number of trucks; this also impacts segregated transport of waste from these transfer stations. Hence, open dumping quantity has increased in the Vellalore disposal site.

Fragility Statements for Solid Waste Management Sector

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement

Note: Refer to examples from the Water Supply, Wastewater Management, and Stormwater Management Sectors.

5. Transportation

Collecting data on the city's transportation system helps assess road network connectivity, freight movement, parking management, and public transport efficiency. This information supports baseline assessment, infrastructure planning, and mobility performance evaluation. Data can be sourced from the Urban Local Body (ULB), Urban Transport Department, Traffic Police, and relevant transport or transit agencies.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Transportation					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: Please provide data for registered vehicles on-road by type of vehicle and by type of fuel Please add data fields for vehicle category and fuel type as applicable Please provide supporting data sheets as and where available					
Road Network					
Total road length and overall network planning approach (ring–radial, grid, or mixed pattern)	km, Description, map				
Road Hierarchy Length of arterial roads Length of sub-arterial roads Length of collector roads Length of local streets	Km, % of total				
Right-of-Way (ROW) Classification % of roads with ROW > 30m % of roads with ROW 24–30m % of roads with ROW 18–24m % of roads with ROW < 18m	%				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Road Condition Index Roads in good condition Roads in poor conditions	%,PCI(Pavement Condition Index) Score				
Drainage along roads Roads with covered drains Roads with no drains	%				
Footpath and cycle network coverage	%				
Number and type of bridges (overbridges, underpasses, flyovers, river or canal crossings)	Count				
Traffic management systems — e-challan cameras, surveillance cameras, traffic signals, and major junctions	Count				
Smart traffic technologies — ATCS (Adaptive Traffic Control System) locations	Count, Description				
Blackspots(Accident-Prone Zones) Number and location of blackspots No. of fatalities and injuries in last 3–5 years	Number				
Freight Mobility					
Major growth centers connected to the city	Names / Locations				
Average daily freight vehicle entries (light/heavy)	Number				
Connectivity details with other cities, highways, and industrial or logistics nodes	Description				
Key zones of industrial and trading activity within the city	Locations / Description				
Freight movement characteristics and traffic hotspot locations	Description / Locations, map				
Restrictions on heavy vehicle entry (timing and regulation)	Hours / Notification details				
Freight-related parking and loading/unloading issues	Description				
Proposed or existing Comprehensive Freight Management Plan	Plan status / Description				
Freight management provisions under the city's Parking Policy	Policy details / Description				
Logistics Infrastructure Warehouses Cold storage facilities Logistics parks	Number, locations				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Parking					
Total number of authorized parking locations and their types (off-street, below flyovers, on-street, multi-level, etc.)	Count				
Existing parking capacity (four-wheelers and two-wheelers)	Number of vehicles				
On-street vs Off-street ratio Length of on-street parking % designated vs undesignated	Km, %				
Assessment of parking adequacy and utilization (underutilization, demand-supply gap, occupancy rate)	Description / %				
Proposed or existing multi-level parking facilities and their locations	Count / Locations				
Details of city parking policy or management framework (objectives, responsible authority, implementation mechanism)	Description				
Dedicated traffic and parking management cell or unit (functions, staffing, responsibilities)	Description				
Components of city parking plan (surveys, prioritization of zones, management approaches, pricing strategies)	Description				
Innovative or smart parking strategies (permits, park & ride, demand-based pricing, digital systems)	Description				
Features of digital or mobile-based parking management applications (real-time data, booking, integration with maps, payment modes)	Functional details				
Pricing strategy Peak/off-peak pricing	INR				
Public Transport					
Types of public transport modes available (e.g., City Bus, BRTS, Metro Rail)	Type / Description, map				
Route network details – total number of routes and total route length for each mode	Count, Kilometers (km), map				
Fleet details – total number of buses/vehicles for each mode and fuel type (Diesel / CNG / Electric)	Count				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Fleet Age & Condition Average age of buses % of buses older than 8 years	Years, %				
Bus Depot & Terminal Infrastructure No. of depots Capacity of depots	Number				
Ridership – average daily passengers for each mode	Number of passengers/ days				
Operational and management model – type of operation (e.g., gross cost, net cost), O&M payment rate, and VGF (if applicable)	Description / INR/km				
Intelligent Transport Systems – existence of command & control center, GPS monitoring, ITMS, integrated ticketing, and features (e.g., journey planning, real-time tracking, payment modes)	Yes / No / Description				
Metro or mass transit details – number of corridors, route names, terminal points, and route lengths	Count / Kilometers (km), map				
Ongoing or proposed transit expansion projects	Description / Status				
Environmental transition plan – target year or plan for phasing out diesel buses and increasing the electric fleet	Year / Description				
Service Quality Indicators Average waiting time (minutes) On-time performance (%) Load factor (%)	Minutes, %				
Intermediate Public Transport (IPT)					
Population within walking distance of public transport services	Percentage (%)				
Walking distance considered for accessibility from bus stops (BRTS or equivalent city bus/BRT systems)	Meters (m)				
Walking distance considered for accessibility from metro stations	Meters (m)				
Method used for accessibility analysis (e.g., grid-based road network and population coverage analysis)	Description				
Reference guideline used for determining walking distances (e.g., URDPFI Guidelines)	Name of guideline				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Parameters excluded from the accessibility analysis (e.g., frequency and quality of services)	Description				
IPT Fare Structure Minimum & maximum fare Permit categories	Descriptive				
IPT Service Performance Average waiting time IPT congestion hotspots	Minutes, location				
Non-Motorized Transport(NMT)					
Footpath Quality Assessment % of footpaths that are continuous % that meet universal accessibility standards Encroachment levels (low/medium/high)	%, levels (low, medium, high)				
Cycle Infrastructure Quality Segregated vs. painted cycle tracks % of safe intersections for cyclists	%				
Public Bike Share (PBS) Docking stations Number of bicycles Ridership	Number				
Electric Mobility					
Charging Infrastructure Number of slow chargers Number of fast chargers	Number, locations				
Battery Swapping Stations Number of stations Operators (e.g., SUN Mobility, Ola Electric)	Descriptive				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
E-Bus Charging Infrastructure Depot charging capacity	Number, locations				
Service Level Information					
As formal service-level benchmarks for the transportation sector are limited, the assessment will compare existing mobility conditions with national guidelines, urban transport standards, policy targets, and best practices to identify gaps and improvement needs.					
Description of Future Plans in next five years(if any)					
Details of project	Budget allocation	Capacity and cost	Current status	Starting and ending dates	Comments/ Sources
For e.g.- Traffic junction development (free left) at 25 locations	172.5 million	25 junctions, INR 1-1.5 crore per junction	Proposal stage	2028-2032	SJMMSVY
Projected service demand assessment					
The projected service demand assessment for transportation will estimate future travel demand based on population growth, land-use patterns, and rising vehicle ownership. By comparing these projections with existing and planned road capacity, public transport services, and non-motorized infrastructure, the analysis will help identify gaps in mobility, congestion management, and accessibility needs for the coming years.					

Gap Analysis

Comparing the current performance of the city's transportation system with the service-level benchmarks and mobility standards will help identify gaps in public transport availability, road infrastructure, traffic management, safety, and accessibility. These gaps may include low public transport coverage, infrequent service, inadequate pedestrian and cycling infrastructure, congestion, safety issues, or weak enforcement.

For example:

- Traffic congestion due to a lack of parking facilities and encroachment of roads by vendors
- Inadequate fleet size of public transport recommended: 0.6/1000 people, actual: 0.12/1000 people.

Fragility Statements for Transportation Sector

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement

Note: Refer to examples from the Water Supply, Wastewater Management and Stormwater Management Sectors.

6. Urban Greening and Biodiversity

Collecting data on the city's urban greening and biodiversity helps evaluate the extent of green cover, tree plantation efforts, and ecological resilience. This information supports baseline assessment, mapping of green infrastructure, and identification of areas with low accessibility to parks and open spaces. It also aids in understanding the role of vegetation in mitigating heat and flood risks and in planning future greening initiatives. Data can be sourced from the Urban Local Body (ULB), Forest or Horticulture Department, and relevant city environment or biodiversity agencies.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Urban Greening & Biodiversity					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: All data in this datasheet pertains to Urban Greening, Green cover, and biodiversity within the city only Please add additional data fields based on parks, tree cover, protected areas, biodiversity hotspots, and green infrastructure projects, as applicable Please provide supporting data sheets, GIS maps, species inventories, or project documents wherever available					
Natural areas in city as compared to total city area (%) *Natural areas are defined as all areas that are natural and not completely man-made landscapes. Examples of natural ecosystems include forests, mangroves, freshwater swamps, natural grasslands, streams, and lakes. Parks, golf courses, and roadside plantings are not considered natural.	%				
Total tree cover in the city (area and % of city area)	Sq km, %, map				
List of native species (Flora and Fauna) – if available	List				
Green cover per person and target benchmark (as per WHO guidelines)	m^2/person				
Urban forests developed in the last 5 years (number, type, and total area covered)	Count, sq km				
Total number of trees planted under city campaigns (with year and tree survival rate)	Count, Year, %				
Citizen participation mechanisms for plantation (e.g., app-based initiatives)	Yes/No				
Ecological parks or green spaces developed on reclaimed sites (area and number of trees)	sq m, Count, map				
Proposed greening initiatives (e.g., Miyawaki forests, dense forests, oxygen parks)	Description				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Loss or shrinkage of natural/biodiversity areas within the last 5 to 10 years	Area or %				
Number of water bodies	Number, area, capacity				
Loss or shrinkage of water bodies within the last 5 to 10 years	Area or %				
Accessibility to Public Parks & Gardens					
Total number of parks and gardens in the city	Count, map				
Accessibility criteria for different park types (neighbourhood, community, city parks)	m (walking distance) / km (driving distance), map				
Population without easy access to public parks	% of total population, number of people				
Wards or localities with low accessibility to parks	List / Names of wards				
Service Level Benchmarks					
As there are no formal service-level benchmarks for the urban greening and biodiversity sector, the assessment will instead compare existing conditions against national guidelines, ecological standards, city-level targets, and best practices to identify gaps and priority needs.					
Description of Future Plans in next five years(if any)					
Details of project	Budget allocation	Capacity and cost	Current status	Starting and ending dates	Comments/ Sources
For e.g., *Plantation of 1.1 million trees in FY 2024-2025*	*INR 25-30 crore (indicative, depending on species and maintenance)*	*INR 200-250 per sapling*	*Ongoing*	*2024-2025*	*ULB/Forest department*
Projected service demand assessment					
The projected service demand assessment for urban greening and biodiversity will estimate future requirements for green spaces, tree cover, and ecological buffers based on population growth, urban expansion, and environmental needs. Comparing these projections with existing and planned green assets will help identify gaps in park provision, canopy cover, habitat protection, and ecosystem restoration for the coming years.					

Gap Analysis

Comparing the current status of urban green cover and biodiversity with the standard benchmarks will help identify gaps in green cover, park access, tree density, and habitat health. These gaps may include inadequate greenery, poor maintenance, or declining biodiversity.

For example:

- The encroachment of wetlands in specific areas disrupts the delicate ecological balance. This could result in the loss of habitats for various species and increase vulnerability to flooding
- Kakinada has inadequate green cover, predominantly concentrated in the north and eastern parts. Regions with limited greenery experience higher land surface temperatures (LST). Given the city's vulnerability to summer heatwaves, this imbalance in the distribution of green cover could adversely impact areas with less green cover.

Fragility Statements for Urban Greening and Biodiversity Sector

Urban system	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Part of city function (Completely / Shared / No)	Fragility statement

Note: Refer to examples from the Water Supply, Wastewater Management, and Stormwater Management Sectors.

7. Built Environment and Energy

Collecting data on the city's building and energy profile helps assess the built environment, building typologies, and potential for renewable energy integration. Information on residential, commercial, and industrial properties, along with roof space availability for solar PV or water heaters, supports energy efficiency planning and sustainable building initiatives. Data on green building certifications and municipal renewable energy projects aids in evaluating progress toward low-carbon and climate-resilient urban development. Data can be sourced from the Urban Local Body (ULB), Building and Energy Departments, and renewable energy agencies.

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Built Environment and Energy					
Concerned Department Name - Name of contact person/ head of department - Contact number - Email ID -					
Note: All data in this datasheet pertains to buildings and energy infrastructure, properties, and renewable energy initiatives within the city only Please add additional data fields based on property types, building typologies, roof space availability, energy consumption, and renewable energy installations, as applicable Please provide supporting data sheets, energy audits, building plans, or project documents, wherever available.					
Built Environment Profile					
Total number of properties in Ahmedabad	Number				
Share of properties by type — residential, commercial, industrial, government/religious	Percentage (%)				
Residential Properties					
Total number of residential properties	Number (year-wise)				
Distribution by type — apartments, tenements, row houses, chawls/poles, bungalows	Percentage (%)				
Total built-up area	Sq.m.				
Total floor- space area	Sq.m.				
Rooftop area	Sq.m.				
Rooftop solar PV installation	kWh				
Green/low-carbon residential buildings	Number, certified green built-up area (sq m.)				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Housing stock • Low-income households • Middle-income households • High-income households • Apartments/single-family/multi-family dwellings	Number				
Slums, squatters, informal settlements, EWS housing	Location, map, sq m.				
Housing unit at risk of flood/storm impacts	Number, sq m., location				
Commercial Properties					
Total number of commercial properties	Number (year-wise)				
Distribution by type — offices/retail, warehouses, service providers, hotels, educational institutions, hospitals, restaurants, healthcare units	Percentage (%)				
Total built-up area	Sq.m.				
Total floor space area	Sq.m.				
Rooftop area	Sq.m.				
Rooftop solar PV installation/water heaters	kWh				
Green/low-carbon commercial buildings	Number, certified green built- up area (sq m.)				
Industrial properties					
Total number of commercial properties	Number (year-wise)				
Total built-up area	Sq.m.				
Total floor space area	Sq.m.				
Rooftop area	Sq.m.				
Rooftop solar PV installation/water heaters	kWh				
Green/low-carbon industrial buildings	Number, certified green built-up area (sq m.)				
Community and Municipal Buildings					
Municipal level data					
Number of buildings (schools, hospitals, WTP/STP, pumping stations, substations, municipal offices, community halls, etc.)	Number (year-wise)				
Total built-up area	Sq.m.				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Total floor space area	Sq.m.				
Rooftop area	Sq.m.				
Rooftop solar PV installation	kWh				
Green or low-carbon buildings	Nos, certified green built-up area (sq m.)				
Land use and development controls					
Predominant residential/commercial/industrial/ institutional zones	Land use shapefile				
Planned future land use	Map, hectares				
Proposed expansion areas	Map, hectares				
Land use density trends	Persons/ha or built-up m^2/ha (year-wise)				
Housing & Socio-economic data					
Household income segmentation	Number of households (Low, middle, high income)				
Affordable housing stock	Number of units (Number)				
Proposed housing projects	Number + budget + sq m.				
Informal settlements mapping	Number of slums, location, area in hectares				
Vulnerability of housing	Number of units in risk zone(flood/heat)				
Property tax and Revenue Data					
Property tax collected	INR (year-wise collection)				
Types of taxes	List (Qualitative)				
Number of households under each tax slab	Number (households per slab				
Digital tax systems	Yes/No, Platform name(portal/app)				
Energy					
Electricity supply & system performance data					
Electricity transmission & distribution (T&D) losses	Year-wise %				
Peak Electricity Demand of the City	Megawatt (MW), Year-wise				
Grid Loss Factor (for estimating T&D Losses)	% or factor value (year-wise)				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Municipal-level electricity					
Number of consumers Public Water Works Street Lighting Municipal Buildings (offices, hospitals, schools, etc.) Other Municipal Services	Number/year (year-wise)				
Electricity consumption Public Water Works Street Lighting Municipal Buildings Other Municipal Services	kWh/year(year wise)				
Month-wise electricity consumption Public Water Works Street Lighting Municipal Buildings Other Municipal Services	Million units per month (Year-wise)				
Sector-wise tariff for each year PWW(Public water works) Street Lighting Municipal Buildings Other civic services	INR/kWh (year-wise)				
Non-Municipal Sector electricity					
Sector-wise Number of Consumers Residential Institutional Commercial Industrial Transport (EV charging) Agriculture Others	Numbers/year (year-wise)				
Sector-wise Electricity consumption Residential Institutional Commercial Industrial Transport (EV charging) Agriculture Others	kWh/year (year-wise)				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Month-wise Electricity consumption Residential Institutional Commercial Industrial Transport (EV charging) Agriculture Others	Million units/month (year-wise)				
Sector-wise tariff for each year Residential Institutional Commercial Industrial Transport(EV Charging) Agriculture) Others	INR/kWh (year-wise)				
Renewable Energy (RE)					
Installed renewable energy capacity: Rooftop Solar Captive Solar Ground-mounted Solar Floating Solar Wind Energy Biomass Other RE	Megawatt, number of installations/connections)				
Electricity generation from renewable energy sources Rooftop Solar PV Captive Solar Ground-mounted Solar Floating Solar Wind Biomass Other RE	kWh/year (year-wise)				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
Cost of RE electricity generation Solar (Roof, Ground, Captive, Floating) Wind Biomass Others	INR/kWh				
Renewable energy targets (next 5 years) Floating Solar Rooftop Solar Ground-mounted Solar Hydro (Large/Small) Wind Biomass Others	MW (Megawatt)				
Renewable energy potential Floating Solar Rooftop Solar Ground-mounted Solar Hydro Wind Biomass Solar Irradiance (W/m^2) Surplus Rooftop Solar Purchase Tariff (INR/kWh)	MW (Megawatt)				
Energy Use Patterns (End-use Consumption)					
Residential electricity use Space Heating Water Heating Space Cooling (fans/ACs) Lighting	%				
Appliance-wise Electricity Share Refrigerator Fans TV Air Conditioners Computers Others	%				

Infrastructure	Unit	Year 1	Year 2	Year 3	Comments/sources
City energy mix Fossil Fuel-based Solar Wind Hydro Biomass	%				
Service Level Benchmarks					
As there are no formal service-level benchmarks for the built environment and energy sector, the assessment will rely on national codes, state policies, energy-efficiency standards, city-level targets, and recognized best practices. Existing conditions will be compared against these reference points to identify performance gaps, inefficiencies, and priority areas for improvement.					
Description of Future Plans for the next five years(if any)					
Details of project	Budget allocation	Capacity and cost	Current status	Starting and ending dates	Comments/ Sources
For e.g., Installation of Rooftop Solar PV on Municipal Buildings	INR 12–15 crore	5–7 MW total capacity; Cost: INR 45,000–55,000 per kW	Ongoing	2026-2030	ULB / DISCOM / State Renewable Energy Agency
Projected service demand assessment					
The projected service demand assessment for the built environment and energy sector will estimate future building and electricity needs based on population growth and urban expansion. Comparing these projections with existing and planned capacities will help identify gaps in built-up area provision, service coverage, connected load, and renewable energy deployment.					

Tool 3.1A

Climate Trends and Past Events

This tool aims to help collect and analyze basic historical weather data for the city. This will help understand trends and patterns in temperature, relative humidity, sea level rise, and precipitation. While the analysis can be substantiated with expert input, even preliminary results can provide a broad understanding of whether there have been significant changes in weather patterns.

Please note that air temperature, relative humidity, sea-level rise and precipitation data are required to understand past climate trends. However, the relevance of specific climate parameters will depend on the city's geographical location and landforms. Therefore, it is vital to understand your city's geographic characteristics, including topography, proximity to large bodies of water, and the presence of large, forested areas and rivers. Classification of a city as coastal, mountainous, or plains will play a crucial role in determining the type of climate data required.

Collecting Climate Data

When collecting climate data from meteorological organizations, it is recommended that it is collected for the longest available period (a minimum of 30 years is recommended). The data selected should be appropriate to the city's geographic context.

To understand past climate events that have impacted the city, data on recorded climate events over a minimum period of 30 years should be collected. The types of climate events that need to be considered will depend on those that have occurred and the city's geographic setting. This data can then be analyzed to understand changes in types, frequency, and intensity of climate events over time. Such events are usually recorded by national meteorological agencies (e.g., IMD) and are often publicized by government departments or collected through administrative processes.

Climate Data

Temperature

For temperature trend analysis, daily minimum and maximum temperature datasets for at least the past 30 years are collected. These data sets will be used to calculate the number and duration of hot and cold days and nights, and the monthly and annual average temperatures. This data can then be analyzed and plotted to assess trends in average minimum or maximum temperatures over time.

Table 1: Temperature Data

Years	Annual Minimum Temperature	Annual Maximum Temperature	Annual Average Temperature
Source: Please insert the source of the information			

Precipitation

Daily precipitation data can be used to calculate monthly and annual rainfall levels. When analyzed and plotted, this data illustrates seasonal rainfall variations in a specific year and the variability in rainfall intensity and patterns. It is recommended that precipitation data be collected from international or national meteorological departments for at least the past 30 years.

Table 2: Precipitation Data

Years	Average Annual Rainfall (mm)	Seasons (please define the seasons for your region/country)			
		e.g., January-March	April-June	July-September	October-November
Source: Please insert the source of information					

Humidity

Humidity data, expressed as a percentage, should include daily minimum and maximum relative humidity data for at least the past 30 years. These datasets can be used to calculate average annual and monthly relative humidity levels, which can then be plotted on graphs to show annual and seasonal variability. Relative humidity can significantly influence the 'feel-like temperature', thereby affecting how a city experiences heat stress or cold weather. Humidity data is typically recorded by meteorological agencies.

Table 3: Humidity Data

Years	Average Annual Relative Humidity (%)	Seasons (please define the seasons for your region/country)			
		e.g., January-March	April-June	July-September	October-November
Source: Please insert the source of information					

Sea-Level Data

Sea-level datasets should be used to calculate annual, mean, and total sea-level changes for at least the past 30 years. Tracking sea-level variations helps understand trends and variability, and coastal vulnerability due to global warming and climate change.

Sea-level data can be obtained from institutions such as the Indian National Centre for Ocean Information Services (INCOIS) and the National Institute of Ocean Technology (NIOT), as well as international agencies such as NASA.

Table 4: Sea Level Data

Years	Annual Sea Level (mm)	Mean Sea Level (mm)	Anomaly (mm)
Source: Please insert the source of the information			

Past Climate Events

Information on past climate events, such as the date, type of event, location, duration and scale of impact should be collected. These records are available with relevant government departments, such as disaster management authorities and international or national meteorological agencies. Analyzing this data helps understand the prevalence, frequency, and intensity of extreme climate events over the past 30 years.

Table 5: Past Events Data

Years	Event	Location	Duration (day or hour)
Source: Please insert the source of the information			

Tool 3.1B

Climate Change Projections and Scenarios

This tool provides guidance for cities to collate and analyze climate change data and generate at least one climate exposure scenario, or projection. A "climate exposure" event is a phenomenon, such as increased precipitation, heat stress, floods, and other extreme weather events, that is increasingly impacting people, infrastructure, and urban systems. Ideally, cities should use local climate data; if such data is unavailable, the tool suggests alternative sources for conducting the analysis.

The tool is divided into two sections. Section I suggests sources of climate data and the process for collating and documenting this information. Section II gives guidance for conducting a preliminary analysis of the data and for writing a Climate Scenario Summary Statement as part of the Climate Risk Assessment chapter of a city's Net-zero Climate Resilient City Action Plan (CRCAP).

Section I

Climate Change Projection

Local climate data and trends identified in previous assessments are used in this exercise to define climate change projections for the city. Climate change projections may be available from city records, universities, research institutes, NGOs, or other bodies. If no city-level assessment is available, regional assessments may be used. For example, Indian Network for Climate Change Assessment's (INCCA) report gives projections for 2030 for some regions in India.

Regional data can provide a useful baseline, even if it is generalized to an area larger than the city boundary. Such information may still be sufficient to initiate discussions on anticipated climate changes at the city level.

You will use trends from higher-scale projections (e.g., an increase in average annual temperatures by 2030) for both average annual values and seasonal variations. Stakeholder consultations may also be used to verify and validate these trends, particularly if there is uncertainty in the available information.

EXERCISE 1

Collection and Documentation of Climate Change Information

Try to collect as much of the following information as possible and summarize it in the template provided in Table 1 (an example is provided for reference):

Name of changing climate condition [e.g., increase or decrease in temperature, precipitation, or extreme weather events]

Amount of expected change (expressed as a range), including baseline year(s) from which change is measured and the planning horizon year by which the change is projected to occur. If possible, the horizon year for which projections are estimated should be same as the planning horizon years for CRCAP.

Geographical area for which climate projection is relevant *[e.g., specific region or location]*

Table 1: Summary of Climate Change Data

Changing Climate Condition	Assessments	Amount of Expected Change (include baseline and planning horizon years)	Geographical Area	Greenhouse Gas Emissions Scenario	Extent of Variability	Level of Confidence	Source(s)
Precipitation change	Regional Assessments	e.g., 1268±225.2 mm to 1604±175.2 mm Baseline year: 1970 Horizon year: 2030	Himalayan Region (Western Himalayas, including Jammu and Kashmir, Uttarakhand, and Himachal Pradesh)	A1B scenario, IPCC	Overall increase in rainfall. June- September: 12 mm October- December: 8 mm January-February: 5 mm	High	4x4 Climate Change Assessment report by Government of India (GoI)
	Supplementary Local Assessments						
Temperature change	Regional Assessments						
	Supplementary Local Assessments						
Extreme events (please specify the event)	Regional Assessments						
	Supplementary Local Assessments						
Sea-level rise	Regional Assessments						
	Supplementary Local Assessments						

Greenhouse gas emissions scenario for which the projection is relevant *[e.g., high- and/ or low-emission scenarios]*

Extent of variability (seasonal variability or climate oscillations such as El Nino and La Nina), including expected seasonal variations (e.g., between summer and winter), and/or events such as heavy precipitation followed by drought

Level of confidence [degree of certainty – low, medium, or high) associated with the projected change

Source of information [to be specified for supplementary local assessments]

Section II

Climate Projection Analysis and Climate Scenario(s)

Analyze the climate change projection data to determine whether there is a consistent set of projections, particularly for the most significant direct climate impacts, such as precipitation patterns, temperature increases, sea-level rise, and extreme weather events.

If the results for a particular "changing climate condition" are quite consistent across both regional and local assessments, a single Climate Scenario Summary Statement can be written for that condition. However, if there are significant variations in the projections, you may need to develop two separate Climate Scenario Summary Statements for each assessment. Some specialist assistance may also be required for this process.

It is critical to ensure that the time horizons for the projections are similar. If the time horizons across data sources differ, it may be necessary to interpolate or extrapolate some data to a common year to assess consistency or divergence between projections.

EXERCISE 2

Developing Climate Scenario Statements

Now write one or more Climate Scenario Statements for the changing climate conditions identified in Table 1 above. A Climate Scenario Statement can be framed in the following manner:

"There is a <insert level of confidence> likelihood of a <insert range of expected change> in <insert changing climate condition> in <insert geographical area> by the year <insert planning horizon year from amount of expected change column>. The projected change is expected to <insert information from extent of variability>."

Table 2: Climate Scenario Statement

Changing Climate Conditions	Assessments	Climate Scenario Summary Statements
Precipitation change	Regional Assessments (4x4 Assessment Report by GoI)	e.g., There is high confidence in an expected change in precipitation from 1268±225.2 mm to 1604±175.2 mm in the Himalayan Region by the year 2030. The projected change is expected to be maximum during the monsoon months (June-September), and minimum during October-December.
	Supplementary Local Assessments	
Temperature change	Regional Assessments	
	Supplementary Local Assessments	
Extreme events (please specify the event)	Regional Assessments	
	Supplementary Local Assessments	
Sea-level rise	Regional Assessments	
	Supplementary Local Assessments	

At the end, summarize this exercise by drafting Climate Scenario Statements that can be used to inform the city's climate risk assessment.

For example:

Climate Scenario Statement 1: Probability of climate change-induced extreme rainfall events may increase even if average annual rainfall decreases in the region.

Climate Scenario Statement 2: The region's average temperature is expected to increase in the future.

Tool

3.1C

Climate Risk Assessment

This tool provides cities with a structured approach to undertake a Climate Risk Assessment (CRA) and develop an analytical foundation for identifying climate-related risks across urban systems and population groups and prioritising ward[1]-level climate resilience solutions. It helps cities assess the exposure and vulnerability of their populations and urban systems to various climate hazards, enabling them to understand the spatial distribution and relative levels of climate risk across the city.

The tool supports evidence-based decision-making for planning and implementing climate change adaptation actions across wards, vulnerable population groups, and fragile urban systems. This will help cities mainstream climate resilience by integrating climate risk considerations into policies and projects and support them in prioritising targeted adaptation interventions aligned with local and national adaptation goals.

SECTION 1

Approach to Climate Risk Assessment

1.1 Conceptual Framework

The core approach for CRA in the Net-zero ClimateResilientCITIES (CRC) methodology is based on the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5) Working Group II conceptual framework.[2] Climate risk is conceptualised as a function of the interaction between climate-related hazards, the exposure of people, infrastructure, and natural systems, and vulnerability arising from socioeconomic and environmental sensitivity and adaptive capacity. It can be represented as follows:

Risk = f {Hazard, Exposure, Vulnerability}

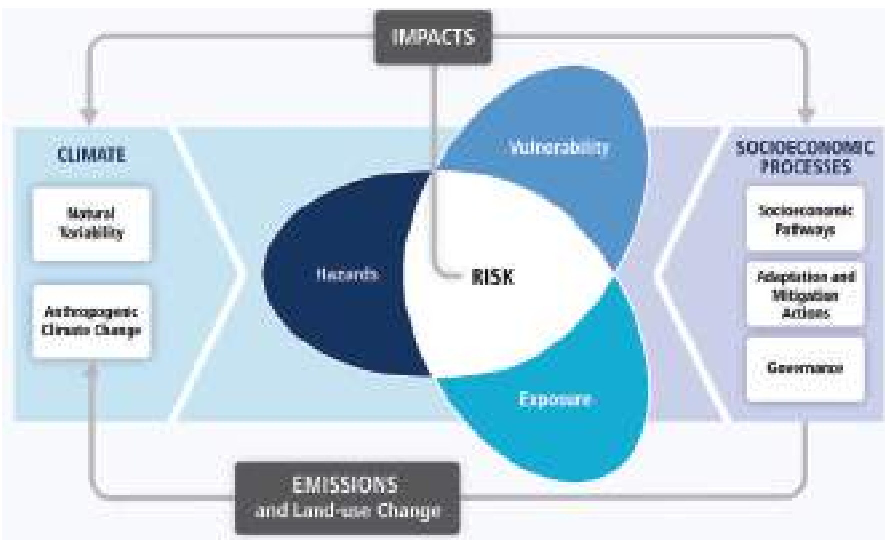


Figure 1: Risk Assessment Conceptual Framework (Source: IPCC Fifth Assessment Report [AR5] Working Group II)

1. A ward is the smallest geographical and administrative subdivision used for local governance and elections in a city, in the Indian context
2. IPCC, [Fifth assessment report, working group ii](), 2018

ICLEI's climate risk assessment methodology follows three key steps:

1) **Hazard assessment.** This involves identifying key city-level hazards, mapping individual hazards for each ward, assigning ward-wise hazard scores, and preparing ward-level hazard maps for individual hazards or combinations of hazards.

2) **Exposure assessment.** This includes mapping urban systems, populations, and natural systems located in hazard-prone areas, deriving ward-level exposure scores, and developing ward-level exposure maps for individual hazards or combinations of hazards.

3) **Vulnerability assessment** comprises two components:

   a) **Sensitivity analysis:** Sensitivity refers to the degree to which urban systems and populations can be adversely impacted by climate hazards. This involves assessing the sensitivity of urban systems and populations, assigning ward-wise vulnerability scores, and generating ward-level vulnerability maps.

   b) **Adaptive capacity analysis:** Adaptive capacity refers to the ability to respond and cope with the consequences of climate hazards. In this assessment, the adaptive capacity of urban systems and actors is assessed qualitatively.

Finally, climate risk maps are developed using the normalised, composite hazard, exposure, and vulnerability scores for each ward.

ICLEI's Net-Zero CRC methodology can be used to calculate the ward-level composite climate risk attributed to individual hazards as well as combinations of hazards

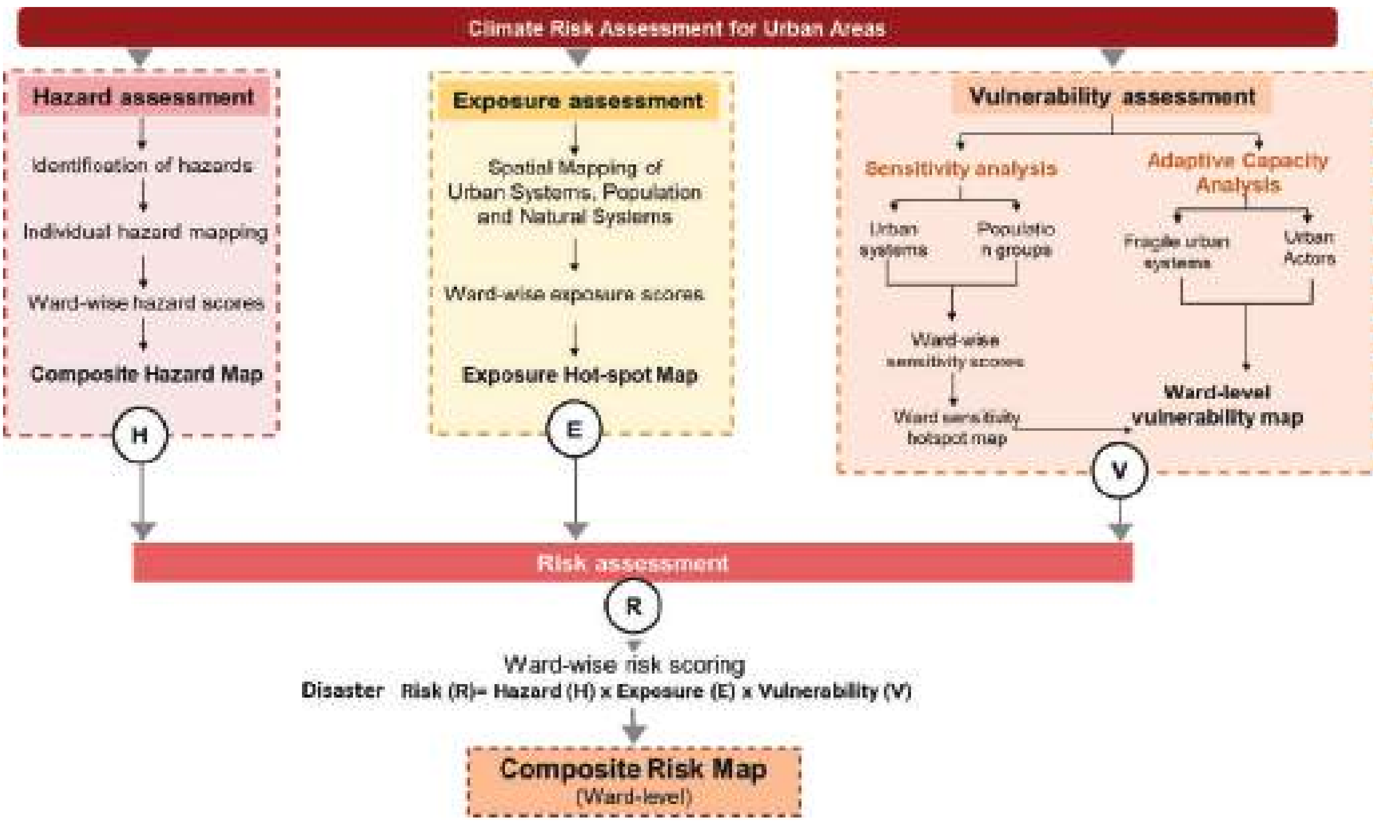


Figure 2: Overview of the Climate Risk Assessment Methodology

1.2. Standardised Categorisation Index and Mapping

Once the hazard, exposure, and vulnerability scores are normalised and used to derive a composite climate risk score using Equation 1, a standardised index is used to categorise climate risk values into four categories: low, moderate, high, and extreme.

Values less than or equal to the first quartile, i.e., 0.250, are classified as low. Values between the first and second quartile, i.e., 0.251–0.500, are classified as moderate, and values between the second and third quartile, i.e., 0.501–0.750, are classified as high. Values above 0.751, the third quartile, are considered extreme. The classification is presented in **Table 1**. Wards are categorised using this index, following which a ward-level climate risk map is developed.

Climate risk maps should be prepared for individual hazards and combinations of hazards to support detailed hazard-wise analysis.

Table 1: Climate Risk Categories

Range	Climate Risk Category
<=0.250	Low
0.251 –0.500	Moderate
0.501 – 0.750	High
>=0.751	Extreme

A similar index is used to categorise ward-level hazard, exposure, and vulnerability scores and derive spatial maps for individual or combinations of hazards.

1.3. Key Terminologies

Climate Risk: The potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of *climate change*, risks can arise from potential *impacts* and human responses. Relevant adverse consequences include those affecting lives, *livelihoods*, health and *well-being*, economic, social and cultural assets, and investments, infrastructure, services (including *ecosystem services*), ecosystems, and species.

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

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by climate hazards.

Vulnerability: The propensity or predisposition to be adversely affected, including sensitivity or susceptibility to harm and a lack of capacity to cope and adapt.

Climate hazard usually refers to the potential occurrence of climate related physical events or trends and their impacts that may cause damage and loss[3]. Based on evidence-based research it has been deduced that the risks of increasing average temperature and varying rainfall events may lead to climate hazards like extreme heat, sea-level rise, droughts/water scarcity, and urban flooding among others.

The first step in climate risk assessment is the climate hazard assessment, which provides spatial and quantitative layers representing the location, magnitude, and frequency of climate hazards.

A ward-level climate hazard assessment involves the following steps:

Step 1: The major climate hazards affecting the city are identified, based on the analysis of climate trends and past extreme events (*Tool 3.1A: Climate Trends and Past Events*). Examples of hazards include extreme heat, urban flooding, cyclones, and droughts.

Step 2: Ward-level spatial hazard layers are then developed using a combination of satellite datasets, meteorological data, and available city-level data. These layers represent the geographical extent and intensity of each hazard.

Step 3: Hazard values for each ward are normalised across hazards and averaged to derive ward-level hazard scores.

Step 4: Wards are categorised based on hazard intensity and spatially mapped to develop a ward-level hazard map for both individual hazards and combinations of hazards.

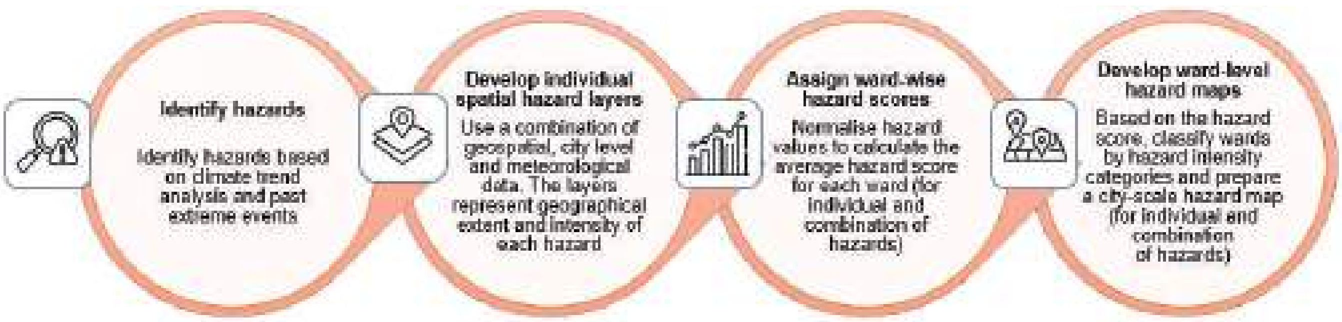


Figure 3: Hazard Assessment Process Overview

2.1. Sample Hazard Assessment Methodology

This section provides the hazard assessment methodology for three hazards, namely, extreme heat, urban flooding, and sea level rise, as these are the most prominent climate hazards observed in the South Asian and South-East Asian contexts.

Extreme heat, urban flooding and sea-level rise are merely examples of hazard assessments. Such assessments should be carried out for all hazards that a city historically experiences. If a city historically does not experience urban flooding, but drought or water scarcity, then the same should be assessed.

2.1.1. Extreme Heat

Extreme heat mapping identifies areas within the city that experience elevated thermal conditions driven by high surface temperatures, high humidity, and limited nighttime cooling. The analysis integrates geospatial and meteorological data to map heat-hazard indicators such as Land Surface Temperature (LST), Feels-Like Temperature (FLT), and Ambient Nighttime Temperature (ANT). Any combination of available indicators should be used for mapping.

3. Climate hazard definition sourced from "Annex II – Glossary" of The Fifth Assessment Report (AR5) of the United Nations Intergovernmental Panel on Climate Change (IPCC)

Land Surface Temperature (LST): This represents the temperature of the earth's surface, including built-up areas, and is a key indicator of the urban heat island effect. LST is derived from the thermal infrared bands of Landsat satellite imagery. The imagery is processed and converted into temperature values using standard radiometric and atmospheric correction methods in Geographic Information System (GIS) software. The resulting LST map is classified to identify spatial variations in surface temperature and highlight high-temperature hotspots across the city. LST hotspots are areas with LST values above the median temperature.

It is recommended that LST analysis be conducted for at least seven days per month over a five-year period. Where data availability is limited, the analysis may be conducted for one day per month over a five-year period. At a minimum, LST maps for one day per month during peak summer months should be prepared.

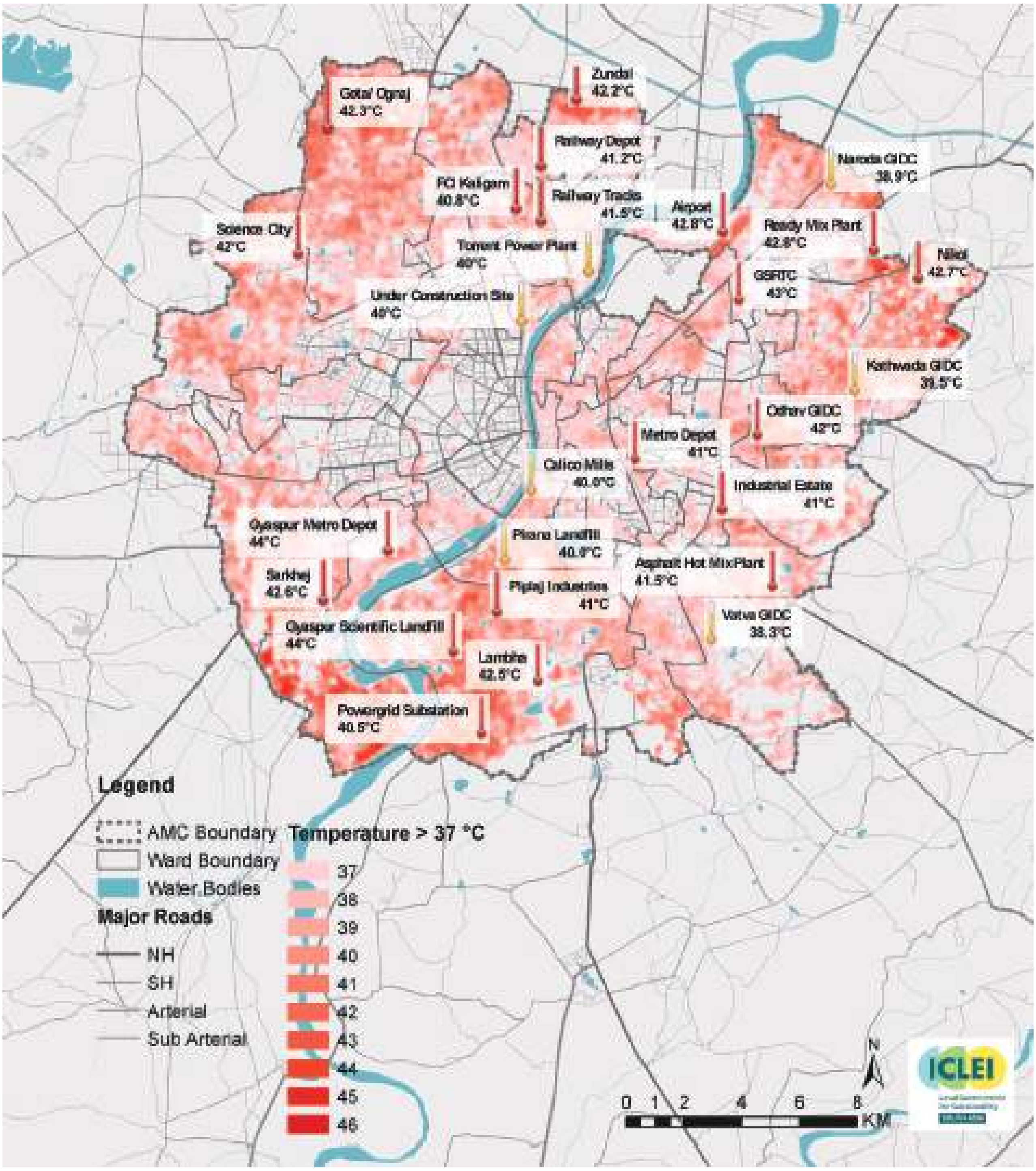


Figure 4: Land Surface Temperature Hotspot Map for Ahmedabad, May 2021 (Ahmedabad CRCAP)

Feels-like Temperature (FLT): FLT represents the temperature perceived by the human body due to the combined effect of air temperature and relative humidity on human thermal comfort. It is represented as a matrix of predefined temperature and relative humidity values that define heat stress threshold levels.

FLT is calculated using ambient temperature (t) and relative humidity (RH) data collected from multiple meteorological monitoring stations within the city. It can be represented as shown in Table 2.

Table 2: FLT Matrix Template

	t_1	t_2	t_3	....	t_n
RH_1	$FLT_{(1,1)}$	$FLT_{(1,2)}$	$FLT_{(1,3)}$		$FLT_{(1,n)}$
RH_2	$FLT_{(2,1)}$	$FLT_{(2,2)}$	$FLT_{(2,3)}$		$FLT_{(2,n)}$
RH_3	$FLT_{(3,1)}$	$FLT_{(3,2)}$	$FLT_{(3,3)}$		$FLT_{(3,n)}$
...					
RH_n	$FLT_{(n,1)}$	$FLT_{(n,2)}$	$FLT_{(n,3)}$		$FLT_{(n,n)}$

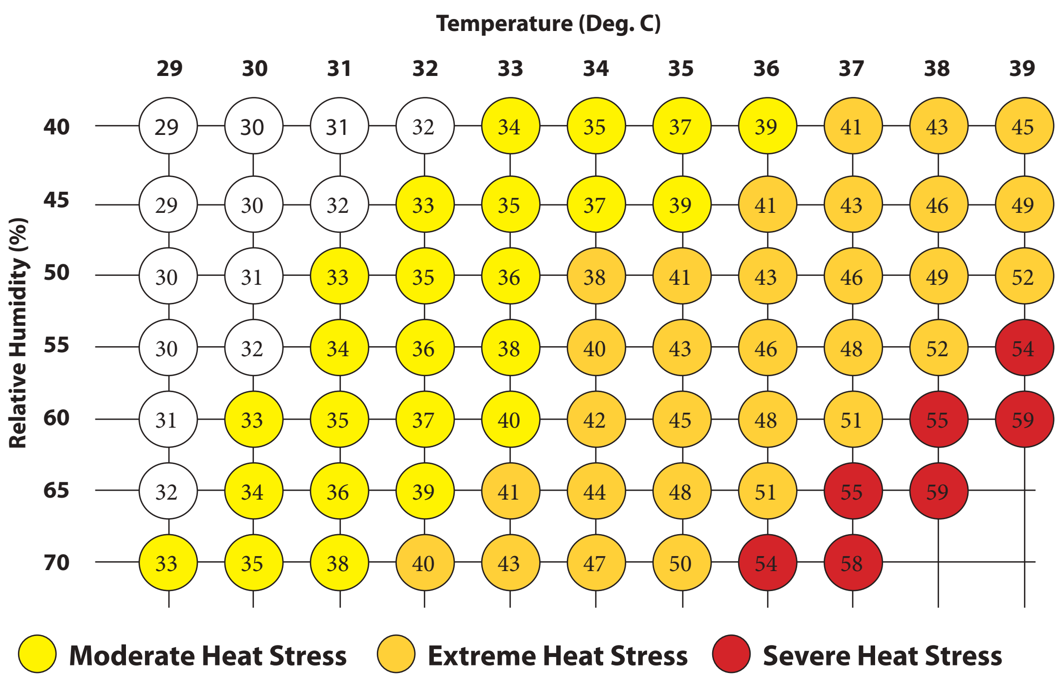


Figure 5: Feels-like Temperature Matrix (Source: National Oceanic and Atmospheric Administration [NOAA], United States Government)

FLT should be calculated daily using maximum daily temperature and relative humidity from multiple stations within the study area. Seasonal averages are then derived and mapped using calculated FLT values for each station. Station-level FLT values are spatially interpolated using GIS-based techniques (e.g., IDW or Kriging in ArcGIS) to generate a continuous feels-like temperature surface across the city.

In cities with only one or no meteorological monitoring station, the mapping exercise may not be feasible due to limited spatial data coverage. Instead, FLT values for such cities can be calculated as seasonal averages and used as supporting evidence to strengthen the analysis on heat stress.

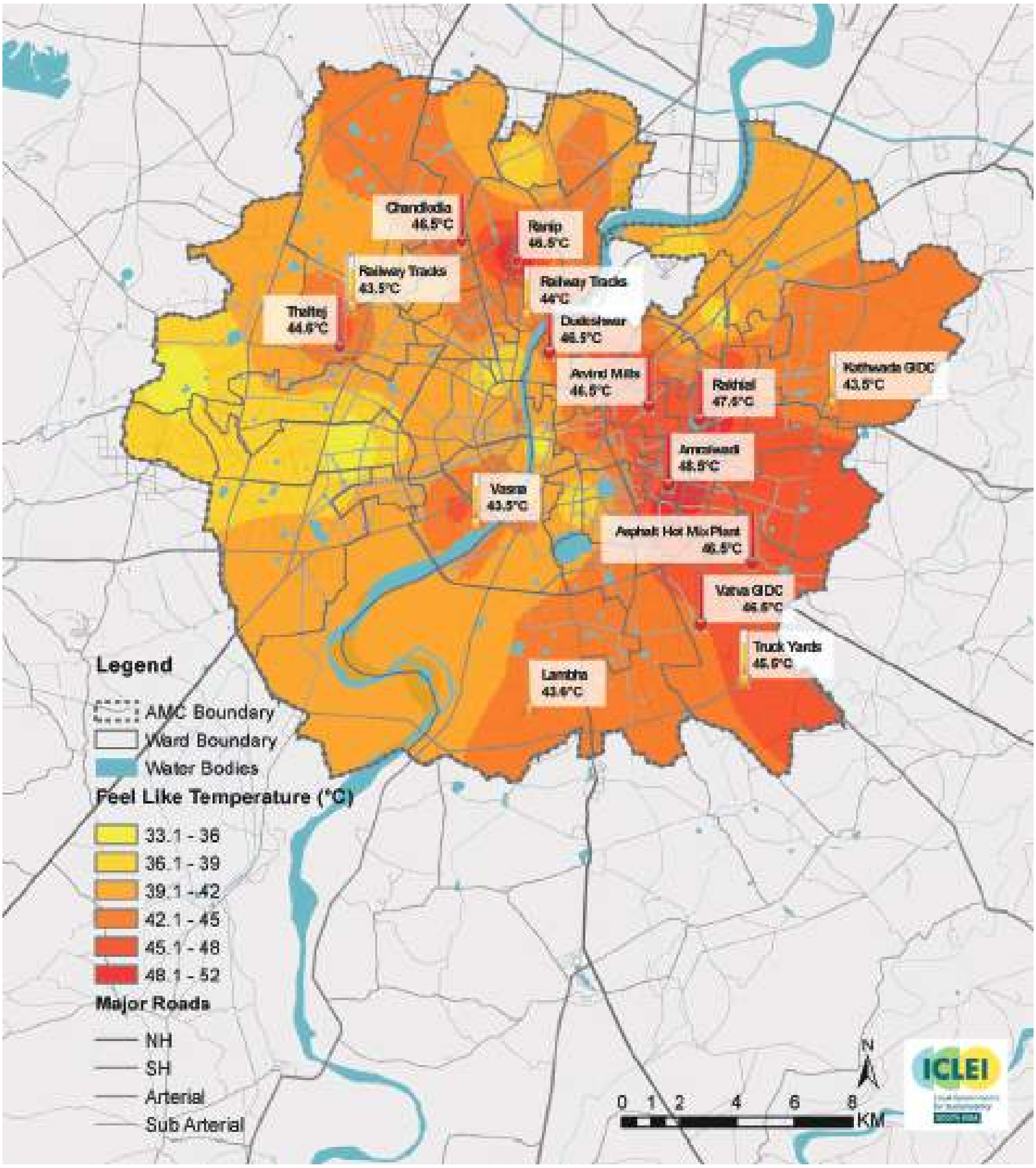


Figure 6: Feels-like Temperature Map for Ahmedabad, May 2021 (Ahmedabad CRCAP)

Ambient Nighttime Temperature (ANT): Ambient Nighttime Temperature analysis assesses minimum and maximum nighttime temperatures using Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery to understand the extent of nighttime heat retention across the city. This step helps identify areas with limited nighttime cooling, which may contribute to prolonged heat stress in urban areas.

2.1.2. Urban Flooding

Flood hazard mapping involves identifying areas within the city that are inundated during heavy rainfall or flood events. Where the city has spatially identified flood- or waterlogging-prone locations (such as recurrent inundation points, historically flooded streets, or affected wards), this information can be directly used for flood hazard mapping.

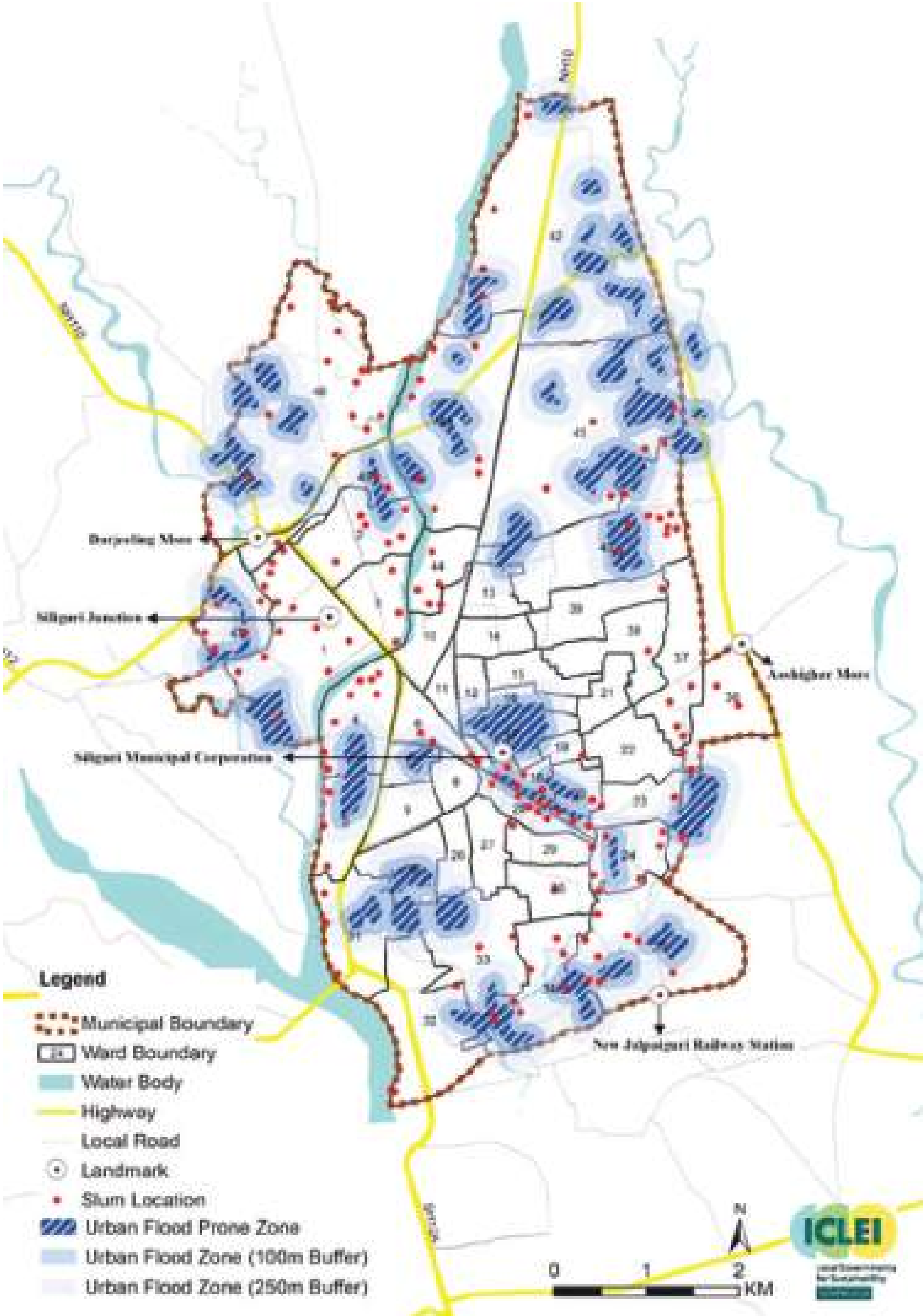


Figure 7: Flood- and Inundation-prone Areas in Siliguri City, West Bengal

In cities where mapped flood locations are unavailable but information on one or more known flooding events is available, flood inundation extents can be derived using satellite imagery. Pre- and post-event satellite images are analysed to extract observed inundation areas, which are then mapped and aggregated to represent flood-affected areas across the city.

In cases where neither spatial flood locations nor specific flood-event dates are available, long-term satellite-derived datasets may be used as proxy indicators. The Global Surface Water Explorer dataset can be analysed using the recurrence layer to identify areas that have experienced frequent surface water presence between 1984 and 2021. These areas can be considered indicative of recurrent flooding or waterlogging.

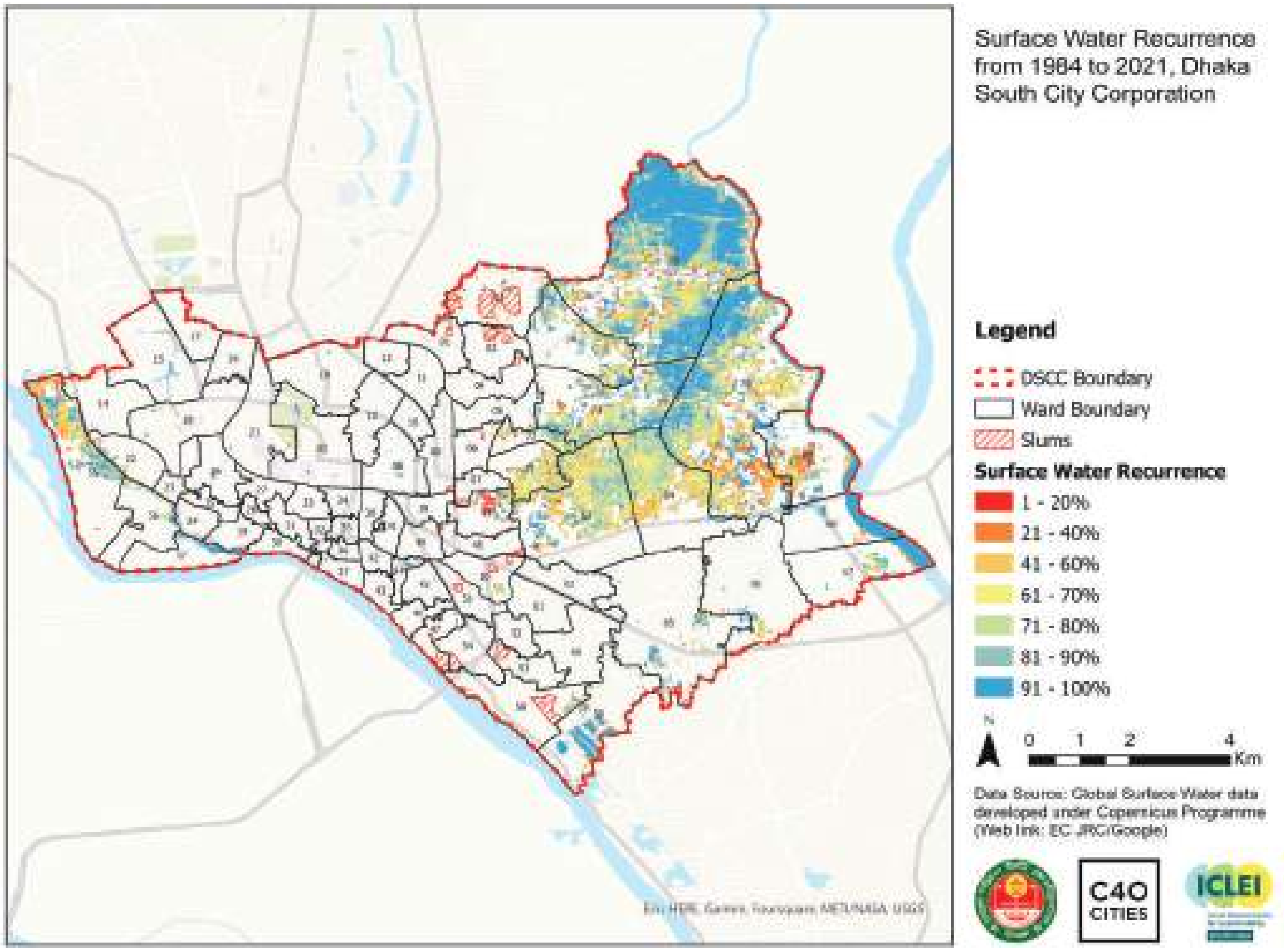


Figure 8: Flood Recurrence Map for Dhaka South City, Bangladesh, Using the Global Surface Water Explorer

2.1.3. Sea-level Rise

Sea-level rise hazard mapping identifies coastal areas that may be affected by future sea-level rise. For analysis, scientifically validated tools, such as the Coastal Risk Screening Tool developed by Climate Central, which is based on peer-reviewed scientific studies and aligned with the IPCC AR5 framework, may be used. The tool combines global sea-level rise projections with coastal elevation data to identify low-lying areas at risk of inundation. The resulting maps show the potential extent of coastal flooding due to sea-level rise. These maps are further analysed in GIS to identify coastal neighbourhoods and urban systems that may be exposed to future impacts. Other reliable, scientifically validated tools for assessing sea-level rise and coastal flooding may also be used, depending on availability and local context.

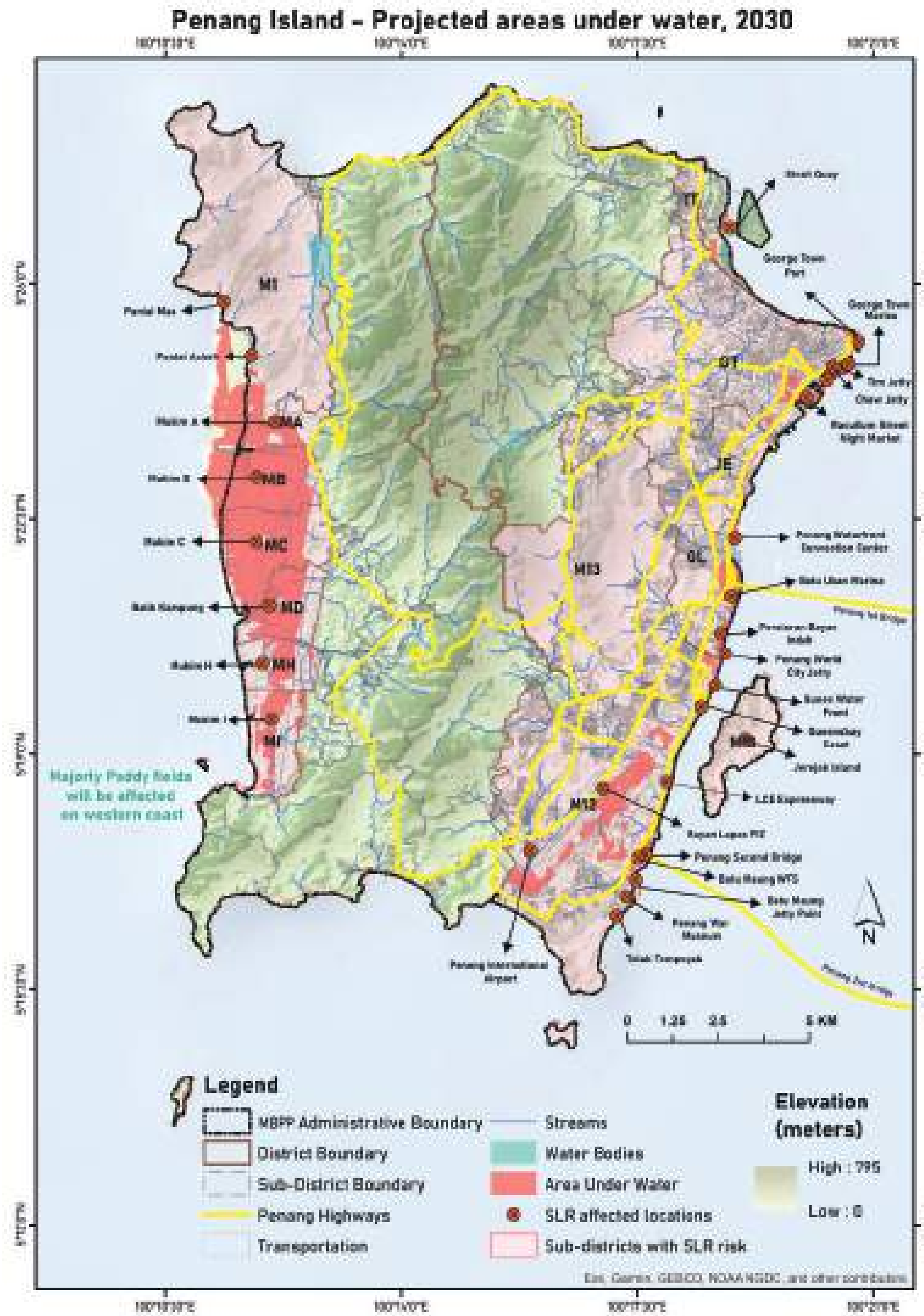


Figure 9: Projected Inundation Areas due to Sea-level Rise for Penang Island, Malaysia

2.4. Ward-level Hazard Mapping

Once hazard values are identified for each ward, cities should develop ward-wise hazard maps to identify wards experiencing relatively higher hazard intensity.

Hazard maps can be developed for individual hazards or combinations of hazards to enable targeted, localised hazard-specific interventions.

In case satellite imagery or spatial data in unavailable for any of the hazard, spatial hazard prone locations should be identified through stakeholder/ community consultations.

Normalise Ward-Level Hazard Indicators

Using the hazard layers generated through city-level spatial mapping of climate hazards, derive ward-level values for each identified hazard indicator (e.g., average intensity, LST, or percentage area affected), specific to each city. These values are then normalised to bring all hazard indicators to a comparable scale ranging from 0 to 1. Using normalised values for hazard indicators is essential as each indicator is measured in different units and ranges. For example, extreme heat hazard-related values are recorded in degrees, whereas urban flooding and sea-level rise are measured by the geographic area affected.

The values are normalised using the following formula:

$$\textbf{Normalised value} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

where,

X is the actual value of the parameter

X_{min} is the minimum value of the parameter in the given range,

X_{max} is the maximum value of the parameter in the given range.

Normalisation converts ward-wise hazard scores to a scale ranging from 0 to 1, allowing fair comparison across hazards, highlighting relative differences between wards, and enabling accurate aggregation. These values are then used to prepare a consolidated table of normalised hazard values for all wards, as shown in **Table 3**.

Wards	Heat Stress		Flood		SLR		Other		Ward-level Composite Hazard Score (Geometric mean of normalised values) = $\sqrt[N]{(a+b+c+ ..N)}$
	LST	Normalised (a)	Flood Area	Normalised (b)	Inundation Area	Normalised (c)	Actual	Normalised (N)	

N - number of hazards

Develop Ward-Level Hazard Maps

Based on the composite hazard score for each ward, classify wards into hazard intensity categories, using Table 4, and prepare a ward-level hazard map using GIS.

Table 4: Climate Hazard Scoring Index

Hazard score range	Hazard Level
<=0.250	Low
0.251 –0.500	Moderate
0.501 – 0.750	High
>=0.751	Extreme

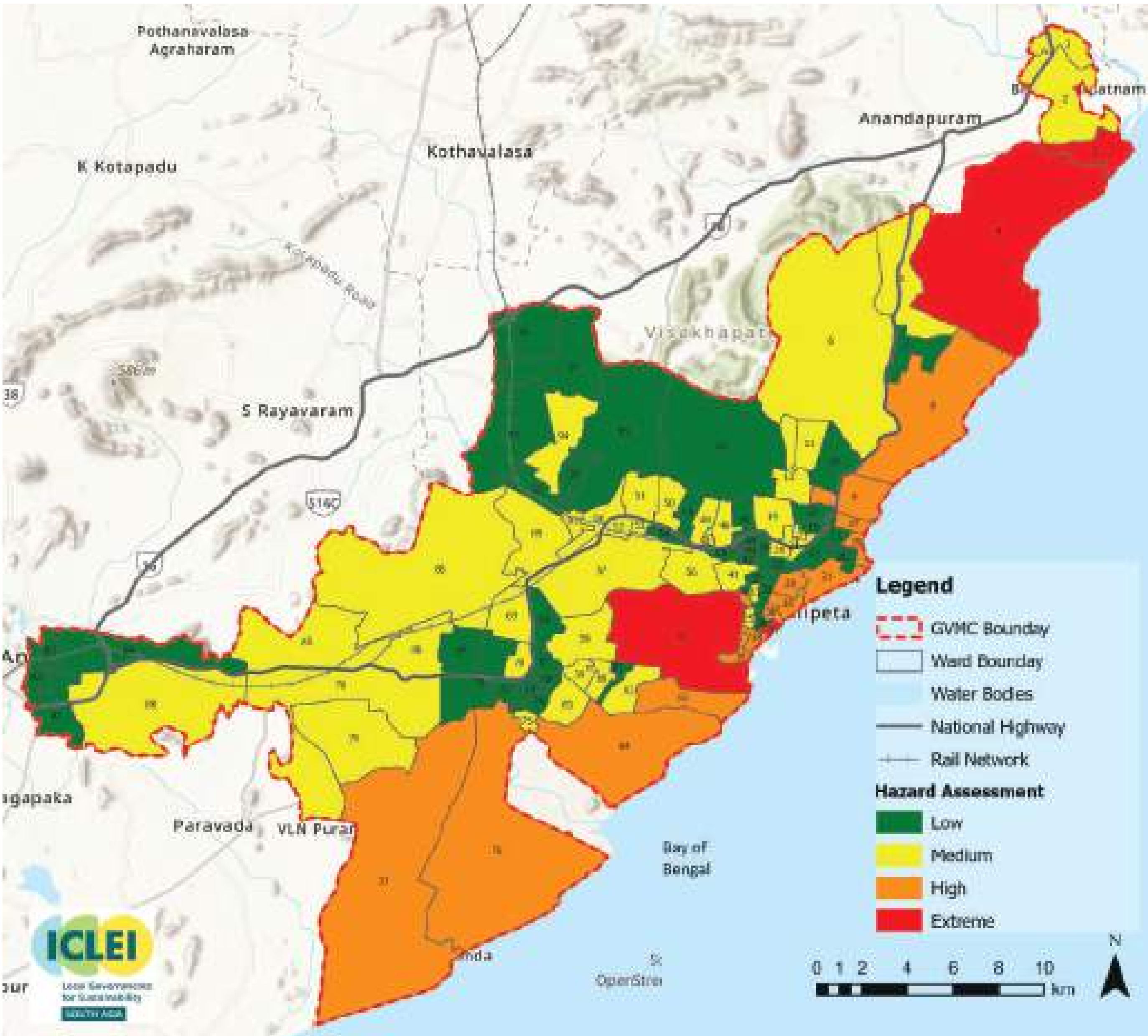


Figure 10: Composite Hazard Map for Visakhapatnam

Individual Hazard Maps Example: Heat Hazard

Ward-level values for LST, FLT and ANT are normalised and averaged to derive ward-wise heat hazard scores, which are then plotted spatially to develop the heat hazard map. All three parameters (LST, FLT, and ANT) are assigned equal weight when calculating ward-wise heat hazard scores. While certain parameters may have greater influence, equal weighting is applied because there is no conclusive evidence/research on their relative contribution to heat hazard. A limitation of this approach is that it may mask the intra-ward interplay between the parameters.

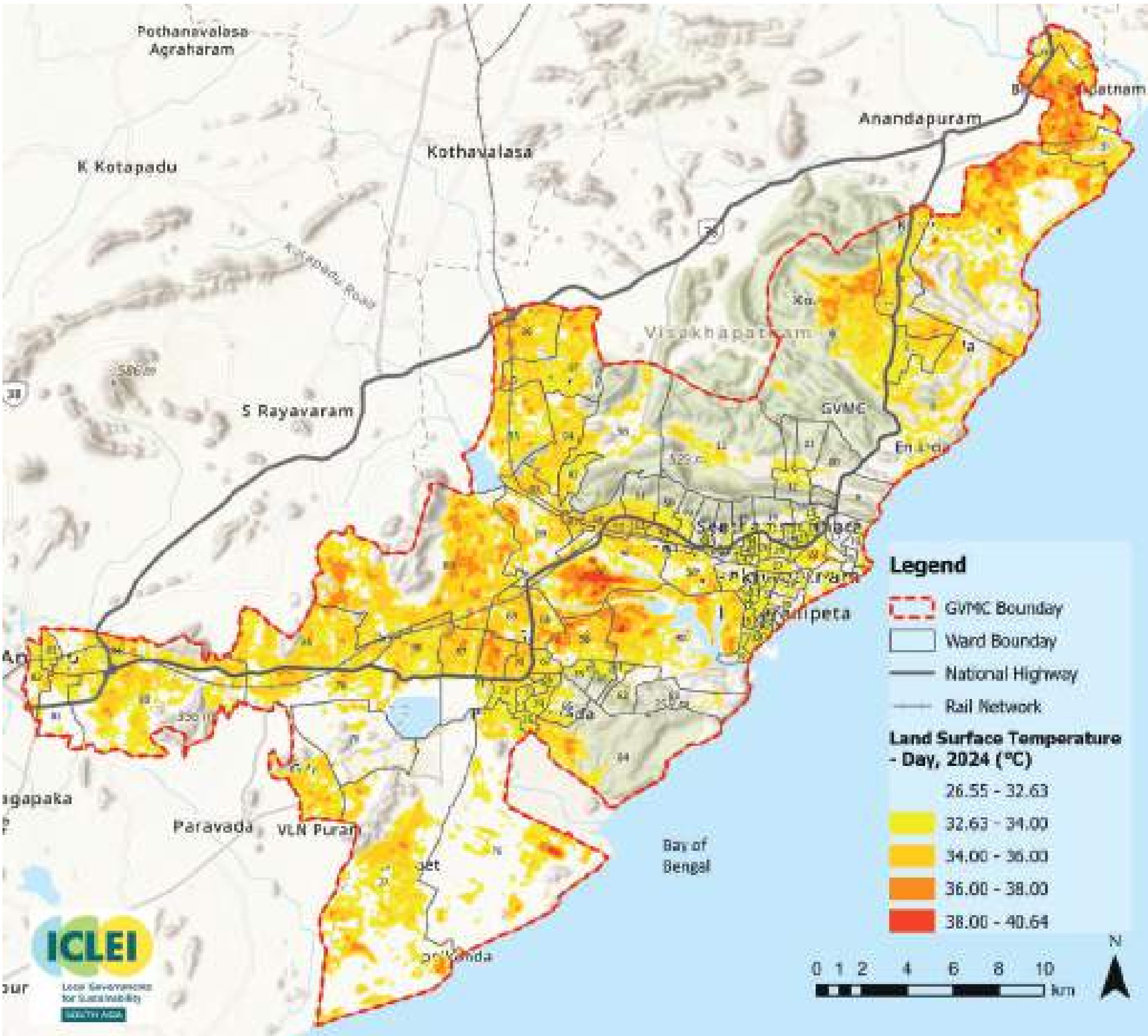


Figure 11: Heat Hazard Map for Visakhapatnam

2.5. Stakeholder Validation for Hazard Assessment

It is important to validate the hazard data and maps through stakeholder consultations. Stakeholder consultations with NGOs, local authorities, resident welfare associations and community groups can be used to map and validate heat hotspots, inundation areas, flood spots and other hazard-prone areas. Data from consultations can also serve as a useful proxy when geospatial information is not available. For example, flood-prone locations identified through consultations can be spatially analysed and overlaid with elevation and drainage network layers to delineate flood-prone zones at the ward or neighbourhood level.

SECTION 3

Exposure Assessment

Exposure refers to the presence of people, physical assets, infrastructure, and ecosystems in areas prone to climate hazards. According to the IPCC AR5 climate risk framework, exposure alone does not indicate impact; rather, it shows where people, assets, and ecosystems are located in relation to climate hazards. When combined with hazard intensity and vulnerability, exposure determines the magnitude of the potential climate risk a city faces.

The exposure assessment uses three categories of spatial layers to identify who and what are located within hazard-prone areas by spatially mapping: 1) urban systems and 2) population and vulnerable social groups. It also maps 3) natural systems to understand their role in mitigating exposure. This assessment is primarily map-based and focuses on understanding the geographic distribution of infrastructure, communities, and ecosystems to identify which populations, urban systems, and natural systems are located in areas subject to climate hazards and may therefore experience damage, service disruption, or environmental degradation.

Exposure assessment is carried out using the following steps:

Step 1: Map urban systems and identify the number of critical infrastructure assets located within hazard-prone areas for each ward.

Step 2: Map vulnerable population groups (such as low-income communities, older persons, children, differently abled, women, outdoor workers, and other relevant groups) and identify the population exposed to hazard-prone areas in each ward.

Step 3: Map natural assets, including green cover and water bodies, using remote sensing indices to identify assets located within hazard-prone areas for each ward.

Step 4: Normalise the exposure indicators for urban systems, vulnerable populations, and natural assets, and calculate the average of the normalised values to derive the overall exposure score for each ward.

Step 5: Classify wards by exposure level and prepare ward-level exposure maps for individual climate hazards as well as combinations of hazards.

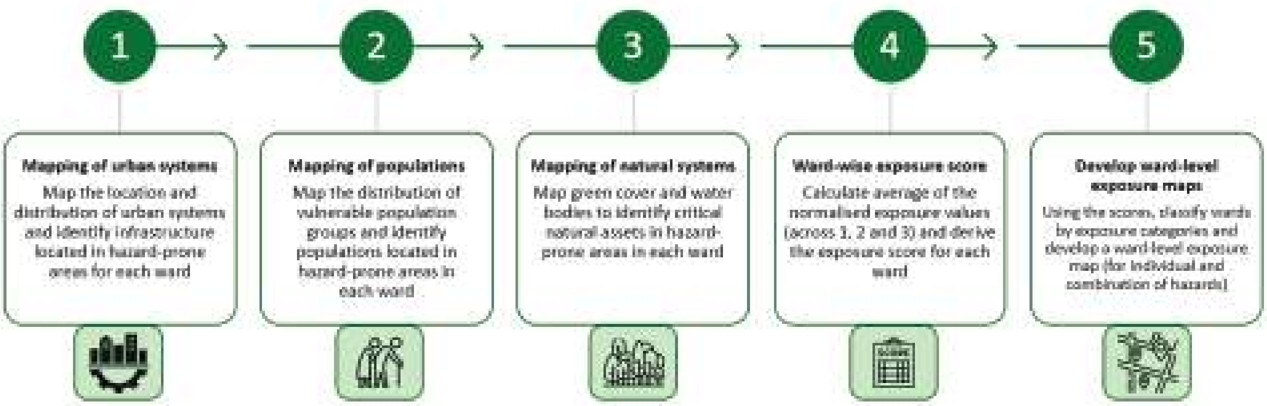


Figure 12: Overview of the Exposure Assessment Process

3.1. Urban Systems

For each urban system assessed in the Net-zero CRCAP, spatial layers are prepared to represent the physical location and distribution of infrastructure and services in each ward. These maps show where the infrastructure is located and whether it intersects with hazard-prone zones. Typical urban system layers may include, but are not limited to:

- Water supply assets (intake points, treatment plants, pump stations, reservoirs, pipelines)

- Sewerage and stormwater networks, pumping stations and treatment facilities
- Solid waste processing/treatment facilities and transfer stations
- Power substations, transmission corridors, and generation facilities
- Roads, bridges, non-motorised transport (NMT) facilities, public transport infrastructure, stops and terminals
- Emergency facilities like healthcare facilities and fire stations
- Built environment, such as building footprints

In addition, data on urban service delivery-related issues can be collected from citizen complaint registers or through consultations with city officials. This can include information on capturing recurrent service disruptions such as waterlogging complaints, sewer overflows, water supply failures, power outages, waste collection issues, and public health issues. Overlaying these datasets with hazard layers will provide contextual insight into operational stress points and reinforce the identification of climate-fragile urban systems.

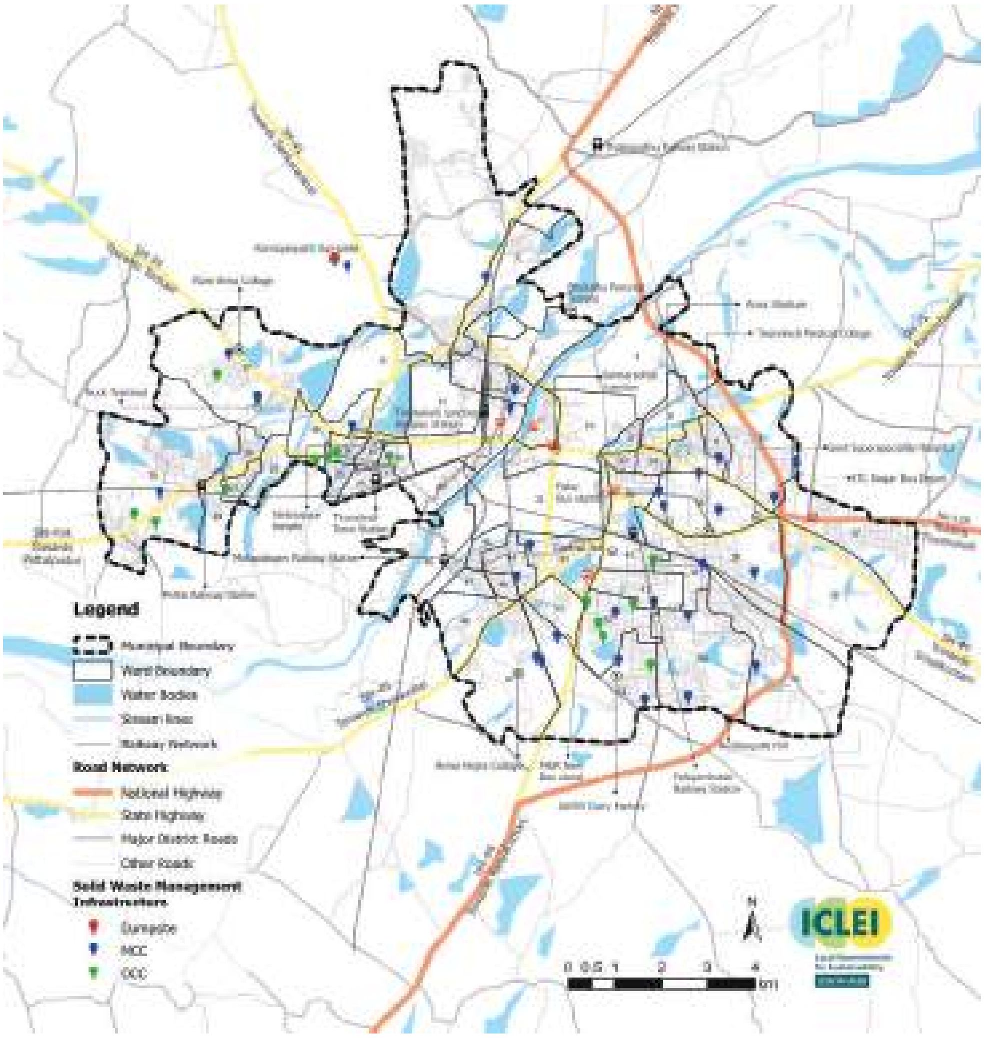


Figure 13: Solid Waste Management Infrastructure Map from Tirunelveli (Tirunelveli CRCAP)

Note: The infrastructure layers used in this exercise can be drawn from or cross-referenced with the spatial outputs of the Urban Systems Analysis chapter.

3.2. Population and Vulnerable Social Groups

Population exposure focuses on the spatial distribution of people and vulnerable groups such as the elderly, women, differently abled, low-income groups, outdoor workers and children. It includes:

- Total population distribution
- Population density (persons per hectare or km^2)
- Informal settlements (slums)
- Critical population clusters

Figure 14: Slum Locations in Kakinada (Kakinada CRCAP)

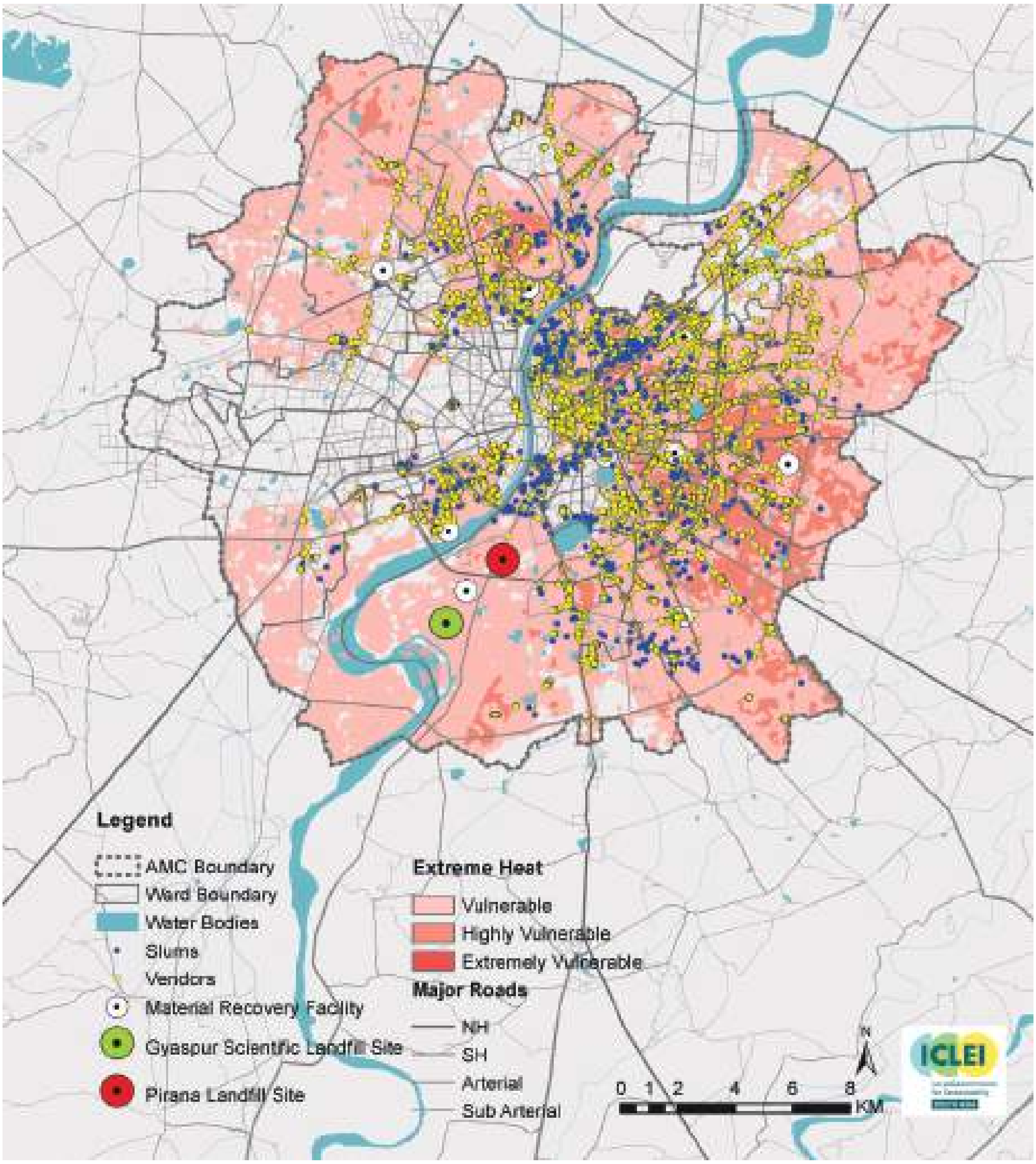


Figure 15: Slums Prone to Extreme Heat in Ahmedabad (Ahmedabad CRCAP)

3.3. Natural Systems

The assessment evaluates the impact of natural systems, such as vegetation and water bodies, on exposure using remote sensing indices such as the Normalised Difference Vegetation Index, or NDVI, which indicates vegetation cover, and the Normalised Difference Water Index, or NDWI identifies surface water bodies, wetlands, or drainage features.

3.3.1. Normalised Difference Vegetation Index (NDVI)

NDVI is used to map vegetated areas across the city. Lower NDVI values indicate reduced green cover, higher surface heat exposure and lower ecological buffering capacity. NDVI is calculated using the reflectance values from the Near-Infrared (NIR) and Red bands:

$$\textbf{NDVI} = \textbf{(NIR - Red) / (NIR + Red)}$$

Satellite imagery is processed to generate a city-wide NDVI map. Pixel values range from approximately –1 to +1, where higher values represent dense and healthy vegetation, and lower values indicate sparse vegetation, built-up areas, or degraded land.

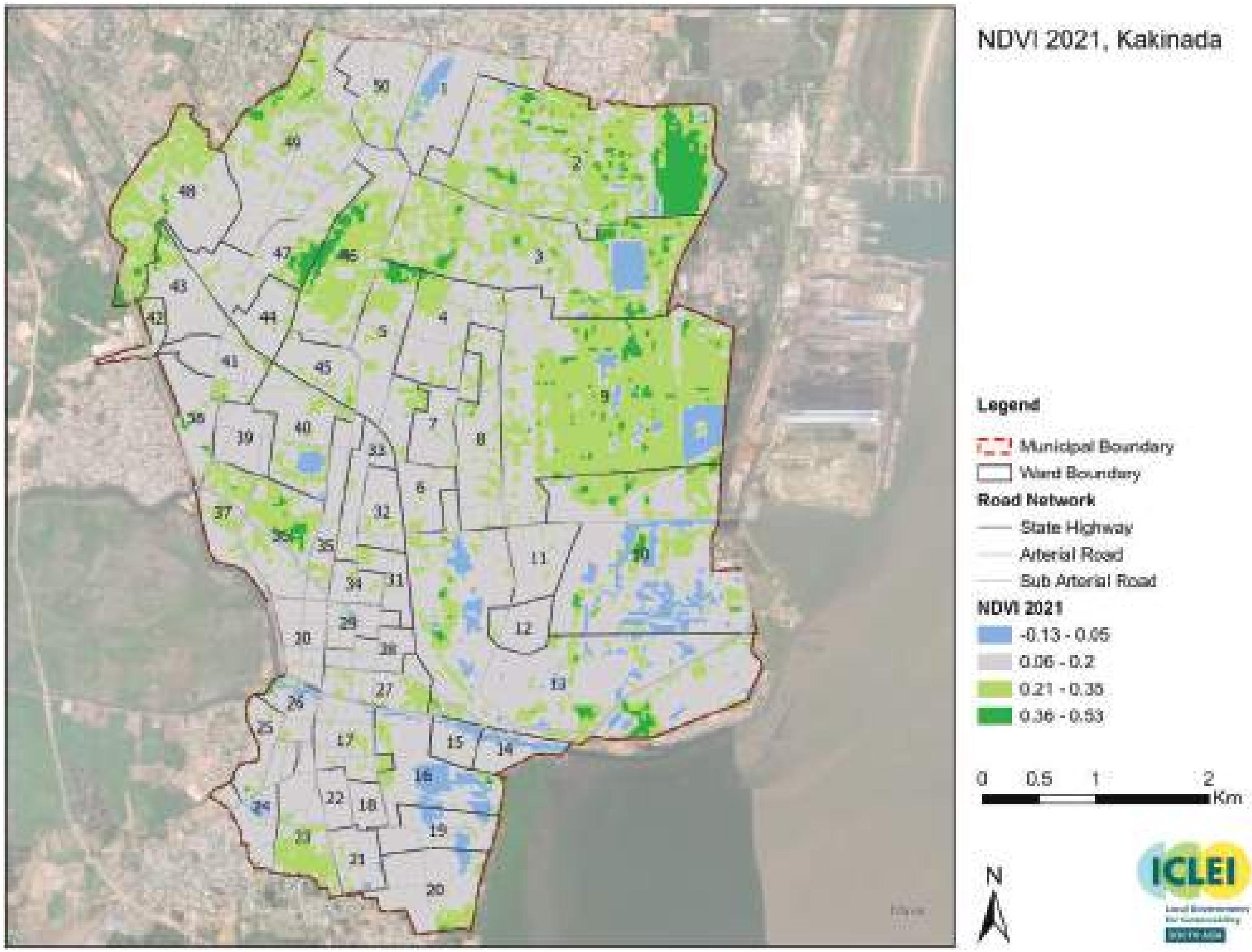


Figure 16: Normalised Difference Vegetation Index (NDVI) Map for Kakinada

3.3.2. Normalised Difference Water Index (NDWI)

NDWI identifies surface water bodies, wetlands, drainage features and moisture conditions. Lower NDWI values indicate reduced water availability and increased exposure to heat stress, flood runoff, and drought. NDWI is computed using reflectance values from the Green and Near-Infrared (NIR) bands using the formula:

$$\textbf{NDVI = (NIR - Red) / (NIR + Red)}$$

Processed satellite imagery is used to generate a city-wide NDWI layer, where positive values indicate water and lower or negative values indicate dry surfaces and built-up areas. These layers do not directly measure environmental vulnerability but provide spatial context for areas with limited thermal buffers, hydrological sensitivity, or ecosystem degradation.

3.4. Ward-level Exposure Mapping

Cities can then develop ward-level exposure maps by combining information on urban infrastructure, population, and natural systems. This helps answer the question: **which wards have the highest concentration of people, critical infrastructure, and natural systems that may be adversely affected by climate hazards?**

Step 1: Compile and Normalise Spatial Layers for Exposure Assessment

Using the spatial layers prepared in the exposure assessment, compile ward-level indicators for the following components. The parameters listed below are indicative and may be expanded based on data availability:

- **Urban Systems:** number of vulnerable or climate-sensitive urban systems within the ward.
- **Population and Vulnerable Settlements:** Total vulnerable population, number of slums or informal settlements, or extent of vulnerable residential areas.
- **Natural Systems:** NDVI and NDWI

To ensure comparability across wards, all exposure indicators are normalised to a common scale between 0 and 1.

For parameters where higher values indicate higher exposure (such as the number of fragile urban systems or the number of slums), normalisation is conducted using the formula:

$$\textbf{Normalised value} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

where,

X is the actual value of the parameter

X_{min} is the minimum value of the parameter in the given range,

X_{max} is the maximum value of the parameter in the given range.

For parameters with an inverse relationship to exposure (such as NDVI and NDWI, where higher values indicate lower exposure), inverse normalisation is applied. This ensures that wards with lower vegetation cover or surface water are assigned relatively higher exposure scores. The inverse normalisation value is calculated by using the formula:

$$\textbf{Normalised value} = \frac{X_{max} - X}{X_{max} - X_{min}}$$

A consolidated table of normalised exposure scores for all wards should be prepared in the format presented in **Table 5**.

Table 5: Normalised Exposure Scores

Wards	NDVI (a)	NDWI (b)									Exposure (geometric mean of normalised values) $\sqrt[N]{(a+b+c+..N)}$
			Actual	Normalised (c)	Actual	Normalised (d)	Actual	Normalised (d)	Actual	Normalised (N)	

N - number of parameters considered

Step 2: Develop the Ward-Level Exposure Map

Based on the composite exposure scores, classify wards into the exposure categories listed in the table below, and prepare a ward-level exposure map using GIS. Exposure maps should be prepared for individual hazards and combinations of hazards.

Range	Exposure
<=0.250	Low
0.251 –0.500	Moderate
0.501 – 0.750	High
>=0.751	Extreme

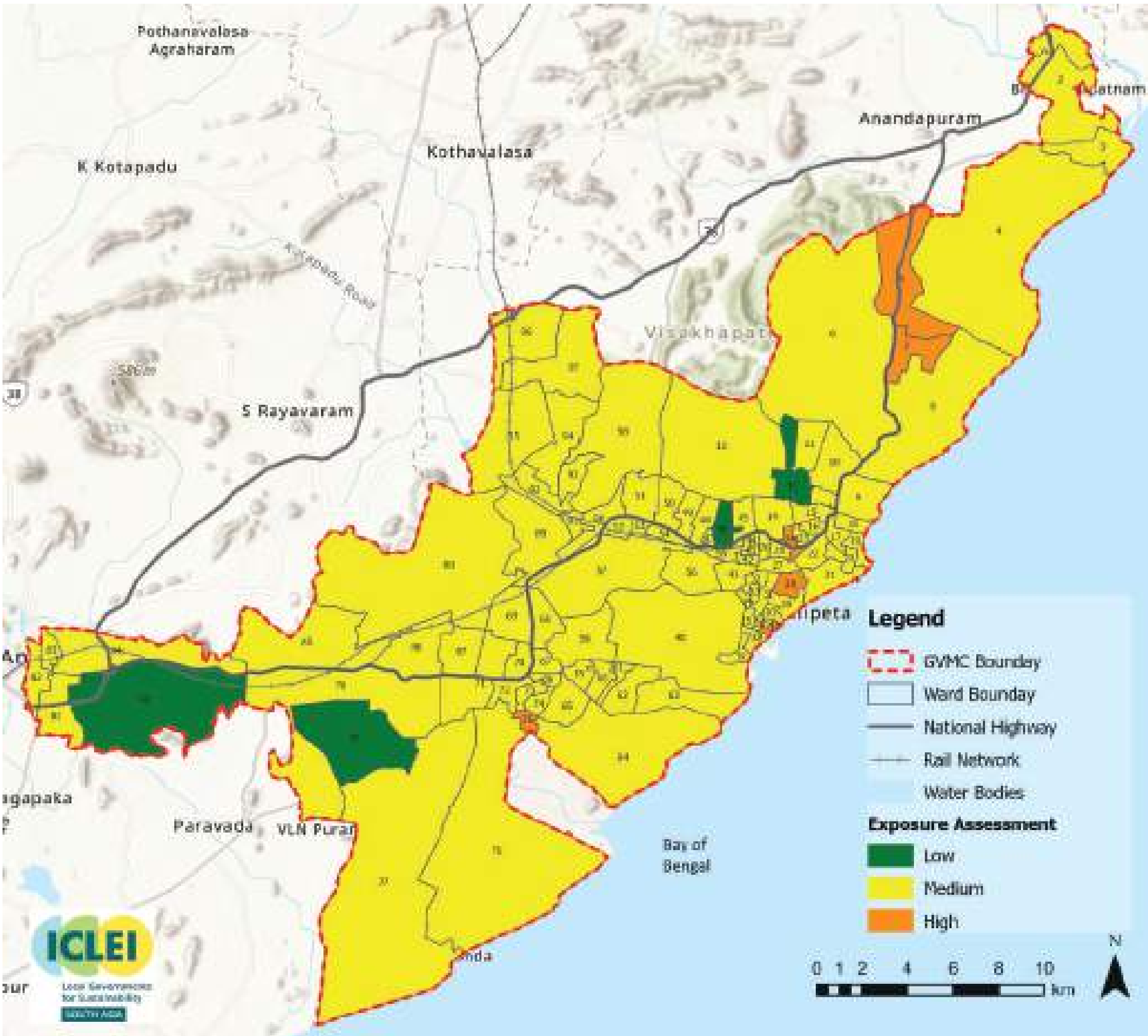


Figure 17: Ward-level Composite Exposure Map for Visakhapatnam

3.5. Stakeholder Validation for Exposure Assessment

The exposure assessment can be validated through consultations with stakeholders such as local authorities, resident welfare associations, civil society organisations and other community stakeholders. Consultations can be used to assess sensitivity and adaptive capacity in cases of geospatial data being not available. Data collected through such consultations should be supplemented by ground-truthing and field-testing exercises.

SECTION 4

Vulnerability Assessment

Vulnerability refers to the extent to which people, systems, or assets are likely to be harmed due to climate hazards and their ability to adapt. According to the IPCC AR5 framework, vulnerability is defined in terms of two components: sensitivity and adaptive capacity.

a) **Sensitivity:** The degree to which a system, population groups, or sectors are either adversely or beneficially affected by climate hazards. Sensitivity of a ward increases with ageing, inadequate infrastructure, urban service delivery issues, higher concentration of vulnerable groups, or degraded ecosystems.

b) **Adaptive Capacity:** The ability of institutions, households, vulnerable groups, and urban systems to anticipate, cope with, and recover from climate impacts. It is shaped by factors such as strong governance systems, access to financial, technical, and human resources, emergency preparedness, and access to basic services.

Sensitivity is directly proportional to vulnerability, i.e., the higher the sensitivity, the higher the ward's vulnerability. Adaptive capacity is inversely proportional to vulnerability; the higher the adaptive capacity, the lower the vulnerability.

In this assessment, a quantitative sensitivity analysis of urban systems and population groups and a qualitative adaptive capacity analysis of urban systems and urban actors are carried out. The sensitivity analysis directly informs the ward-level vulnerability maps, while the adaptive capacity analysis identifies actors and urban systems with low or high adaptive capacities.

The outcomes of this assessment are validated through a joint workshop with the Climate Core Team and the Stakeholder Group. The assessment produces the following outputs:

- Identification of vulnerable wards in the city with vulnerability scores derived through sensitivity analysis
- Assessment of adaptive capacity of urban systems and actors

4.1. Sensitivity Analysis

Conducting a sensitivity analysis comprises the following steps:

Step 1: Assessing sensitivity of urban systems by developing climate fragility statements to calculate ward-level urban system sensitivity scores. These scores are then normalised and averaged to get a **ward-level urban system sensitivity score**.

Step 2: Assessing sensitivity of vulnerable population groups using data on the number of vulnerable population groups in each ward. The data for each population group are normalised across wards and averaged across population groups to get the **population sensitivity score for each ward**.

Step 3: Next, urban system sensitivity and population sensitivity scores for each ward are averaged to obtain an **overall ward-level vulnerability score**.

Step 4: Wards are then categorised based on vulnerability levels from low to extreme, and **ward-level vulnerability maps** are developed for both individual hazards and combinations of hazards.

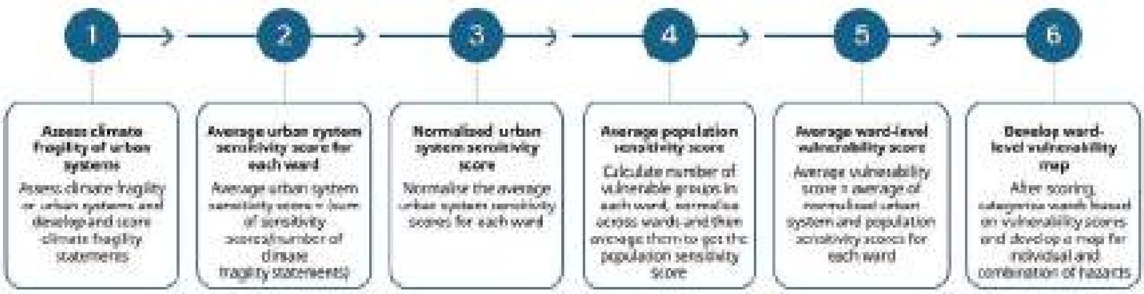


Figure 18: Overall Process to Develop Vulnerability Maps

4.1.1. Sensitivity of Urban Systems

Step A: Assessing the Climate Fragility of Urban Systems

As seen in Step 2.3 of the Net-Zero CRC methodology, a fragile urban system is one which is vulnerable to external disruptions, including climate hazards. Such disruptions can prevent the system from continuing to perform normal functions and deliver services. A list of fragile urban systems was already identified in Step 2.3. To assess the impacts of climate change on fragile urban systems, the following steps should be followed:

Sub-step A.1: Use the fragile systems identified in your city and the corresponding fragility statements developed in Tool 2.3B.

Sub-step A.2: Consider the Climate Scenario Summaries developed in Tool 3.1B to understand the potential future changes in temperature, precipitation and other climate-related parameters for the city.

Sub-step A.3: List all fragile urban systems and climate scenario statements and develop climate fragility statements for each urban system. A climate fragility statement should describe how projected climate change can impact the identified fragile systems. In most cases, climate change may threaten or weaken a system (e.g., poor drainage systems may deteriorate further due to increased precipitation). In some cases, climate change may bring benefits (e.g., water supply systems that experience inadequate supply may benefit from increased precipitation).

Table 6: Developing climate fragility statements for urban systems

Urban System	Fragility Statement	Climate Scenario Statements	Climate Fragility Statement for Climate Scenario Statement	Impacted Wards
Transport	Inadequate public transport (0.12 buses per 1000 people, < MOHUA benchmark of 0.6) and limited non-motorised transport infrastructure for last-mile connectivity. Compromised road infrastructure in certain parts of the city, with potholes and raised manhole covers	Increased precipitation	Increased precipitation can worsen road conditions; waterlogging can lead to traffic congestion, affecting connectivity and increasing emissions.	2,5,6
		Increased temperatures	Increased temperatures can adversely affect the health and comfort of commuters waiting at public transit stations, increasing the demand for private modes, particularly air-conditioned four-wheelers. This will in turn increase traffic congestion and vehicular emissions.	1,2,6

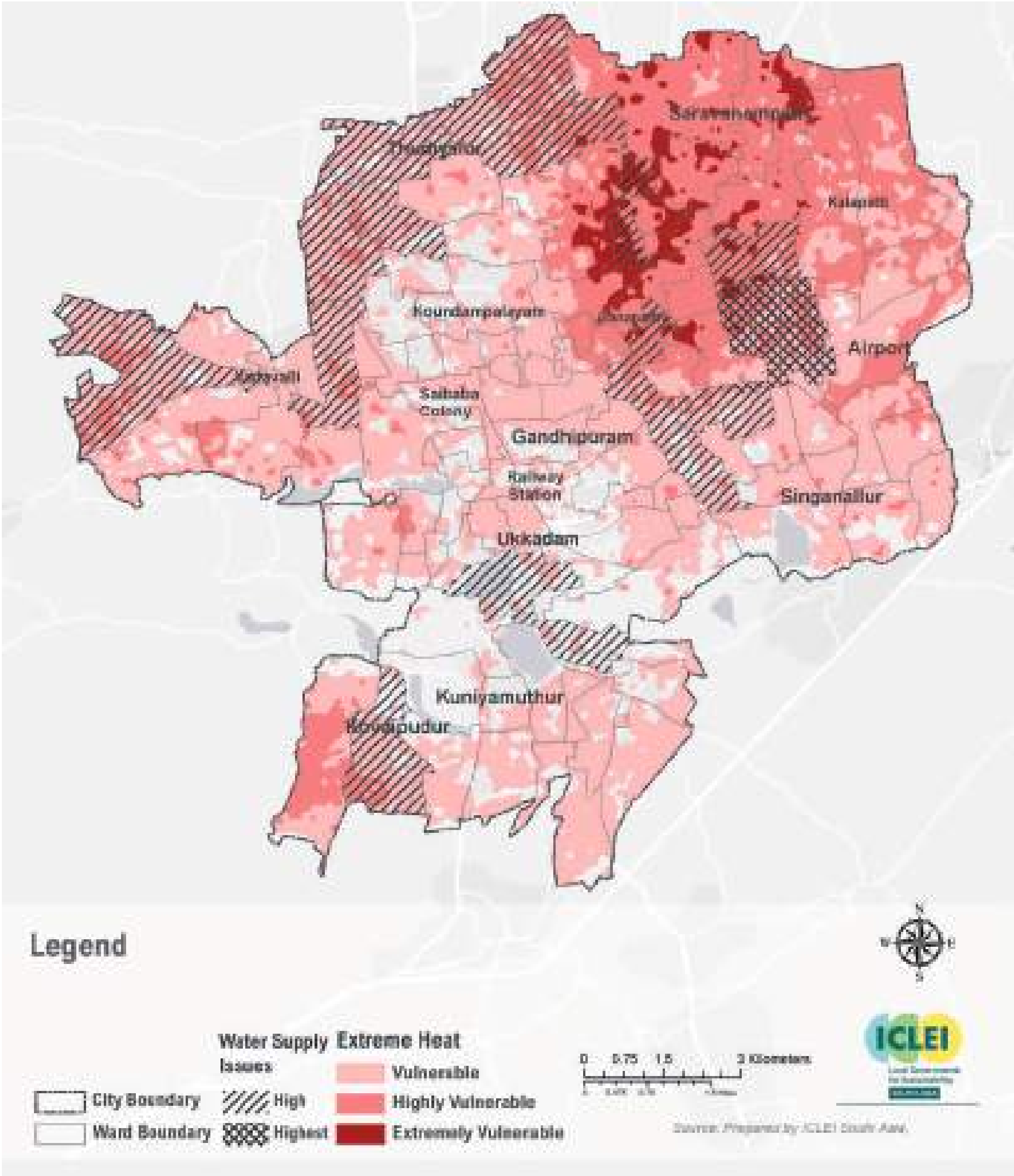


Figure 19: Vulnerability of Water System to Extreme Heat in Coimbatore

Step B: Sensitivity Scoring of Climate Fragility Statements

Sub-step B.1: Next, a sensitivity score for each climate fragility statement across urban systems is calculated by:

- Assigning a '**Likelihood**' score (likelihood of each climate scenario statement occurring)
- Assigning a '**Consequence**' score (intensity of impact) to each identified climate fragility statement

Likelihood score: The likelihood score represents the probability that a climate scenario will occur, ranging from rare to almost certain. For assessing likelihood, refer to the confidence levels of climate projections in Tool 3.1B. A high confidence level indicates a high likelihood.

Table 7: Examples of Likelihood Rating and Scoring

Likelihood rating	Description	Score
Almost certain	Highly likely to occur; it could occur several times per year. The likelihood is probably greater than 50%	5
Likely	Reasonably likely to occur once per year. Approximately a 50% probability	4
Possible	May occur, perhaps once in 10 years. Likelihood is less than 50% but still quite high	3
Unlikely	Unlikely but should still be considered; may arise once in 10 to 25 years Likelihood probability, significantly greater than zero	2
Rare	Unlikely in the near future – negligible probability	1

Consequence score: The consequence score represents the level of impact on the system and populations, ranging from insignificant to catastrophic. For assessing consequence level, consider the exposure of vulnerable populations and urban systems in the city. The higher the exposure, the greater the consequence. Table 8 shows one way of assessing the different consequence ratings, using "Impact on the system" and "Impact on vulnerable population groups" as measures. Cities may also develop their own Consequence Scale.

The focus of this assessment is to identify system failures that could have direct, serious impacts on the city's poorest and most vulnerable groups. Therefore, it is recommended to consider the impacts on both the system and vulnerable populations.

Table 8: Consequence Rating and Scoring

Consequence Rating	Impact on System	Impact on Vulnerable Population Groups	Score
Catastrophic	The system fails completely, is unable to deliver critical services, and may cause other connected systems to fail.	Severe impacts on poor and vulnerable groups, leading to situations of extreme destitution.	5
Major	Serious impact on the system's ability to deliver critical services; however, this does not result in complete systemic failure.	Loss of confidence in city government and increased public criticism; the ability to achieve the city's vision and mission is seriously affected. Significant impacts on poor and vulnerable groups, affecting their lives and livelihoods.	4
Moderate	The system experiences significant problems but is still able to deliver some degree of service.	Moderate impacts on the lives and livelihoods of poor and vulnerable groups.	3
Minor	Minor problems reduce the effectiveness of service delivery and may affect certain systems or groups.	Minor impacts on the lives and livelihoods of poor and vulnerable groups.	2
Insignificant	Minimal impact on the system; it may require some review or repair but is still able to function.	Minimal impacts on the lives and livelihoods of poor and vulnerable groups.	1

Sub-step B.2: Having assigned a 'Likelihood' and 'Consequence' score to each of the identified climate fragility statements, multiply the two scores to derive the 'Sensitivity Score' for each fragile system.

Sensitivity score (SS) = Likelihood score × Consequence score

Sub-step B.3: Finally, for each climate fragility statement, assess its sensitivity status using the Sensitivity score. Refer to the 'Summary of Sensitivity Matrix' in Table 9 for this assessment.

Table 9: Example Summary of a Sensitivity Matrix

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Moderate (SS* = 5)	Moderate (SS = 10)	High (SS = 15)	Extreme (SS = 20)	Extreme (SS = 25)
Likely	Low (SS = 4)	Moderate (SS = 8)	High (SS = 12)	High (SS = 16)	Extreme (SS = 20)
Possible	Low (SS = 3)	Moderate (SS = 6)	Moderate (SS = 9)	High (SS = 12)	High (SS = 15)
Unlikely	Low (SS = 2)	Low (SS = 4)	Moderate (SS = 6)	Moderate (SS = 8)	Moderate (SS = 10)
Rare	Low (SS = 1)	Low (SS = 2)	Low (SS = 3)	Low (SS = 4)	Moderate (SS = 5)

*SS: Sensitivity Score

Note: If more than one climate variation is used, then this assessment would need to be repeated.

Table 10: Sensitivity Score Analysis – Urban Systems

Urban System	Climate Fragility Statements (CFS)	Likelihood	Consequence	Sensitivity Score (Likelihood x Consequence)	Sensitivity Status	Wards Impacted
Water supply	Increased precipitation disrupts/damages water supply infrastructure	4	4	16	High	2,5,6
	Increased precipitation in the form of snow can cause water to freeze in the pipelines	4	4	16	High	1,2,4,5
	Increased temperatures will lead to increased demand for water, thereby putting additional stress on the supply system	3	3	9	Moderate	1,2,6

Step C: Deriving a ward-level urban system sensitivity score

For each ward, **an average urban system sensitivity score** is calculated as the average sensitivity score of all climate fragility statements (CFS) applicable to that ward. This ensures that wards affected by multiple high-risk system failures are ranked as more sensitive than those with fewer fragile urban systems. This is calculated using the following formula:

$$\textbf{Average Ward level Urban System Sensitivity Score} = \frac{\textbf{Sum of sensitivity scores for the ward}}{\textbf{Number of applicable climate fragility statements}}$$

To enable comparison across wards, the sensitivity scores should be normalised to a scale ranging from 0 to 1 to **obtain an average normalised ward-level urban system sensitivity score, using this formula**.

$$\text{Normalised Urban System Sensitivity Score} = \frac{\text{Actual Value - Minimum Value}}{\text{Maximum Value - Minimum Value}}$$

Table 11: Normalised Ward-level Urban System Sensitivity Score

Wards	Sensitivity Score	
	Actual Value (Average of the Sensitivity Scores for all CFS)	Normalised Value $\left(\frac{\text{Actual Value - Minimum Value}}{\text{Maximum Value - Minimum Value}}\right)$
1	(16+9)/2 = 12.5	[(12.5-0)/(16-0)] = 0.78
2	(16+16+9)/3 = 12.7	[(12.7-0)/(16-0)] = 0.79
3	0	[(0-0)/(16-0)] = 0
4	16	[(16-0)/(16-0)] = 1
5	(16+16)/2 = 16	1
6	(16+9)/2 = 12.5	0.78
7		

4.1.2 Sensitivity of Population and Vulnerable Social Groups

This step assesses the degree to which various population groups are adversely affected by climate hazards. It depends on several intrinsic demographic and socio-economic indicators, such as the number of elderly people (above 65 years), children (below 6 years), outdoor workers, people with disabilities, women, homeless population, urban poor / low-income population / slum population, proportion of households staying on rent, and proportion of temporary settlements, kutcha houses, dilapidated and damaged houses. Ward-wise data on these indicators can be collected from the Census, Statistical Department, and Municipal Corporation records, and supplemented with primary surveys where required. The collected data will be processed and calculated in the required format, after which it should be normalised for analysis to **derive an average ward-level population sensitivity score.**

Table 12: Normalised Ward-level Population Sensitivity Score

Wards	Elderly Population	Normalised Elderly Population Value (e)	Female Population	Normalised Female Population Value(f)	...n_x	Normalised Population Sensitivity Score $\frac{e+f+n_x}{\text{Total no of indicators}}$
1	500		1000			
2	200		1500			
3	100		2000			
..n_w						

4.2. Ward-level Vulnerability Mapping

In this step, the ward-wise sensitivity scores of urban systems and population groups are averaged, as shown in Table 13, to derive a ward-level vulnerability score.

Table 13: Ward Vulnerability Score

Wards	Normalised Urban System Sensitivity Score (Nu)	Normalised Population Sensitivity Score (Np)	Ward Vulnerability Score = $\frac{(N_u + N_p)}{2}$
1			
2			
..n			

Using the ward-level vulnerability scores (obtained from table 13), classify wards into vulnerability categories, as shown in Table 14, and prepare a ward-level vulnerability map using GIS. Vulnerability maps can be prepared for individual hazards or combinations of hazards.

Table 14: Ward-level Vulnerability Scoring Index

Range	Vulnerability
<=0.250	Low
0.251 –0.500	Moderate
0.501 – 0.750	High
>=0.751	Extreme

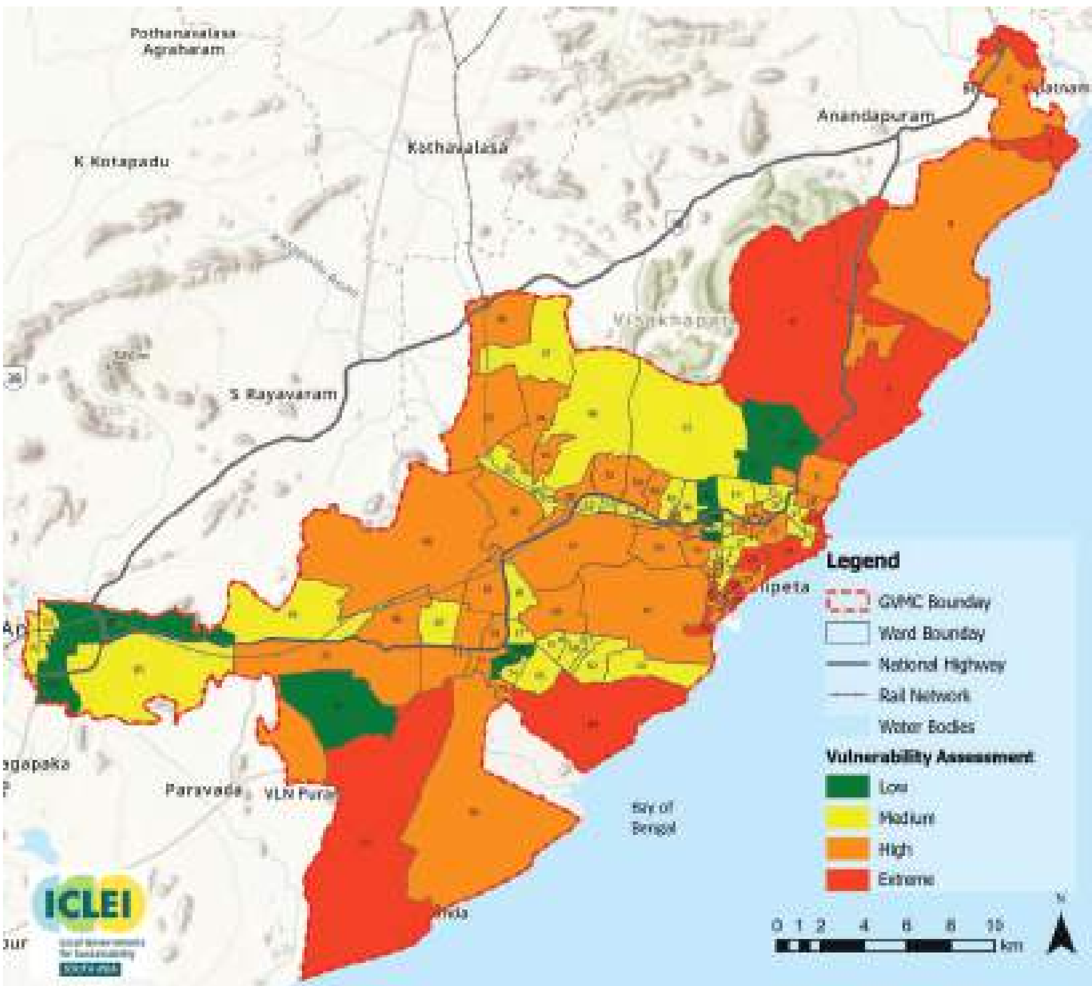


Figure 20: Composite Ward-level Vulnerability Map for Visakhapatnam

Vulnerability maps/scores are to be read in conjunction with the adaptive capacity scores to obtain a holistic perspective of the ward-wise vulnerability.

4.3. Adaptive Capacity Analysis

Adaptive capacity is the ability of people, institutions, and systems to prepare for, respond to, and cope with climate change impacts. It therefore plays an important role in determining urban resilience. It is the ability to shift strategies as conditions change to maintain the well-being of populations and the ecosystems on which they depend[4].

In the context of climate change, adaptive capacity requires actors to make choices and respond to opportunities in ways that manage both direct and indirect climate impacts. Actors' level of access to resilient systems influences their adaptive capacity, as does the manner in which institutions structure relationships among actors and between actors and systems.

This methodology qualitatively examines the adaptive capacity of both urban systems and urban actors.

Step A: Determining the Adaptive Capacity of Urban Systems

Sub-step A.1: Complete Table 15 below. Select only the identified fragile urban systems used for analysis in Step 1 of Section 3: Vulnerability Assessment (e.g., water supply).

Sub-step A.2: For each fragile urban system, describe its adaptive capacity across five broad parameters. If some parameters are not applicable to a particular system, they can be omitted.

1. **Economic:** Assess whether the system has access to sufficient financial resources to respond to climate change impacts.
2. **Technology and infrastructure:** Assess whether the system's existing infrastructure and technological capacity are adequate to manage additional climate stresses.
3. **Governance:** Assess the enabling policies, governance structures, and distribution of responsibilities among stakeholders for effective management of the system.
4. **Social:** Assess whether communities have the awareness and resources to support adaptation interventions.
5. **Ecosystem services:** Assess the system's ability to contribute to restoring natural systems or its dependency upon natural ecosystems

Sub-step A.3: For each fragile system, rate each of the five categories of adaptive capacity as low, moderate or high, using stakeholder inputs.

Guiding questions to assess adaptive capacity:

Economic: Does the system have adequate financial resources, such as budget allocation, tax base, and the ability to charge fees, to manage climate change? Can it operate as a "business" or does it follow the traditional public service model?

Technology/infrastructure: Does the system have the necessary technological capacity and resources? Is the existing infrastructure adequate to cope with additional climate stress? Are major changes to technology needed? What is its capacity to introduce the required changes?

4. Stephen et al, A framework for urban climate resilience, 2012

Governance: Is responsibility for this system clearly established? Does the responsible entity have the necessary authority to implement changes? Is there sufficient coordination and support from higher levels of government and stakeholders?

Social: Does the community have the awareness and resources necessary to contribute effectively? Is the community part of the problem, or part of the solution?

Ecosystem Services: Is the system dependent on natural ecosystems? What is the capacity of this system to protect or restore ecosystems?

Table 15: Reference Table for Assessing the Adaptive Capacity of Fragile Urban Systems

	Economic	Technology / Infrastructure	Governance	Social	Ecosystem Services
Low	Limited inherent economic ability to adapt to impacts (e.g., no legal authority to raise funds; weak tax base)	Limited inherent technological/ infrastructure capacity to adapt to impacts (e.g., use of outdated materials in structural codes; no system for integrating new knowledge)	Limited governance structures in place to adapt to impacts (e.g., lack of interagency collaboration; limited support from higher levels of government)	Limited social capacity to adapt to impacts (e.g., disengaged or uninvolved communities)	Limited ecosystem services capacity (e.g., absence of natural buffers such as marshes or dunes to provide storm protection)
Moderate	Moderate inherent economic ability to adapt to impacts (e.g., some mechanisms for raising funds exist, but financial resources or revenue generation are constrained)	Moderate technological/ infrastructure capacity (e.g., infrastructure generally meets standards; some mechanisms exist to incorporate new technologies and knowledge)	Moderate governance capacity (e.g., coordination mechanisms exist but are not effectively implemented; some fragmentation across departments)	Moderate social capacity (e.g., some community participation and support networks exist but are limited to certain population groups)	Moderate ecosystem services capacity (e.g., natural buffers are present but degraded or limited in extent)
High	Robust inherent economic ability to adapt to impacts (e.g., strong own source revenue mechanisms; city is able to raise climate finance)	Robust inherent technological/ infrastructure capacity (e.g., modern structures constructed using current materials that comply with structural codes; new knowledge is regularly integrated into purchasing agreements)	Robust governance structures (e.g., good interagency coordination; effective collaboration with higher levels of government; presence of Climate Action Cells)	Robust social capacity (e.g., active community participation in policy making and project implementation)	Robust ecosystem services capacity (e.g., well-functioning natural buffers, restoration of lakes and urban forests)

An example of an adaptive capacity analysis for two fragile urban systems is provided in Table 16.

Table 16: Adaptive Capacity of Fragile Urban Systems

Fragile Urban System	Economic	Technology/ Infrastructure	Governance	Social	Ecosystem Services
e.g., Water Supply	**Low** (limited funding for new infrastructure)	**Moderate** (access to improved technology through private sector engagement)	**Moderate** (coordination with state and city departments needs improvement)	**High** (increasing public demand for improved water supply systems)	**Low** (loss of water bodies in the city)
e.g., Transport	**Moderate** (dedicated funds for public transport and road expansion, high upfront cost for electric vehicles)	**High** (access to several models for electric vehicles)	**Low** (fragmented coordination between operators across modes)	**High** (increasing demand from citizens for improved non-motorised transport and public transport, high public transport ridership)	NA

Step B: Assessing the Adaptive Capacity of Urban Actors

Actors (i.e., individuals, households and public/private sector organisations) play a critical role in building urban climate resilience. Their ability to contribute to resilience and adaptation is broadly dependent on the following three key capacities:

Capacity to organise and respond - the ability to organise and re-organise in response to threats or disruptions.

- *Example: Slum communities in flood-prone areas are trained in water purification and hygienic practices, or community-based search-and-rescue teams are established to respond effectively during floods.*

Access to Resources – Access to resources necessary to respond (such as manpower, technology, and funds).

- *Example: Slum communities in flood-prone areas have been provided with water filters to ensure safe drinking water even during flood situations. Search and rescue teams have the necessary equipment and medicines.*

Access to information – Availability of data and information required to develop effective plans and actions, and to improve responses to climate disruptions.

- *Example: Slum communities in flood-prone areas have access to locally managed information systems, such as early warning systems, which would enable more effective response. Additionally, regular refresher training programmes are conducted for members of search-and-rescue teams.*

The combination of these capacities determines the adaptive capacity of each urban actor.

The following steps will help assess the adaptive capacity of urban actors:

Sub-step B.1: For each urban system, list the key actors affected by or having control over the system. For example, Ward XY is vulnerable to flooding, so the affected actors may include residents (e.g., low-income households, a hospital, an NGO working on education, and street vendors). Actors who may have control may include the Department of Water Resources or the Department of Sewerage and Drainage.

Be as specific as possible (e.g., "women, children and the elderly in Slum 22" instead of "residents"). The more precisely actors are identified, the easier it becomes to target and organise effective responses.

Sub-step B.2: Use Table 17 to assign scores (low, moderate, or high) to actors based on: capacity to organise and respond, access to resources, and access to information. This should be done in consultation with the relevant actors and other stakeholder groups.

Table 17: Actors' Capacity Rating and Scores

Key Criteria	Score
Capacity to Organise and Respond	
Low ability to organise and reorganise in response to threat or disruption	1
Moderate ability to organise and reorganise in response to threat or disruption	2
High ability to organise and reorganise in response to threat or disruption	3
Access to Resources	
Low access to the resources necessary to respond (manpower, technology, funds)	1
Moderate access to the resources necessary to respond (manpower, technology, funds)	2
High access to the resources necessary to respond (manpower, technology, funds)	3
Access to Information	
Low availability of data and information necessary to develop effective plans and actions, and to improve responses to disruptions	1
Moderate availability of data and information necessary to develop effective plans and actions, and to improve responses to disruptions	2
High availability of data and information necessary to develop effective plans and actions, and to improve responses to disruptions	3

Sub-step B.3: Calculate the Adaptive Capacity Score for each actor by multiplying the scores for the three criteria.

Sub-step B.4: Classify actors based on their adaptive capacity scores using Table 18.

Table 18: Levels of Adaptive Capacity of Urban Actors

Score Range	Level
1 – 8	Low
9 – 17	Moderate
18 – 27	High

Actors with low adaptive capacity should be targeted specifically through actions (or resilience strategies) to reduce the fragility of the identified urban system.

Actors with high adaptive capacity can support the proposed actions by effectively responding to impacts on fragile systems. Actors with moderate adaptive capacity may need targeted support or can be engaged in the proposed actions, depending on where they fall in the score range, i.e., closer to the 'low' or 'high' categories.

Table 19: Actor Analysis

Urban System	Area/Ward	Actors	Capacity to Organise and Respond (A)	Resources (B)	Access to Information (C)	Adaptive Capacity Score (A x B x C)	Supporting Notes
Water Supply	Ward 5	Slum dwellers	1	1	1	1 (Low)	They depend on shallow aquifers that are easily contaminated; access to water tankers is too expensive; no information on water purification techniques
		Private Sector	2	3	2	12 (Moderate)	
		Resident Welfare Association	2	2	1	4 (Low)	
		Water Authority	2	3	3	18 (High)	
		NGO	2	1	3	6 (Low)	

After assessing the adaptive capacity of urban systems and actors, summarise the assessment conducted in Section 3: Vulnerability Assessment as per Table 20:

Table 20: Summary of Vulnerability Assessment

Urban System	Vulnerable Areas	Urban Actors		Resilience Capacity of the System		
		Vulnerable Actors	Potential Supporting Actor	Low	Moderate	High
Water Supply *E.g., contamination of the water supply due to flooding made worse by the lack of alternative sources*	Ward 5	• Slum Dwellers, • Resident Welfare Association, • NGOs	• Private Sector • Water Authority	• Economic/ Source of Finance • Ecosystem Services	• Technology/ Infrastructure • Governance	• Community • GHG Emissions

How to use the findings from the adaptive capacity analysis?

Use adaptive capacity analysis to identify urban systems and actors that are least prepared to respond to climate risks. Prioritise the proposed interventions by focusing on systems and actors with low adaptive capacities. Apply the findings to design targeted adaptation measures, capacity-building initiatives, and institutional strengthening actions, and to identify potential supporting actors for implementation. This will help ensure that the proposed climate actions are need-based, inclusive, and focused on enhancing overall urban resilience.

4.4. Stakeholder Validation for Vulnerability Assessment

The vulnerability assessment can be validated through consultations with stakeholders such as local authorities, resident welfare associations, civil society organisations and other community stakeholders. Consultations can be used to assess sensitivity and adaptive capacity in cases of geospatial data being not available. Data collected through such consultations should be supplemented by ground-truthing and field-testing exercises.

STEP 5

Climate Risk Assessment

The final step in the CRA is to integrate the results of hazard, exposure, and vulnerability analyses to identify climate risk hotspots within the city. This composite assessment supports the identification and prioritization of wards requiring immediate and targeted adaptation interventions. Several risk estimation/calculation methods are available in the scientific community. However, the IPCC does not specify a particular method or formula for estimating climate risk. Instead, it provides a conceptual framework (Figure 1) and references multiple research and knowledge products, while discussing the methodology to assess risk. These include the United Nations Office for Disaster Risk Reduction (UNDRR) and the Sendai Framework for Disaster Risk Reduction (DRR) which provide quantitative, semi-quantitative, and qualitative approaches for conducting risk assessments. Following a review of such research and knowledge products, ICLEI's Net-zero CRC Methodology adopts a composite quantitative and qualitative route for estimating climate risk. This method requires assessing hazard, exposure, and vulnerability levels, the methodology of which is given in the preceding sections. Based on these approaches, ICLEI's Net-zero CRC Methodology adopts a quantitative approach to estimating climate risk. This method requires quantifying hazard, exposure, and vulnerability levels, as described in the subsequent sections. The IPCC's Special Report (2012) states that practitioners, including the former UNISDR, apply Crichton's Risk Triangle, which expresses risk as a product of hazard, exposure, and vulnerability:

$$\textbf{Risk} = \textbf{Hazard} \times \textbf{Exposure}^{\circ} \times \textbf{Vulnerability}^{\circ}$$

This formula, however, introduced an element of extremity which was later eliminated by the European Commission's Index for Risk Management (INFORM) partnership[5], which introduced the cubic root to the original product formula. Thus, the formula to quantitatively measure climate risk by ICLEI's Net-zero CRC Methodology is the geometric mean, i.e, cubic root of the product of hazard, exposure and vulnerability, expressed as given below:

$$\textbf{Climate Risk} = \sqrt[3]{(\textbf{Hazard} \times \textbf{Exposure} \times \textbf{Vulnerability})}$$

At the ward level, a composite risk score is calculated by combining the normalized scores for hazard, exposure and vulnerability (sensitivity score) using the above formula (Table 21). It should be noted that the numerical value of climate risk will not depict the entire picture if there is an element of subjectivity in vulnerability and exposure, introduced through qualitative methods of assessment. Adaptive capacity of institutions, systems and population groups is assessed qualitatively through consultations, FGDs, and KIIs. In such cases, the overall climate risk to be understood as a combination of both the quantitative score and qualitative information. The qualitative information is scored on a numerical scale, as explained in relevant sections. The numerical scale supports decision making and prioritisation of climate action.

Table 21: Ward-wise Risk Scores

Wards	Hazard Score	Exposure Score	Vulnerability (Sensitivity Score)	Climate Risk = $\sqrt[3]{(\text{Hazard} \times \text{Exposure} \times \text{Vulnerability})}$
1	0.25	0.30	0.25	
2				
3				

5. INFORM is a collaboration of the Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness and the European Commission

Based on the risk scores, wards are classified into climate risk categories and a ward-level Climate Risk Map representing the spatial distribution of climate risk across the city is developed.

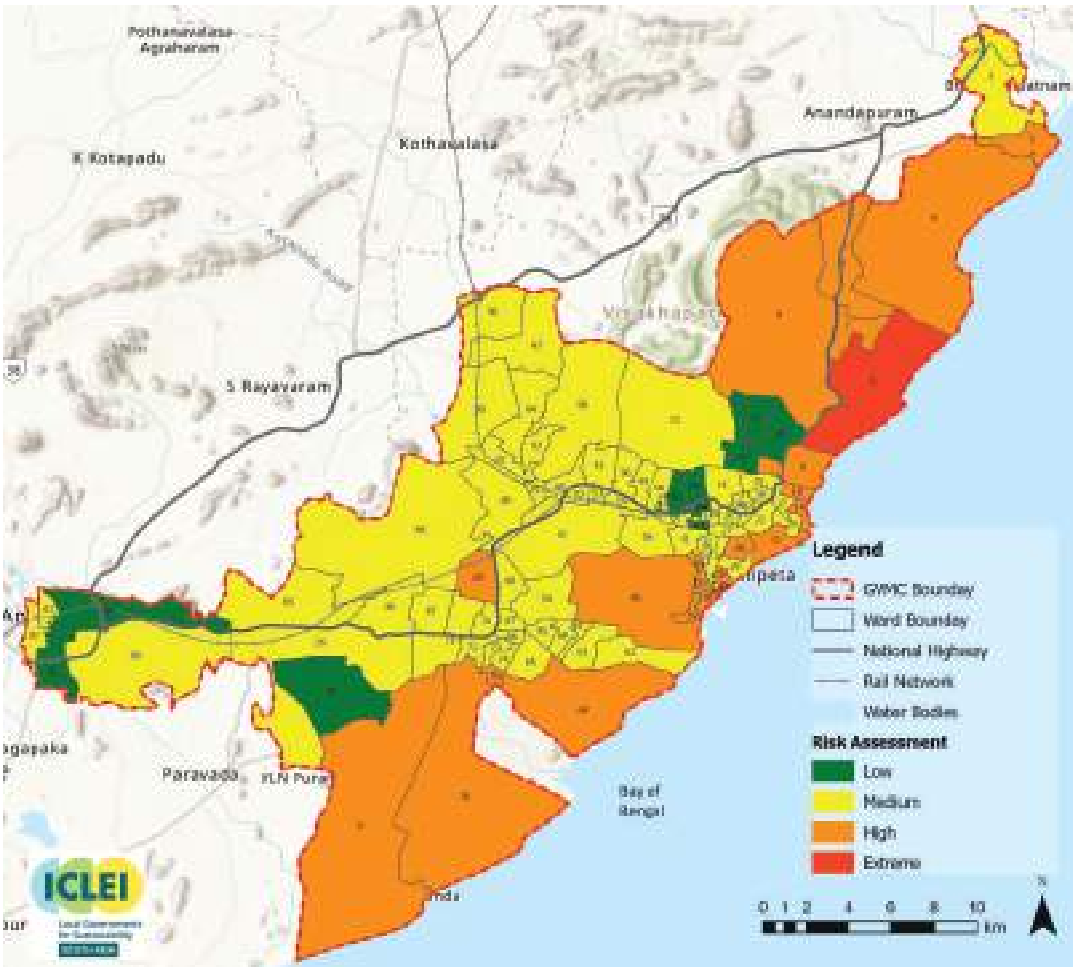
Table 22: Climate Risk Scoring Index

Range	Climate Risk Category
<=0.250	Low
0.251 –0.500	Moderate
0.501 – 0.750	High
>=0.751	Extreme

Climate risk maps should be developed for combinations of hazards as well as for individual climate hazards to support detailed hazard-wise climate risk analysis. Understanding the ward-level risk of individual hazards is crucial for supporting targeted resilience interventions that reduce the impacts of these hazards and strengthen the resilience of local communities.

A brief narrative summary should accompany the risk map to support interpretation and decision-making, and should clearly highlight:

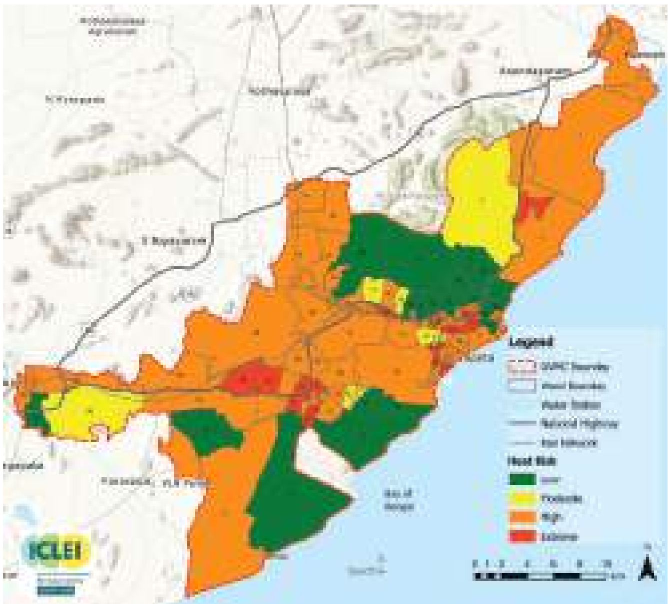
- Number and name of wards across each risk category
- Hazards contributing to high- and extreme-risk wards
- Exposure factors, such as population density, slum concentration, and critical infrastructure presence



High climate risk: 21.7% of the population, including 166 slums

Extreme climate risk: 2.24% of the population, including 25 slums

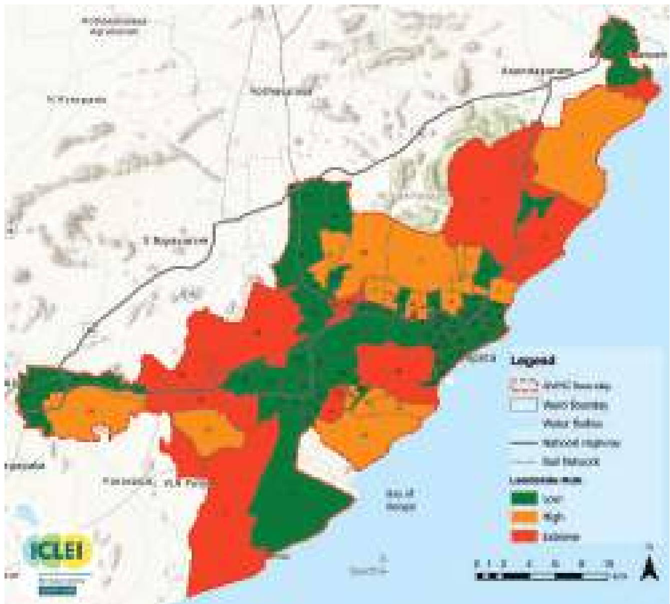
Figure 21: Composite Climate Risk Map for Visakhapatnam



Extreme heat risk: No. of wards – 20

7, 22, 23, 27, 33, 34, 35, 37, 43, 54, 67, 70, 72, 74, 75, 86, 87

Figure 22: Ward-level heat risk map for Visakhapatnam



Extreme landslide risk: No. of wards – 17

3, 5, 6, 8, 40, 47, 59, 65, 77, 79, 85, 88, 90, 91

Figure 23: Ward-level landslide risk map for Visakhapatnam

The climate risk assessment must be validated through shared learning dialogues with stakeholders such as local authorities, resident welfare associations, civil society organisations and other community/government stakeholders.

Prioritisation of action for vulnerable wards and stakeholders should be combination of the climate risk assessment and the adaptive capacity

Tool 3.2A

Preparation and Management of GHG Emissions Inventory

This tool provides cities with guidance on establishing a transparent and consistent process for preparing, managing, and reporting their community-wide greenhouse gas (GHG) emissions inventory. It guides cities in understanding the basics of GHG emissions inventory preparation and the processes required to manage it effectively. It is recommended that cities put in place a well-designed inventory management plan so that they clearly understand the steps involved in compiling the inventory and can maintain the systems and practices needed to ensure reliable updates at regular intervals.

Section A

Developing a City-level GHG Emissions Inventory

What is a GHG Emissions Inventory?

A ***GHG Emissions Inventory*** is an accounting of the GHGs emitted and removed from the atmosphere over a specific period. It is a measure of the impact of human activities on global warming and climate change, expressed as emissions generated across activities within a jurisdictional boundary.

A GHG emissions inventory helps cities identify which activities contribute most to emissions, enabling local governments to develop targeted mitigation strategies and track progress over time. Cities are required to prepare their GHG emissions inventories in accordance with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).[1] The GPC is a standardized international framework for city-level GHG emissions inventories that aligns with the Intergovernmental Panel on Climate Change (IPCC) guidelines. This ensures consistency, scientific rigor, and comparability of emissions data across cities or local communities globally. The GPC framework helps cities to:

- Develop a comprehensive GHG inventory for planning climate actions
- Monitor and report emissions regularly
- Share their climate efforts at the international level
- Highlight contributions to global climate goals

The GPC guidelines are available as Tool 3.2B: GPC Standards

Assessing GHG emissions in the baseline year is the first step in developing a plan to reduce emissions. The GHG emissions inventory provides baseline data to understand trends in energy consumption, activity levels, and emissions across sectors, and to identify priority sectors and sources that require mitigation actions. The estimated baseline GHG emissions provide a basis for setting reduction targets and tracking progress.

The sectors and sources of GHG emissions considered for the inventory, in line with the GPC BASIC and BASIC+ framework, are shown in Table 1:

[1] Greenhouse gas protocol, Global Protocol for Community-Scale Greenhouse Gas Inventories https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf.

Table 1: Sectors and Sources of GHG Emissions under GPC Framework

Sector	Sub-sector	Potential GHG Sources
Stationary Energy	Residential Buildings; Commercial and Institutional Buildings / Facilities; Manufacturing Industries and Construction; Agriculture, Forestry and Fishing Activities (i.e., mainly Agriculture)	Grid Electricity, Liquefied Petroleum Gas (LPG), Diesel, Petrol, Piped Natural Gas, Kerosene, Biomass
Transportation	On-road Transportation, Aviation, Railways, and Water-borne Navigation	Petrol, Diesel, Electricity, Compressed Natural Gas, Auto-LPG
Waste	Solid Waste Disposal, Biological Treatment, Incineration and Open Burning, Wastewater Treatment and Discharge	Methane (CH_4), Nitrous Oxide (N_2O) from waste treatment and disposal processes
Industrial Processes and Product Use (IPPU)	Industrial Processes, Product Use	Process-related CO_2 (e.g., cement clinker production, lime production), non-CO_2 gases (N_2O, HFCs, PFCs, SF_6) from refrigeration, air-conditioning, foams, solvents, and other product uses
Agriculture, Forestry, and Land Use (AFOLU)	Livestock, Land, Other Agricultural Activities	Methane (CH_4) from enteric fermentation and manure management; Nitrous Oxide (N_2O) from agricultural soils and fertilizer use; CO_2 emissions and removals from land-use change, cropland, grassland, and forestry
Legend	BASIC	BASIC+

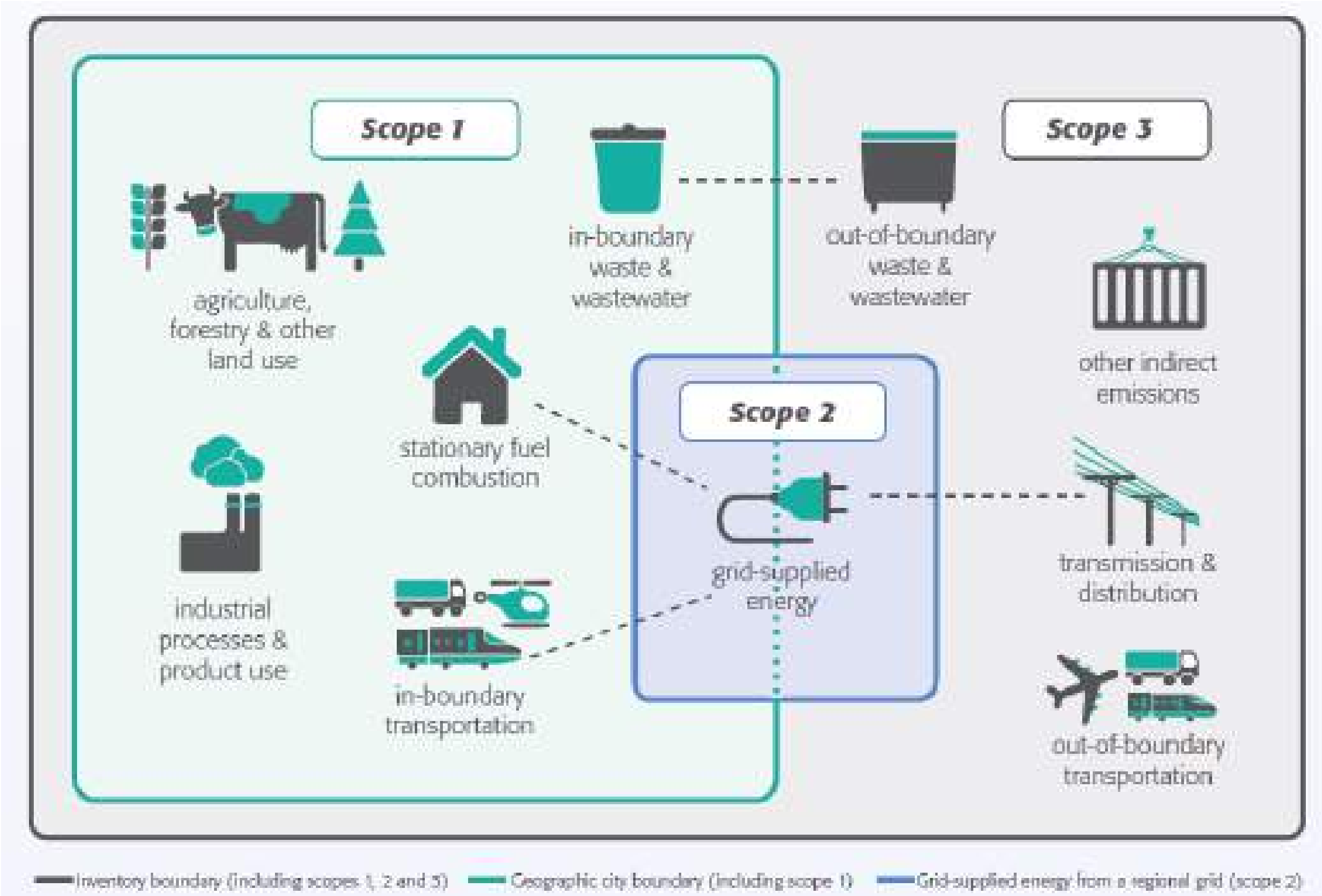


Figure 1: Sources and Boundaries of GHG Emissions Sources

(Source: Report of Global Protocol for Community-Scale Greenhouse Gas Inventory V2.0.)

How to Develop a GHG Emissions Inventory?

Developing a GHG inventory involves a structured, step-by-step process to ensure accurate and reliable measurement of emissions, as described below:

Step 1: Planning and Design / Scoping

Cities should establish an Inventory Management Team under the guidance of the ***Climate Core Team (Refer Tool 1.2: Formation of Climate Core Team),*** led by the city's leadership, with clearly defined roles and responsibilities and **timelines** for completing the inventory (Refer Section B: Planning for GHG Inventory for more details).

The planning and scoping stage establishes the foundation of a comprehensive and transparent GHG emissions inventory. It clearly defines what is included in the inventory to ensure consistency over time and supports comparability across cities, states, or reporting years. The planning and scoping steps for preparing the GHG emissions inventory include:

1. **Geographic Boundary:** Define the spatial extent of the inventory. This typically corresponds to the city's ***administrative boundary***. All emission sources and sinks occurring within this boundary are considered, except where scope definitions require inclusion of indirect emissions occurring outside the boundary (e.g., grid electricity generation, solid waste disposal outside the city limits).

2. **GHG Emission Sources / Sectors:** Determine the sectors and sub-sectors to be covered in the inventory, generally aligned with GPC categories. These include Stationary Energy, Transportation, Waste, Industrial Processes, Product Use (IPPU), and Agriculture, Forestry and Land Use (AFOLU). Clear identification of sector/sub-sectors and sources ensures completeness and avoids double-counting across sectors, as well as which reporting framework, BASIC/BASIC+, will be adopted.

Accounting Emissions from Municipal Operations: While the community-wide inventory, in line with the GPC sectors and sub-sectors, provides a comprehensive assessment of city-wide emissions, cities may also choose to develop a Local Government Inventory to separately account for and analyse emissions associated with municipal assets and service delivery. The local government inventory accounts for GHG emissions originating from energy consumption and fuel use in municipal buildings, street lighting, water supply systems, wastewater treatment facilities, municipal vehicle fleets, and waste management facilities.

The local government inventory is generally a subset of the community-wide inventory, i.e., energy consumption and emissions from municipal facilities are already included in the community-wide inventory. For example, electricity consumption in municipal facilities for water supply, waste management, and street lighting is included in the community-wide dataset for the commercial and institutional buildings/facilities sub-sector under the Stationary Energy sector. Similarly, fuel consumption and associated emissions from municipal vehicle fleets are accounted for under the relevant on-road or off-road transportation sub-sectors within the Transportation sector of the community-wide inventory.

Developing a separate local government inventory enables cities to better understand the emissions associated with their own operations and assets, identify opportunities for targeted emissions reductions, monitor the effectiveness of climate actions, and demonstrate leadership in implementing transformative climate efforts in their communities.

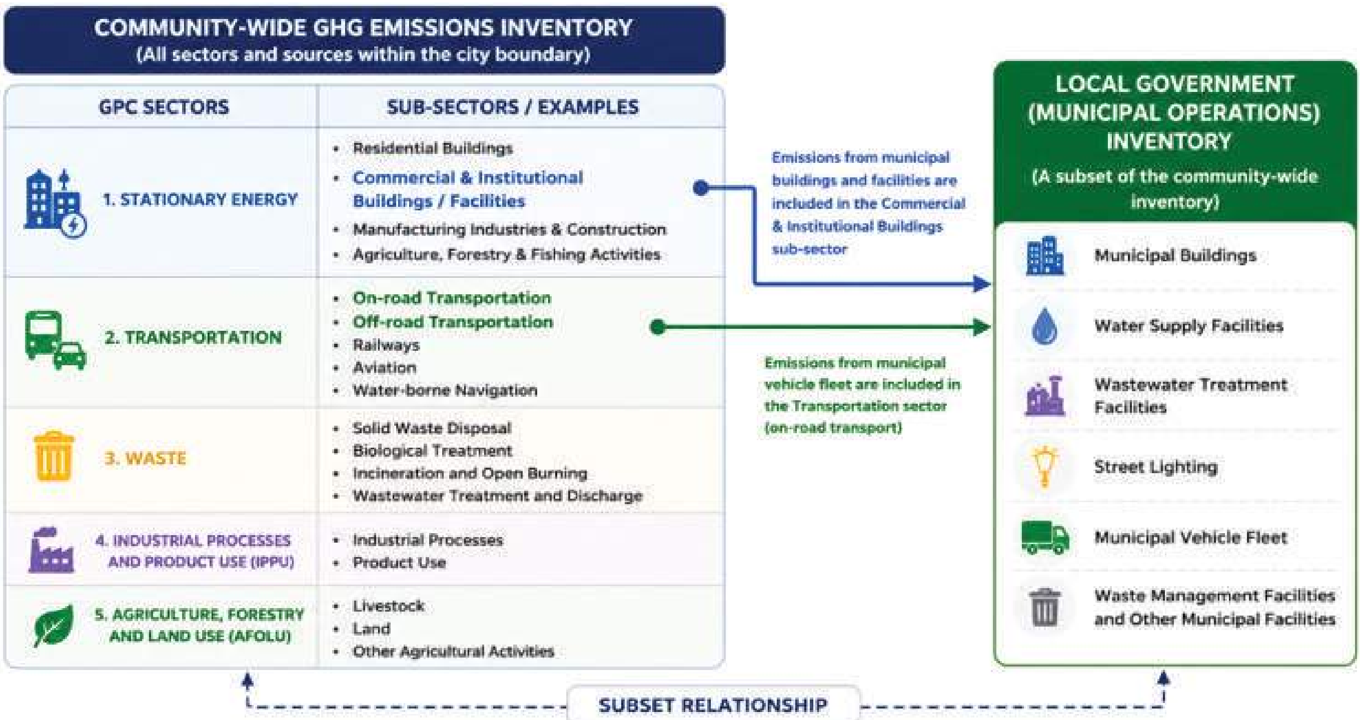


Figure 2: Local Government Inventory as a Subset of the Community-wide GHG Inventory

3. **Greenhouse Gases (GHGs):** Include CO_2, CH_4, and N_2O, and where data permits, other gases such as hydrofluorocarbons, perfluorocarbons, SF_6, and NF_3.

4. **Time Period (Base Year):** Select a ***base year*** for the inventory, usually the most recent year with complete data. The base year serves as the reference point for tracking emission trends, evaluating mitigation actions, and setting reduction targets. Consistency in methodology across years is critical for meaningful comparisons.

5. **Categorizing Emissions by Scope:** The GPC categorizes emissions into three groups based on where they occur: Scope 1, Scope 2, and Scope 3.

Scope	Definition
Scope 1	GHG emissions from sources located within the city boundary
Scope 2	GHG emissions occurring from the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

Step 2: Calculating GHG Emissions

GHG emissions are calculated using the formula:

Activity Data x Emission Factor = GHG Emissions

Activity Data – Data representing the magnitude of human activity resulting in GHG emissions (e.g., volume of fuel in liters, weight of fuel in kg, electricity use in kWh, distance traveled in km).

Emission Factor **–** The average emission rate of a given GHG for a given source is relative to the type of activity and indicates the amount of GHG released per unit of activity. They are always expressed as ratios, for example, 2.68 kg of CO2 per liter of diesel.

Table 2 shows the GHG emissions calculation from electricity consumption in buildings.

Table 2: GHG Emissions calculation from electricity consumption

Sectors	Activity Data – Electricity Consumption (Million kWh)	Grid Emission Factor (CO2/ Million kWh)	GHG Emissions (tCO2e)
Residential Buildings	750.6	750	562,950
Commercial and Institutional Buildings/Facilities	1010.5	750	757,875
Manufacturing Industries and Construction	1500.8	750	1,125,600
Total Emissions			2,446,425

CO_2e is a unit of measurement that accounts for the Global Warming Potential (GWP) when measuring and comparing GHG emissions from different gases. To ensure consistency in estimating CO_2e values for gases such as CH_4 and N_2O, the GWP of each gas for a 100-year period is factored. The GWP factors are defined by the IPCC and reflect the climate change impact, in terms of global warming, of each GHG with respect to CO_2. For example, the GWP values for CO_2, CH_4, and N_2O are 1, 28, and 265, respectively, as per the IPCC Fifth Assessment Report (AR5).

The Harmonized Emissions Analysis Tool Plus (HEAT+)

HEAT+ is an easy-to-use online tool created by ICLEI Local Governments for Sustainability to help cities measure pollution and GHG emissions. It allows local governments to track different types of emissions, set goals to reduce them, and monitor their progress over time. Cities can use this tool to plan actions that reduce pollution, forecast future emissions, and report their data through global platforms like CDP – ICLEI Track, which also helps cities in getting Global Covenant of Mayors badges. HEAT+ aligns with international standards (IPCC guidelines) and is helpful for engineers, planners, and city officials involved in climate action planning and implementation.[2]

[2] For more information visit - http://heat.iclei.org,

Step 3: Reporting of GHG Emissions Inventory

The GPC sets out two levels of reporting requirements that a city can choose for its inventory:

BASIC: This level requires the reporting of all Scope 1 sources (except those listed below), all Scope 2 sources and waste sector Scope 3 sources. Scope 1 emissions not required under BASIC are:

1. Emissions from energy generation
2. Emissions from in-boundary disposal and treatment of imported waste
3. Emissions from IPPU
4. Emissions from AFOLU

BASIC+: This level covers all sources required for BASIC, plus Scope 1 emissions from AFOLU and IPPU, and Scope 3 emissions from transportation and stationary units. Cities reporting BASIC+ shall indicate any data or reporting gaps (using notation keys) for any of the sub-sectors within these additional emission sources and shall have no emissions from BASIC sources that are "Not Estimated".

Cities must report GHG emissions by sector, gas type, and emission scope (Scope 1, 2, and 3). **Tool 3.2E: GHG Emissions Inventory Analysis and Synthesis** provides guidance on GHG Emissions Inventory Reporting. Given the data availability, reporting limitations, and variations in emission sources across cities, notation keys should be used when reporting in line with the GPC. Table 4 presents the key notation to be used for GPC reporting, based on data availability and nature.

Table 4: Notation Keys for GHG Emissions Reporting

Notation Key	Definition	Explanation
IE	Included Elsewhere	GHG emissions for this activity are estimated and reported in another inventory category. That category shall be noted in the explanation.
NE	Not Estimated	Emissions occur but have not been estimated or reported; justification for exclusion shall be noted in the explanation
NO	Not Occurring	An activity or process does not occur or exist within the city
C	Confidential	GHG emissions, which could lead to the disclosure of confidential information, cannot be reported.

Example of emission sources excluded and included elsewhere: If the GHG emissions inventory is compliant with the requirements of the GPC BASIC reporting framework, then the following emission sources are excluded.

- The community-level energy consumption and GHG emissions data already account for local government operations. For example, electricity consumption in municipal facilities for water supply, wastewater management, and street lighting is already accounted for in the commercial and institutional facilities sector's electricity consumption data, based on relevant customer/end-user categories as prescribed under the electricity distribution and tariff arrangements.
- Emissions from AFOLU and IPPU are excluded from the inventory as they fall beyond the scope of the GPC BASIC framework.
- Emissions related to transmission and distribution losses associated with grid-supplied electricity are not accounted for in the inventory as they fall beyond the scope of the GPC BASIC framework.
- Due to a lack of disaggregated data on fuel consumption for off-road transport within the city, emissions from such sources are included in the emissions reported under on-road transportation emissions.

Table 3: Sources and scopes required under BASIC and BASIC+ Reporting of GPC

Sector / Sub-sector	Scope 1	Scope 2	Scope 3
Stationary Energy			
Residential buildings	X	X	X
Commercial buildings	X	X	X
Institutional buildings	X	X	X
Manufacturing industries and construction	X	X	X
Energy industries	X	X	X
Agriculture, forestry, and fishing activities	X	X	X
Non-specified sources	X	X	X
Fugitive emissions from mining, processing, storage, and transportation	X		
Fugitive emissions from oil and natural gas systems	X		
Transportation			
On-road	X	X	X
Railways	X	X	X
Waterborne navigation	X	X	X
Aviation	X	X	X
Off-road	X	X	
Waste			
Solid waste disposal	X		X
Biological treatment of waste	X		X
Incineration and open burning	X		X
Wastewater treatment and discharge	X		X
Industrial Processes and Product Use (IPPU)			
Industrial processes	X		
Product use	X		
Agriculture, Forestry, and Land Use (AFOLU)			
Livestock	X		
Land	X		
Other agriculture	X		

Legend: BASIC | BASIC+

- If a substantial portion of the municipal area is designated as a reserved forest, this highlights its significant potential as a carbon sink within the city. However, if the GHG emissions inventory complies with GPC's BASIC-level reporting, and due to a lack of information, the emissions profile does not include carbon sequestration estimates.

Section B

Planning for GHG Emissions Inventory

Step 1: Identify and secure the resources and administrative approvals

The first step in GHG emission inventory planning is to ensure the administrative and budgetary resources required for the preparation of the inventory are available. Cities should determine which internal approvals are required before preparing the inventory. These included buy-in from decision-makers, sign-off from senior officials, formal communication from city leadership, permissions for staff deployment, and administrative and budgetary approval to engage external consultants or technical experts to undertake GHG emissions inventory development on behalf of the city.

Internal approvals should be formally documented to ensure that the initial decisions stay valid throughout the preparation period and that expectations are met and communicated through continuous monitoring and reporting on the status of inventory development. Cities should also outline the budgetary requirements for preparing the inventory, particularly if it is being prepared through their own or government resources. Typical cost categories include consultancy or technical assistance, data collection, stakeholder meetings, office supplies, communication or dissemination, and staff costs.

Step 2: Setting up the Inventory Management Team

Developing a robust GHG emissions inventory requires a simple but flexible institutional structure, and cities are encouraged to establish an Inventory Management Team under the guidance of the city's ***Climate Core Team*** **(Refer Tool 1.2: Formation of Climate Core Team)**. Establishing an inventory management team will help ensure data integrity and continuity in the development process, and the inventory management plan should specify the team's structure and include key contact details to prevent future changes to the team from disrupting continuity and clarity of roles. While structures differ between cities, a typical arrangement can include:

- **Inventory Focal Points** – provide overall leadership and coordination, guide the process, facilitate high-level data requests, liaise with departments, and approve outputs
- **Inventory Coordinator** – manages operational tasks such as timelines, approvals, progress tracking, and coordination with the compilation team and external stakeholders
- **Lead Compiler(s)** – responsible for the technical preparation of the inventory, including data processing, application of methods, quality control, emissions calculations, and documentation
- **Sector Leads** – collect and process sector-specific data, coordinate data requests, verify raw data, apply necessary adjustments, and provide sub-sector inputs

Step 3: Establishing Timelines for Inventory Development

The inventory timeline needs to be realistic but flexible, as it may change during each compilation cycle. Key factors that can affect the timeline include:

- **Local and national regulatory requirements:** The GHG emissions inventory should be produced and reported in line with local, national, and international deadlines.
- **The availability of key staff and stakeholders to fulfil commitments made and meet deadlines set:** The team's availability should be kept under review
- **The availability of data**: Inventories move faster when data is readily accessible; first-time data collection may require more time.

- **Cooperation of data providers:** Delays may occur if agencies provide data late; formal requests or alternative datasets may be needed
- **Level of detail required:** More detailed inventories (BASIC+) take longer; coverage should be pre-determined based on data availability and local context (relevant/high-emitting sectors).

Section C

Tracking Emissions Over Time

Tracking emissions over time is essential for a GHG emissions inventory, as it records past trends and assesses the impact of mitigation policies and actions. As per the **Global Covenant of Mayors for Energy and Climate (GCoM) Common Reporting Framework (CRF)**, cities are required to develop the baseline GHG Inventory within two years of joining the GCoM and to monitor it every four years from the year of initial preparation.[3]

Emissions should be estimated consistently over time. Using different methods, data sources, or applying different boundaries in a time series can introduce bias, as the emissions trend will reflect both fundamental changes in emissions and methodological refinements.

When Should Cities Recalculate Base Year Emissions?

While inventories are updated regularly, the base year should be recalculated only under specific circumstances. Cities should recalculate base year emissions when:

- There are structural changes in the inventory boundary, such as modifications to the jurisdiction or inclusion/exclusion of sectors.
- There are changes in calculation methodology or substantial improvements in data accuracy.
- Significant errors are discovered in previously reported data.

Cities **s**hould not recalculate base-year emissions for routine or organic changes, such as growth in city activity levels or minor fluctuations in data. Changes in grid-related emission factors or GWPs arising from new research also do not qualify as methodology changes and should not trigger recalculation. To maintain consistency, cities can establish internal protocols, for example, recalculating base-year emissions only when changes resulting from new data or methodologies exceed a certain threshold (e.g., 5%).

Table 5: When to Recalculate GHG Emissions?

Goal Type	Example	Recalculation needed (if significant)	Recalculation not needed
Changes in the inventory boundary	A community is included in or set aside from a city's administrative boundary	X	
	Change in goal boundary from BASIC to BASIC +, or from 6 GHGs to 7 GHGs (i.e., coverage in terms of sectors or gases)	X	
	Shutting down of a power plant		X
	Building a new cement factory		X
Changes in calculation methodology or improvements in data accuracy	Change in calculation methodology for landfilled municipal solid waste, from the Methane Commitment Approach to the Frst-Order Decay Method	X	
	Adoption of more accurate activity data instead of a scaled-down national figure	X	
	Change in global warming potential factors used		X
	Change in the electricity emission factor due to energy efficiency improvement and the growth of renewable energy utilization		X
Discovery of significant errors	Discovery of a significant mistake in the unit conversion in the formula used	X	

[3] GCoM Common Reporting Framework - https://www.globalcovenantofmayors.org/wp-content/uploads/2023/11/CRF7-0-2023-09-14-final.pdf.

Section D

Keeping the Inventory Management Plan Up to Date

The Inventory Management Plan includes essential elements required to develop, maintain, and update a community-wide GHG emissions inventory in a consistent, structured, and repeatable manner. The inventory management plan should be regularly reviewed to reflect changing policies, new data availability, updated methods, and lessons from previous cycles. It should be reviewed before each new inventory and updated immediately after its completion. Every update should be saved as a new version, with a brief explanation of the changes, to maintain transparency and help future teams understand the system's evolution.

It defines how the city will manage the inventory in line with the GPC framework and outlines the overall approach to key steps, including project planning, setting boundaries, identifying emission sources, and selecting data and methodologies. A strong plan is essential because it clarifies why the city should regularly develop and update its GHG emissions inventory, provides a structured process for compiling it, assigns responsibilities across departments, and captures challenges or gaps from earlier cycles so that each future inventory can be improved.

The **key components of an Inventory Management Plan** typically include the following:

- Inventory Planning, which outlines how the city will initiate the inventory process. This includes identifying the required budgets and securing administrative approvals. Additionally, the planning should be done under the guidance of the City Climate Core Team, headed by the City Municipal Commissioner, with clearly defined roles and responsibilities for the committee members involved, and with agreement on the overall timelines for completing the inventory cycle. The team should include inventory focal points, inventory coordinator, lead compiler(s), and sectoral leads (see Section B: Planning for GHG Emissions Inventory for the role and responsibilities of the inventory management team).
- The next component addresses data collection and processing, calculation and synthesis of emissions, and reporting. The detailed steps for the GHG emissions inventory data collection, analysis and reporting are covered in Tool 3.2D: GHG Emission Inventory Data Collection and Management, and Tool 3.2E: GHG Emissions Inventory Analysis and Synthesis.
- The final part of the inventory management plan should focus on a monitoring framework for tracking GHG emissions in the city over time, including how and when periodic updates should be made, how changes in data or methods should be documented, and how version control should be maintained.

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Section E

Quality Assurance and Quality Control (QA/QC)

Ensuring the accuracy and consistency of the GHG emissions inventory requires a well-structured QA/QC system against GPC standards (completeness, consistency, accuracy, transparency, and relevance). It should also verify whether all required sectors and scopes have been reported, whether any exclusions are justified, and whether the assumptions and data used represent the best possible estimates for the city.

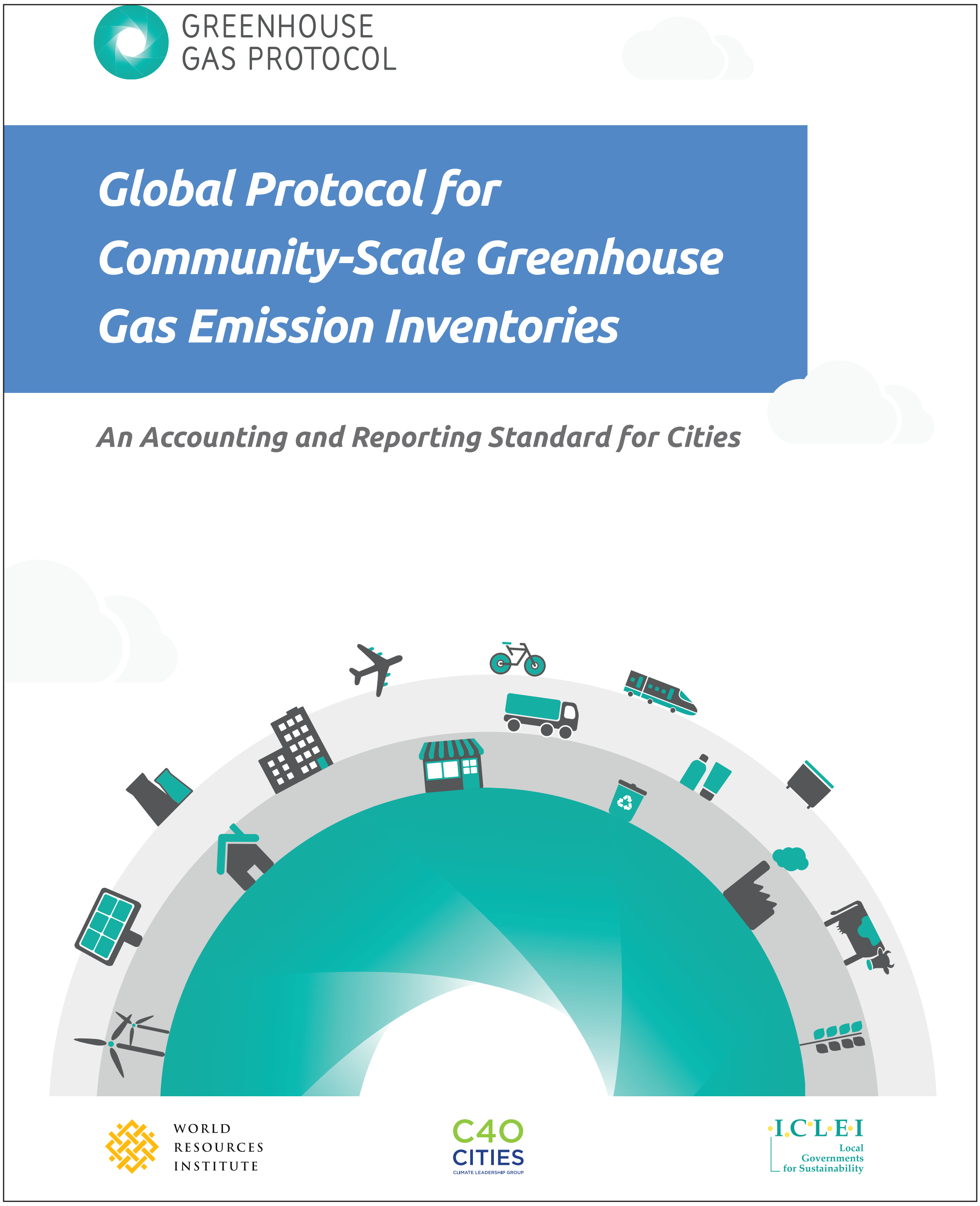
The QA process typically identifies two types of outcomes:

- **Compliance-related issues**, which must be resolved before the inventory can be finalized, and
- **Long-term improvement areas**, which may include strengthening data collection systems, improving assumptions or enhancing the accuracy of emission factors. Refer to Tool 3.1D for QA/QC for inventory data.

Formal third-party verification may not be undertaken initially, but the inventory management plan should leave room for introducing such steps as the city's systems mature.

Tool
3.2B

Global Protocol for Community-Scale Greenhouse Gas Emission Inventories



https://ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf

Tool 3.2C

HEAT Plus Manual

https://southasia.iclei.org/wp-content/uploads/2026/07/Tool-3.2C_HEAT-Plus-Manual.pdf

Tool

3.2D

GHG Emissions Inventory Data Collection and Management

This tool provides guidance for cities on collecting, recording, and organizing the activity data (e.g., electricity and fuel consumption, waste treated, etc.) needed to prepare a comprehensive GHG emissions inventory. By bringing together information from key sectors such as stationary energy (for buildings and infrastructure), transportation, and waste, the tool supports cities in estimating, analyzing, and establishing their baseline GHG emissions. It also helps planners understand past trends and use this information to build future scenarios.

A data inventory format is provided in Annexure I of the tool to support this process. While expert input or sector-level consultations may help validate information and improve data accuracy, initial data entry using this template can help assess data completeness and identify major data gaps. This dataset will also serve as the foundation for subsequent stages of climate action planning, including business-as-usual (BAU) projections and the development of net-zero-emission pathways.

Section A

Defining data requirements and templates

Before starting the data collection and storage process, it is essential first to specify the exact data required, such as -

- Description of data
- Geographic boundary of data
- Year and months for which the activity data is required (e.g., January–December 2025 or financial year April 2024–March 2025)
- Sectors and sub-sectors covered (e.g., electricity consumption in commercial buildings)
- Activity data units (e.g. kWh)
- Data format (e.g., Excel spreadsheet)
- Web links, if available
- Timeline for data submission
- Contact details of data provider (i.e., inventory team)

Cities should also collect supporting information to improve data interpretation, such as:

- Brief description of how data is produced (e.g., surveys, metered data, utility billing)
- Assumptions used (e.g., breakup between commercial and residential LPG consumption is estimated from previous years' data)
- Known data gaps/problems (e.g., data available for only 9 months)
- Frequency and timeline of data availability (report available every June for the previous year)

While developing a GHG emission inventory, cities should collect and compile the most complete dataset possible. Ideally, the data should correspond to the most recent year for which records are available and align with the city's administrative and geographic boundaries.

Types of Data Required

A comprehensive GHG emissions inventory should provide a clear picture of GHG emissions estimation from different sectors and sources. It should also provide information to understand the local context and correlate it to emission trends – such as demographic data, urban infrastructure and utility services, the different activities taking place within the city, how energy is supplied and used, and economic activities and drivers.

Broadly, a comprehensive GHG emissions inventory requires three types of data:

1. Activity Data

Activity data refers to measurable quantities of energy use or services delivered within a sector, and forms the core input for emissions estimation, as shown below:

Activity Data* × *Emission Factor*[1] = *GHG Emissions

Examples include:

- **Energy consumption:** electricity in buildings, public infrastructure/utilities, industries, and agricultural activities; LPG, diesel for generators in commercial operations, industrial fuels (diesel, furnace oil, etc.)
- **Transportation activity:** vehicle-kilometers traveled, fuel consumed, public transport ridership
- **Waste:** solid waste and wastewater generated and treated

2. Urban infrastructure and service data

In addition to the activity data, cities should collect supplementary information on infrastructure and service systems to improve accuracy and provide context for emission calculations, such as to estimate the correct methanation factor for specific waste treatment methods. This information is also used in emissions calculations for several sub-sectors.

Examples include:

- **Wastewater systems:** type of treatment, capacity, population coverage, proportion of treated vs. untreated, etc.
- **Solid waste systems:** collection efficiency, quantum processed through composting, bio-methanation, recycling, or landfilling
- **Energy systems:** T&D losses, number of streetlights, etc.

3. General and Socio-Economic Data

This includes background information and scaling parameters that support emission calculations, normalization, and the estimation of key performance indicators (KPIs), allowing cities to compare their sustainability performance with other global cities and understand where they stand and where improvement is needed.

Examples include:

- Population and demographic data
- Number of households and average household size
- Number of vehicles by category
- Land area and administrative boundary

[1] An emission factor represents the amount of GHG emissions released per unit of activity. It connects the activity to its related emissions and is typically expressed as emissions per unit of fuel burned, electricity used, waste processed, or similar measures. More details and guidance on selecting emission factors are available in Tool 3.2 B.

Engaging data providers

Some data can be downloaded from the web, but some can only be obtained from providers upon request. Sometimes it is necessary to reach out to them to understand the downloaded data and obtain metadata. Cities may obtain data through:

- A written data request from the Climate Core Team, Inventory Coordinator, or the inventory team representative
- In-person meetings with data providers to clarify data requirements, why it is required, how it will be used, and to improve the compilers' understanding of data.
- Secondary sources (open datasets, research studies, statistical publications)

Following initial requests, cities should engage with data providers to clarify data requirements, address questions, and facilitate timely and accurate data sharing.

Data documentation

Cities should record the source of each dataset, including:

- name of the organization or agency
- the department, authorizing official, and their contact details
- if secondary data is used, then publication type, year, author, and weblinks.

Thorough documentation improves inventory quality and makes it easier to verify information, correct errors, and resolve discrepancies.

While engaging with data providers for data collection, it is essential to reach an understanding of the following:

- **Deadline for providing data** – this may need to be flexible depending on the capacity and reporting cycles of different data providers.
- **Any amendments to the city's data request templates** – where data providers have information in a different format, or data is not accessible in a way that supports the use of the data templates (e.g., available only in hard copy), this should be discussed, and an approach to supplying data should be agreed upon.
- **Communication approach** – how the data provider will share the data and how communication will be managed
- **Any confidentiality requirements from data providers,** including the need to sign a confidentiality agreement or provide an official letter of request from the concerned city authorities. Sometimes data providers allow confidential data to be reported if it is aggregated and merged with other data.
- **Any other requirements or requests from the data provider**, such as access to the inventory and its supporting documentation, in return. This can help in developing a good working relationship with an important data provider.

Recording and processing the data collected

Once the data is obtained, it should be saved in a single file or workbook that is accessible to the inventory development team. The inventory data format provided in **Annexure I** can serve as a reference for collecting and recording data. A file-naming and version-control protocol should be implemented so that everyone has a clear understanding of each file's contents and knows the most recent version. Quality control procedures should also be applied to check for data completeness, accuracy, consistency, transparency, and relevance.

Data collected may not always be directly usable for calculating emissions; for example, it might not cover the whole year, may represent a geographic area smaller or larger than the city boundary, or may not be disaggregated by sub-sectors. In such cases, the data needs processing and adjustments. It is essential to document how the data has been processed to maintain transparency and support future updates, including in case of staff turnover.

For instance, a city may receive electricity consumption data from the local power distribution company that covers the entire metropolitan region, not just the area within the city's jurisdictional boundary. In such cases, the electricity data can be scaled down using the best possible assumption, such as the per capita consumption (estimating per capita electricity consumption for the whole metropolitan region and applying it to the population living within the city) or per household consumption (using a similar approach). However, such assumptions must be clearly documented. An example is provided in **Table 1** below.

Table 1: Data Gaps, Assumptions, and Estimations

Sector	Energy Source/Activity	Sub-Sector	Data Gaps	Data Assumptions and Estimations
Community-level GHG emissions inventory				
Stationary Energy	Electricity	Residential Buildings	Electricity consumption data for 2024 is not available	Electricity consumption for 2024 was estimated using data on electricity consumption and the number of consumers. The number of consumers for 2024 was calculated using the Consumer Growth Rate from 2017 to 2023. The average electricity consumption per consumer during the period was used to estimate consumption in 2024.
		Commercial and Institutional Buildings/Facilities		
		Manufacturing Industry and Construction		

Ensuring Data Quality

Quality control procedures help ensure that the data used in the GHG inventory are accurate, complete, and consistent before they are used in calculations. This includes checking raw data for apparent errors, verifying units and conversions, comparing values with trends in previous years, and confirming that all required datasets and sub-sectors are covered. Any gaps or anomalies identified during quality control should be corrected or documented so that the final inventory reflects the best available data.

Annexure I - Data Inventory Format

The inventory data format workbook is attached.

Table 2: Data quality checks to be undertaken

Principles	Checks to perform
Completeness	Check that assumptions and information on the data boundaries, base year, methods, data sources, and other parameters are consistent and documented
	Confirm that estimates are reported for all categories and for all years from the appropriate base year to the current inventory year.
	Check the aggregation of data across source categories, sectors, etc., and ensure that all desired sources and categories are included
Consistency	Check time-series consistency by comparing with previous year(s) to identify errors
	Check for consistency in the methods used for sourcing and/or calculating activity data throughout the time series (consistent with previous years)
Accuracy	Check data processing steps (e.g., equations) in spreadsheets and verify that calculations are working correctly (e.g., formulae and ranges are correct and consistent)
	Check a sample of activity data for transcription errors, and verify a representative sample of calculations, manually or electronically.
	Check for unusual or unexplained trends in activity data or other parameters across the time series
	Use simple approximation methods to assess likely accuracy (e.g., calculate per capita and per unit GDP metrics to identify anomalous trends, and/or compare them with national statistics, national inventories, and data from other cities
	Check that the spreadsheet input data and calculated data are clearly differentiated
Transparency	Ensure that raw data is saved in a central location with an agreed file naming format
	Ensure that version control procedures for electronic files have been implemented
	Check that units, parameters, and conversion factors are appropriately labeled
Relevance	Ensure that the highest priority activities achieve the highest levels of quality checking and accuracy

Tool

3.2E

GHG Emissions Inventory Analysis and Synthesis

This tool provides a template for a Greenhouse Gas (GHG) Emissions Inventory Analysis and Synthesis Report. It suggests a structure for the report that covers both community-scale (city-wide) emissions and GHG emissions from local government operations (which are a subset of the community-scale emissions). A suggested table of contents and indicative text for the report are included. All text provided is illustrative, and all the graphs, tables, and charts are given only to indicate the type of information to be presented.

This GHG emissions inventory reporting template and its structure are aligned with the Global Protocol for Community-Scale GHG Emission Inventories (GPC) framework and the reporting requirements of the Global Covenant of Mayors for Climate & Energy (GCoM). The GPC Reporting Format and the GCoM Common Reporting Format (CRF) are attached as annexures to support reporting of emission estimates to international platforms. Cities should follow these formats while reporting their GHG emissions inventories. The detailed reporting guidance for the GCoM CRF is available here, and guidance for the GPC Reporting Format is available here.

Cities are advised to prepare GHG emissions inventories in accordance with GPC V2.0 (see Tool 3.2B: GPC standards). Cities can use the GHG emissions inventory software tool HEAT+ (available at http://heat.iclei.org) to prepare their inventory. City-specific access to the tool may be obtained by writing to heat@iclei.org. In addition, cities may also use ICLEI's Excel-based GHG Emissions Inventory Data Format available as Annexure in Tool 3.2D: GHG Emission Inventory Data Collection and Management.

While preparing the inventory report, cities should contextualize the information presented. The text in this template is suggestive and not to be replicated as is. All numerical values presented in the tables and figures are indicative and do not represent actual data.

1 Introduction

The GHG emissions inventory for [City Name] has been prepared for the [Period]. The baseline year for the inventory is [Year]. The emissions inventory has been prepared following the GPC framework.[1] This inventory complies with the BASIC level reporting of GPC, which covers Scope 1 emissions from stationary energy sources and in-boundary transportation, Scope 2 emissions from consumption of grid-supplied electricity, and Scope 1 and Scope 3 emissions from waste.[2]

The GHG emissions inventory consists of two analyses -

1. **Community-level emissions inventory** – includes GHG emissions from energy consumption and emission sources in residential buildings, commercial buildings, institutional/public buildings and facilities, transport, and those resulting from solid waste and domestic wastewater within the municipal boundary. This helps establish a baseline and supports the development of evidence-based mitigation strategies and actions for multiple sectors at the city scale.
2. **Local government emissions inventory** –includes GHG emissions from municipal operations and services such as municipal buildings, street lighting, water supply, wastewater treatment, municipal vehicle fleet, and waste management facilities. In Hyderabad, water supply and wastewater treatment are administered by the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB), while the rest of these services are administered by the Greater Hyderabad Municipal Corporation, the local administrative body of the city.

The community-level energy consumption and GHG emissions data already account for emissions related to local government operations. For example, the electricity consumption in municipal facilities for water supply, wastewater management, and street lighting is already likely accounted for in the city-wide dataset for the commercial and institutional facilities sub-sector, based on relevant electricity customer/end-user categories, as prescribed under electricity distribution and tariff arrangements.

Thus, the local government energy consumption and emissions profile is a subset of the community-level profile. Assessing energy use and emissions for municipal operations separately helps city governments take targeted low-carbon actions in their municipal infrastructure and urban service delivery. It enables cities to demonstrate leadership in implementing transformative climate efforts in their communities.

2 Methodology

The GHGs considered in the GHG emissions inventory are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), which account for nearly 99% of global GHG emissions.

The GHG emissions inventory has been reported in terms of emissions of each individual GHG and the total carbon dioxide equivalent (CO_2e) emissions. To derive CO_2e values, the global warming potential (GWP) of each gas for a 100-year time period is factored. GWP reflects the climate change impact of each gas, in terms of its warming effect on the atmosphere, compared to CO_2. The GWP values based on the Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report (2007) are presented in Table 1 below.

Table 1: 100-year GWPs of GHGs relative to CO_2

Gas	Lifetime (Years)	GWP for 100 years
CH4	12	25
N20	114	298

[1] Refer for more information on GPC - https://ghgprotocol.org/ghg-protocol-cities (accessed 24 January 2024)

[2] Scope 1 emissions include GHG emissions from sources located within the city boundary; Scope 2 emissions include- GHG emissions occurring because of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary; Scope 3 emissions include all other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

Emission Factors:

For estimating GHG emissions from various activities or sources in a city, it is not feasible to carry out a direct physical measurement of GHGs emitted. The common methodology for estimating GHG emissions is through the use of emission factor[3] and the relevant activity data[4].

Where,

GHG_A = GHG emissions resulting from activity A

EF_A = emission factor for activity A

D_A = data for activity A

For a city-level GHG emissions inventory, emission factors available in the HEAT+ tool, developed by ICLEI, can be used to estimate emissions from different sources and activities. For emissions from solid waste disposal, the Methane Commitment (MC) methodology is employed.[5] This method calculates landfill emissions based on the amount of waste disposed of in a given year. It uses a lifecycle and mass-balance approach to estimate emissions, regardless of when they actually occur.

To estimate on-road transport emissions, the fuel sales method is used. This method estimates emissions based on the total fuel sold within the city limits, treating fuel sales as an indicator of transport activity within the city.[6]

Emissions from rail transit within the city boundary are estimated based on electricity consumption data for rail and metro[7] received from [distribution company]. For aviation, the Landing and Takeoff (LTO) emissions are considered. This approach estimates emissions based on the number of LTOs (aggregate or per aircraft type) and default emission factors per LTO cycle, corresponding to the aircraft type.

2.1 Tool Used

Provide a brief description of the tool used for emission estimates.

2.2 Data Sources and Collection

The baseline year for this study is the financial year [Year]. Relevant data for analysis and estimation were collected for a five-year period preceding the baseline year, i.e., from [Year] onwards.

[City Name] officials engaged various agencies and local and sub-national stakeholders listed in Table 2 through official letters and meetings to obtain relevant energy consumption data, focusing on primary emission sources within the municipal area. Both supply-side and demand-side data were collected and analyzed. The various sources of energy and other relevant data used in the report are elaborated in Table 2.

3 The emission factor for a particular activity is dependent on the energy use and the direct emissions of GHGs resulting from the activity. As a result of this dependency, emission factors tend to vary over locations and for different technologies. For example, the emission factor per kWh of electricity used would vary over countries or regions due to the varying energy mix, characteristics of fuel used, and the efficiency of electricity generation. The emission factor per km travelled would vary depending on the fuel characteristics, the engine characteristics for the vehicle, and the driving and traffic patterns prevalent. For accurately estimating a GHG emissions inventory, it is important to use the emission factor best suited to the location.

4 Activity data is a quantitative measure of a level of activity that results in GHG emissions occurring during the given period of time.

5 To learn more about the Methane commitment (MC) methodology for accounting GHG emission from Municipal solid waste (MSW) refer Section 8.3 Calculating emissions from solid waste disposal, Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. Available at: https://ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf

6 To learn more about fuel sales approach refer GPC - https://ghgprotocol.org/ghg-protocol-cities (accessed 18 October 2023)

7 In mid-2018-19 TGSPDCL integrated Metro consumption along with rail sector

Table 2: Source of energy consumption data for GHG emission estimations [Example]

Fuel Type	Sector	Source of Data
Electricity	Residential, Commercial/Institutional Facilities, Manufacturing Industries and Construction, Agriculture, Forestry and Fishing Activities (i.e. mainly Agriculture)	
	Municipal Buildings, Streetlights, Municipal Vehicles	
	Water Supply, Wastewater Management	
Diesel and Petrol	Community Transport, Commercial/Institutional Facilities, Manufacturing Industries and Construction	
	Municipal Vehicles	
LPG	Residential, Commercial/Institutional Facilities, Manufacturing Industries and Construction, Auto LPG – Community Transport	
CNG	Transport	
	Municipal Vehicles	
PNG	Residential, Commercial/Institutional Facilities, Manufacturing Industry and Construction	
Furnace Oil & LDO	Manufacturing Industry	
Solid Waste Management		
Wastewater management		
Rail		
Metro		
Aviation		

Data Gaps and Assumptions

The [City Name] GHG emissions inventory [Period] relies on a comprehensive set of data assumptions and estimations essential for the accurate calculation of GHG emissions across sectors and parameters relevant to [City Name] for the specified period. Several data gaps were encountered during the development of the GHG emissions inventory. Annexure I presents all identified data gaps, assumptions, and estimations used for [City Name] GHG emissions inventory.

3 Community-Level Energy Consumption and GHG Emissions

The following section includes inventory details on energy consumption and GHG emissions in [City Name].

3.1 City-Scale Energy Consumption and GHG Emissions in [City Name] [Year]

Table 3: Key Indicators8 - City-Scale Energy Consumption and GHG Emissions [Year] -Example

Total Energy Use9	178.82 million GJ
Total GHG Emission	26.32 million tCO_2e
Per Capita Energy Use	16.87 GJ[10]
Per Capita GHG Emission	2.45 tCO_2e[120]

[8] These indicators can enable comparison with other Indian cities as well as cities around the globe. However, such a comparison should be done with due caution since results may vary across cities, even amongst those located in the same country, on account of the different local context (in terms of socio-economic conditions and drivers), data availability, data management practices followed in the cities, and the overall methodology adopted for developing the GHG inventory.

[9] Includes direct energy use (from combustion of fuels such as kerosene, LPG, petrol, diesel) and indirect energy use (due to consumption of grid electricity)

[10] Population for [Year] is estimated to be XX.YY million

Table 4: Sector-wise energy consumption and GHG emissions [Year]

Sector/Sub-Sector	Energy Use (Million GJ)	GHG Emissions (Million tCO_2e)
Stationary Energy	109.85	16.76
Residential Buildings	53.30	7.22
Commercial and Institutional Buildings/ Facilities (i.e., Commercial sector)[11]	25.96	4.56
Manufacturing Industries and Construction (i.e., Industrial sector)	30.53	4.97
Agriculture, forestry, and fishing activities (i.e. mainly agriculture)	0.06	0.01
Transportation	**68.97**	**5.45**
On-road Transportation	68.14	4.89
Railways (incl. Metro)	0.83	0.16
Aviation	-	0.4
Waste	**-**	**4.12**
Solid Waste[12]	-	2.6
Wastewater	-	1.52
Total	**178.82**	**26.32**

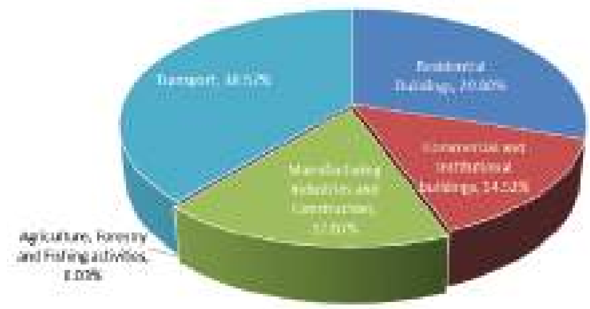


Figure 1: Sector-wise share of energy consumption [Year]

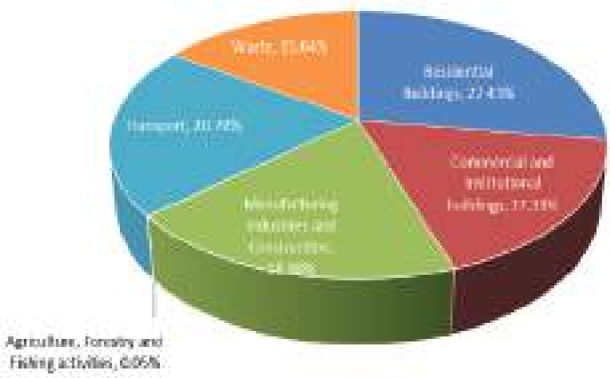


Figure 2: Sector-wise share of GHG Emissions, [Year]

Highlights - Example

Energy-intensive sectors: Transport (38.57%); Residential Buildings (29.8%); Manufacturing Industries and Construction (17.07%); and Commercial and Institutional Buildings/ Facilities (14.52%)

Energy consumption trend [Inventory Period]: 22.91% increase, averaging 5.7% annually[13]

Sectors with significant GHG emissions: Residential Buildings (27.43%), Transport (20.7%), Manufacturing Industries and Construction (18.88%), Commercial and Institutional Buildings/ Facilities (17.31%), and Waste (15.64%).

GHG emissions trend [Inventory Period]: 22.67% increase, averaging 5.67% annually

[Provide an explanation for any increase/decrease/ variation observed in the trend] - Example

The overall GHG emissions and energy consumption in [City Name] have increased in 2024-25 as compared to 2018-19. However, both GHG emissions and energy consumption began to decrease in FY 2020-21, primarily due to the implementation of the COVID-19 restrictions and lockdown measures. This indicates that the pandemic-induced lockdown had a temporary positive impact on environmental indicators; however, as economic activities resumed, there was a modest rebound in emissions and energy use.

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[11] Along with commercial and institutional buildings/ facilities it also includes streetlights, water works, general purpose, temporary supply, airport, railway stations and bus stations, lift irrigation

[12] Includes emission from solid waste disposal and biological treatment.

[13] All annual growth rates are Average Annual Growth Rates (AAGR)

3.1.1 Trend in Community-Level Energy Consumption and GHG Emissions in [City Name] - Example

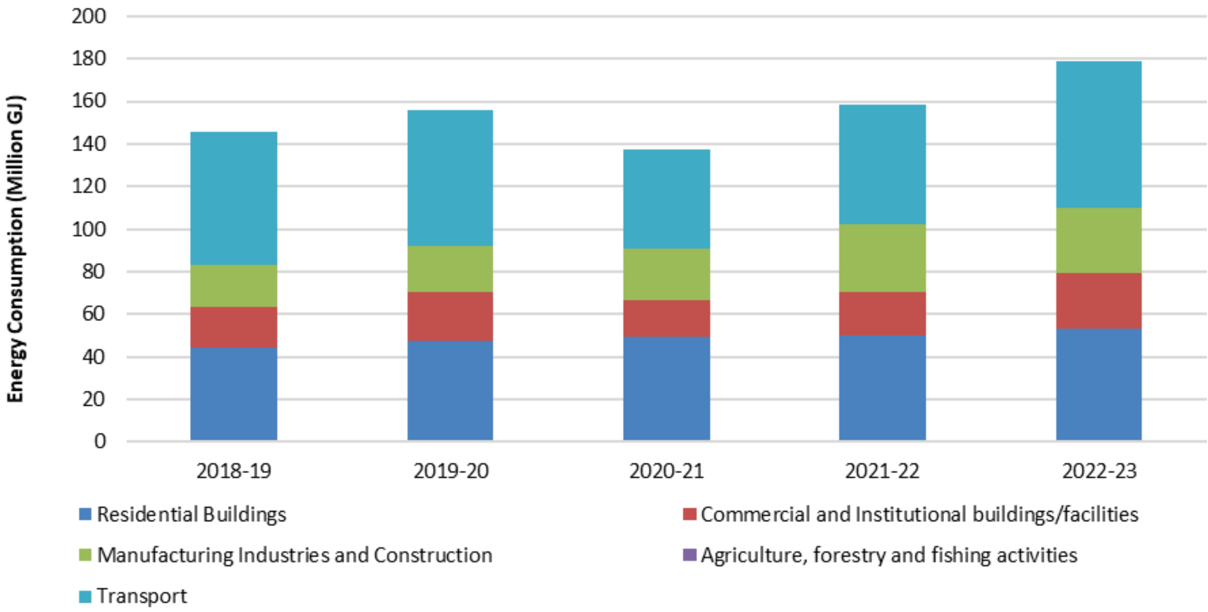


Figure 3: Trend in energy consumption [Inventory Period]

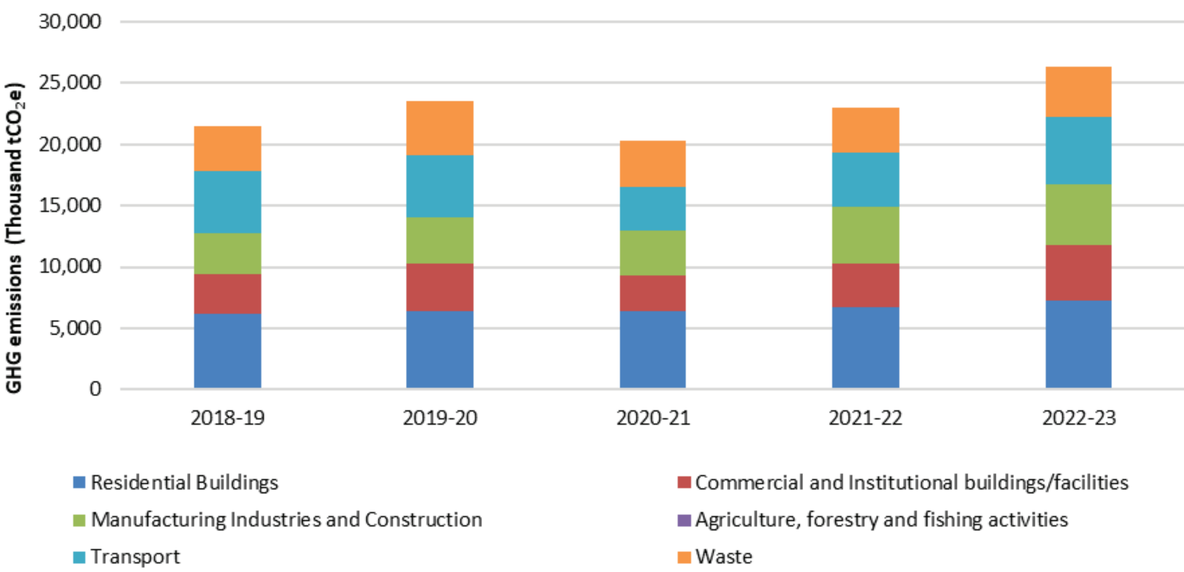


Figure 4: Trend in GHG emissions [Inventory Period]

3.2 Energy Consumption and GHG Emissions by Energy Source

Highlights - Example

Predominant energy sources: Electricity (40.5%), Diesel (23.4%), Petrol (17.3%), and LPG (16.4%)

Energy sources with significant GHG emissions: Electricity (66.04%)[14], Diesel (14.27%), Petrol (9.85%) and LPG (8.49%)

[14] Although electricity accounts for 40.5% of the energy mix, it contributes to 66.04% of the GHG emissions in [City Name], largely due to India's GHG-intensive thermal power-based generation system.

Table 5: Energy consumption and GHG emissions by energy source [Year]

Fuel/Energy Source	Energy Use by Source (Million GJ)	GHG emission by Source (Million tCO_2e)
Diesel	41.84	3.11
Petrol	30.88	2.15
CNG	1.95	0.11
LPG	29.32	1.85
Kerosene	-	-
Coal	-	-
Furnace Oil	2.3	0.18
Light Diesel Oil (LDO)	0.11	0.01
Electricity	72.41	14.40
Total	**178.82**	**21.81**

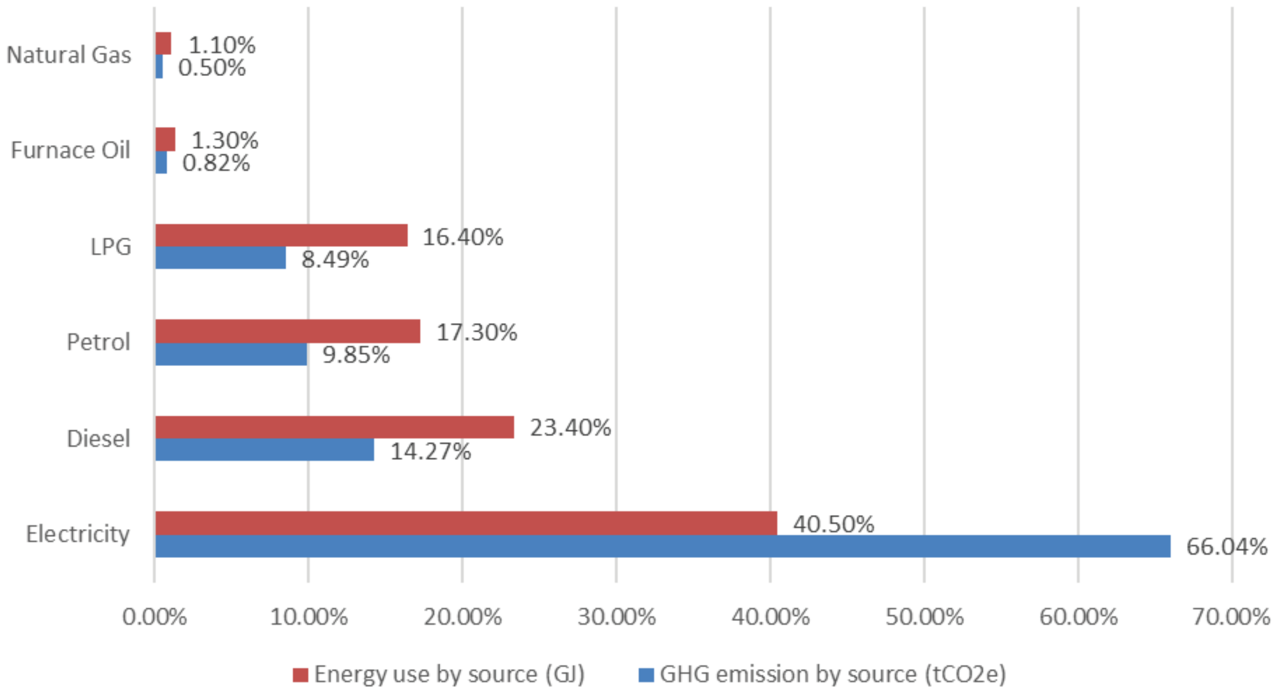


Figure 5: Energy consumption and GHG emissions by energy source [Year]

3.3 Sectoral Insights and Trends of Energy Consumption and GHG Emissions

3.3.1 Sectoral Electricity Consumption and GHG Emissions

Highlights - Example

Total electricity consumption in [Year]: 19,861.32 million kWh

Per capita electricity consumption [Year]: 1,897.04 kWh[15]

GHG emissions from electricity consumption in [Year]: 14.22 million tCO2e

Trend in electricity consumption [Inventory Period]: 36.91% increase averaging 9.23% annually

[15] Population for [Year] estimated at XX.YY million

Trend in GHG emissions [Period]: 31.75% increase averaging 7.94% annually

Sectoral electricity consumption and GHG emissions [Year]: Residential Buildings (39.74%), Manufacturing Industries and Construction (30.23%), and Commercial and Institutional Buildings/Facilities (30.04%)

[Add explanation for any increase/decrease/variation observed in the trend] - Example

The electricity consumption profile of [City Name] shows a mixed pattern between 2018-19 and 2024-25. Although consumption generally increased over the years, a noticeable decline occurred in FY 2020-21, primarily due to reduced commercial and industrial operations during the COVID-19 lockdowns. With a large portion of the city's electricity demand coming from these sectors, the shutdown of commercial and industrial units temporarily reduced overall consumption. In subsequent years, however, electricity consumption gradually increased again as economic activities resumed.

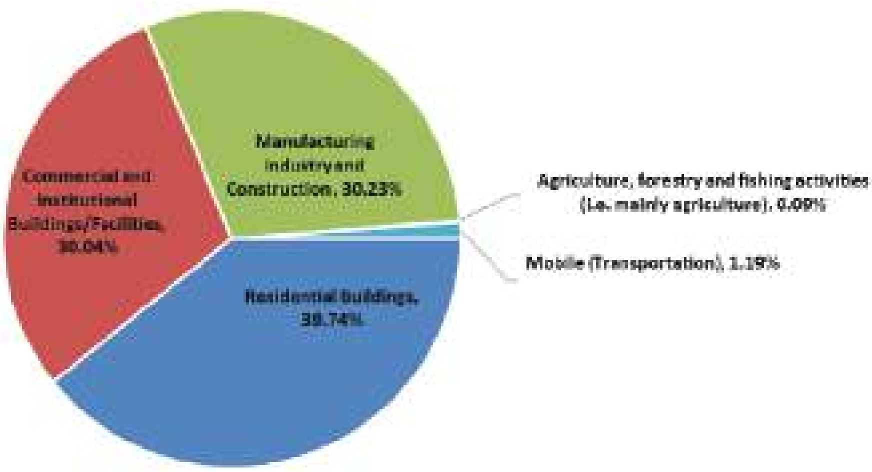
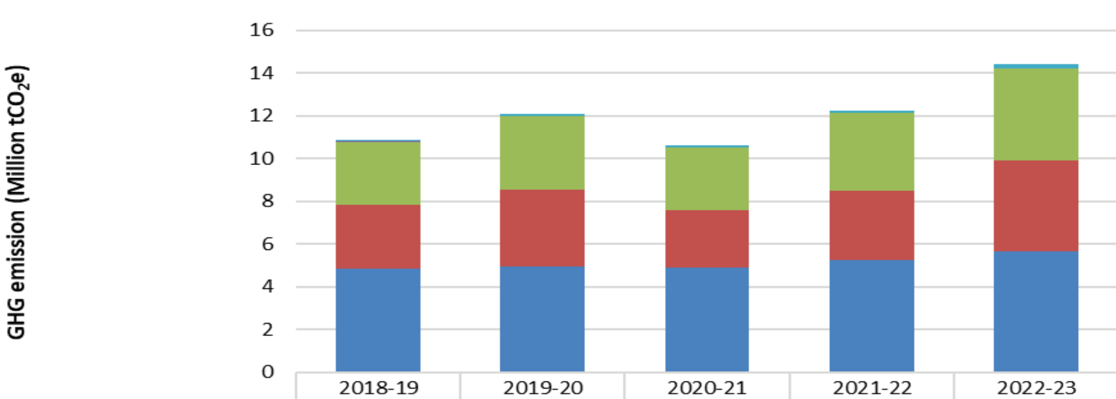


Figure 6: Sector-wise share of GHG emissions from electricity consumption [Year]



	2018-19	2019-20	2020-21	2021-22	2022-23
Mobile (Transportation)	0.02	0.13	0.08	0.13	0.17
Agriculture, forestry and fishing activities	0.01	0.01	0.01	0.01	0.01
Manufacturing Industry and Construction	2.98	3.42	2.95	3.61	4.30
Commercial and Institutional Buildings/Facilities	2.99	3.60	2.69	3.28	4.27
Residential Buildings	4.82	4.95	4.88	5.23	5.65

Figure 7: Trend of GHG emissions from electricity consumption [Inventory Period]

3.3.2 GHG emission from stationary fuel consumption[16]

Highlights - Example

Sectoral share in energy consumption from stationary fuel [Year]: Residential Buildings (65%), Manufacturing Industries and Construction (23.29%), Commercial and Institutional Buildings/Facilities (11.71%)

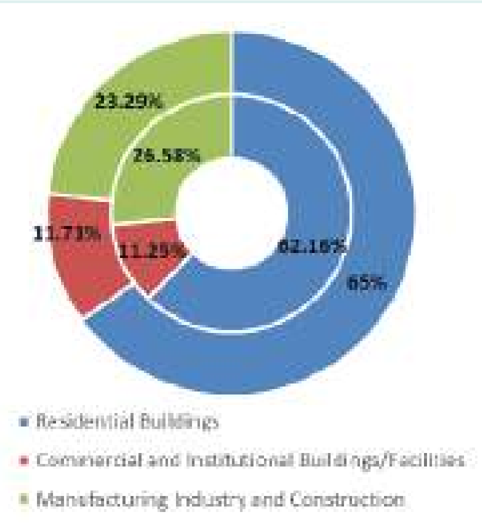
Trend in energy consumption from stationary fuel [Year]: 24.63% increase, averaging at 6.2% annually

Sectors with significant GHG emissions: Residential Buildings (62.16%), Manufacturing Industries and Construction (26.58%), Commercial and Institutional Buildings/Facilities (11.25%)

Trend in GHG emissions from stationary fuel [Inventory Period]: 26.06% increase, averaging at 6.51% annually

Table 6: Energy consumption and GHG emissions from stationary fuel consumption [Year]

Sector	Energy consumption (Million GJ)	GHG Emissions (Million tCO_2e)
Residential Buildings	24.88	1.57
Commercial Sector	4.48	0.28
Industrial Sector	8.92	0.67
Total	**38.29**	**2.52**



Highest Stationary Fuel Consuming and GHG Emitting Sector - Example

Residential Buildings

Percentage share of Energy Consumption (outer graph)

Percentage share of GHG Emissions (inner graph)

Figure 8: Sector share in energy use and GHG emissions from stationary fuel consumption [Inventory Period]

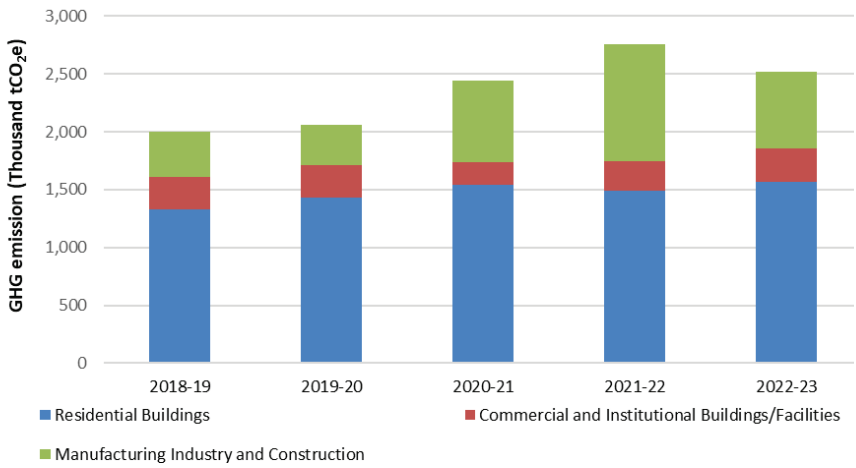


Figure 9: Trend in GHG emissions from stationary fuel consumption [Inventory Period]

[16] Stationary fuel consumption refers to the fuel used for all purposes other than transport (e.g. LPG for residential use, furnace oil used for industrial purposes), which leads to direct emissions of GHGs

3.3.2.1 Residential Buildings

Highlights - Example

Energy consumption from stationary fuel consumption [Year]: 24.88 million GJ[17]

GHG emissions from stationary fuel consumption [Year]: 1.57 million tCO2e

Trend in energy consumption [Inventory Period]: 18.45% increase, averaging at 4.61% annually

Trend in GHG emissions [Inventory Period]: 18.19% increase, averaging at 4.55% annually

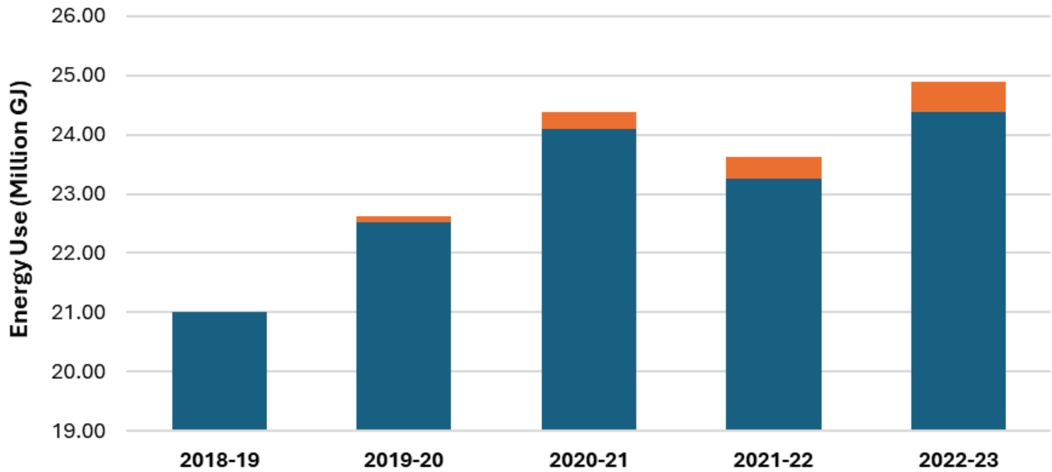


Figure 10: Trend in stationary fuel energy consumption in residential buildings [Inventory Period]

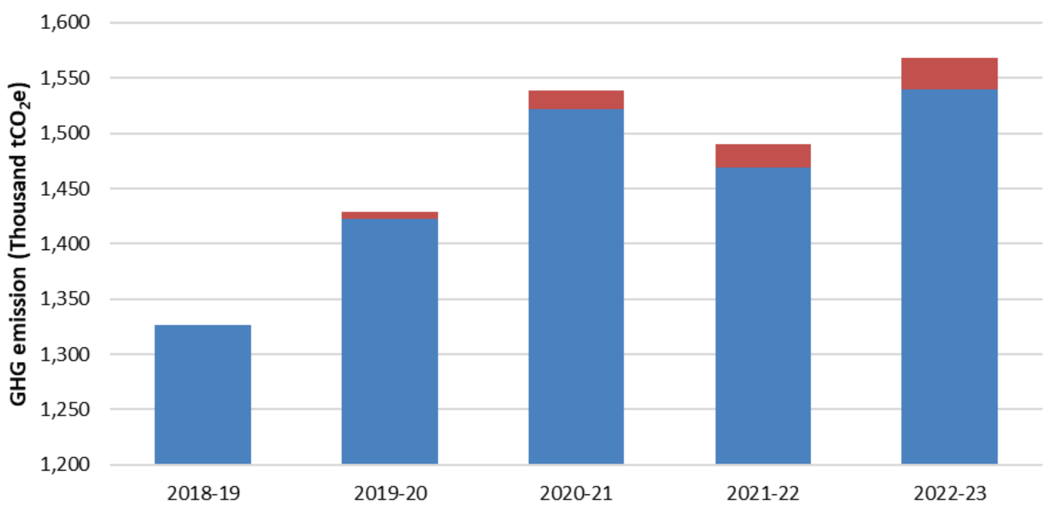


Figure 11: Trend in GHG emissions from stationary fuel consumption in residential buildings [Inventory Period]

[17] PNG consumption data is available from [Year] FY onwards

3.3.2.2 Commercial and Institutional Buildings and Facilities (i.e., Commercial sector)

Highlights - Example

Energy consumption from stationary fuel consumption [Year]: 4.48 million GJ18

GHG emissions from stationary fuel consumption [Year]: 0.27 million tCO2e

Trend in energy consumption [Inventory Period]: 0.85% decline, averaging at 0.21% annually

Trend in GHG emissions [Inventory Period]: 1.73% decline, averaging at 0.43% annually

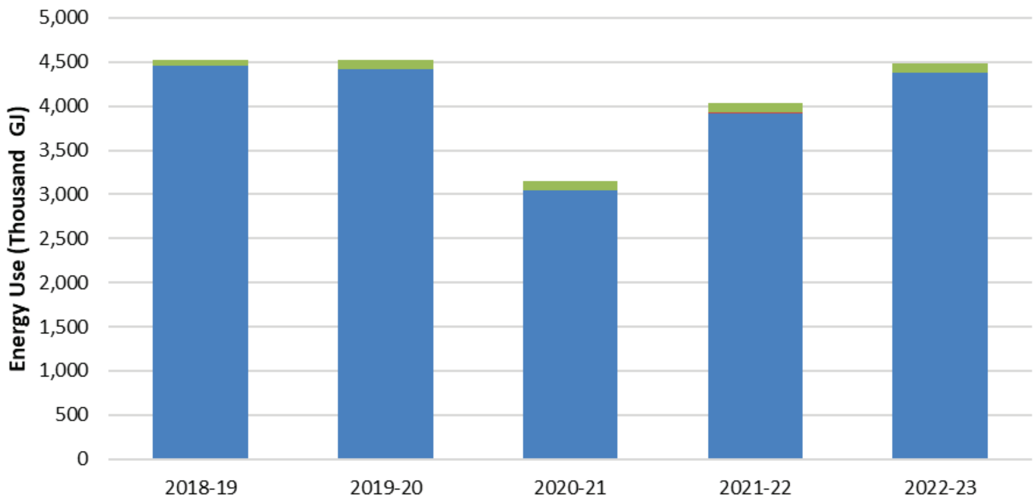


Figure 12: Trend in stationary fuel energy consumption in the commercial sector [Inventory Period]

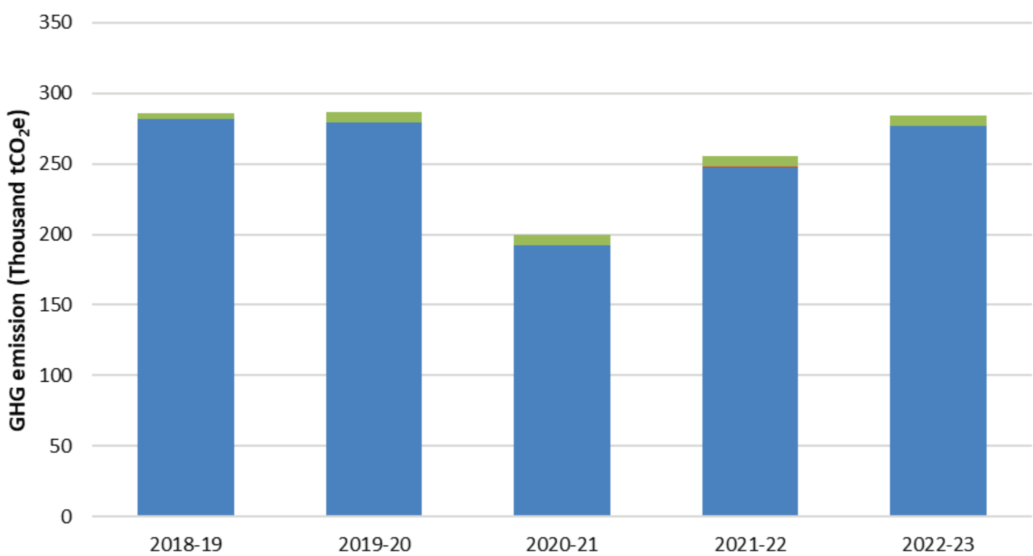


Figure 13: Trend in GHG emissions from stationary fuel consumption in the commercial sector [Inventory Period]

[18] PNG consumption data is available from[Year] onwards

3.3.2.3 Manufacturing Industries and Construction (i.e., Industrial sector)

Highlights - Example

Energy consumption from stationary fuel consumption [Year]: 8.9 million GJ

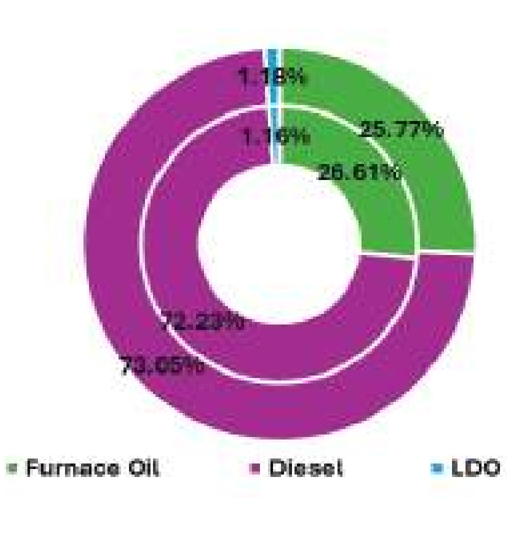
GHG emissions from stationary fuel consumption [Year]: 0.67 million tCO2e

Trend in energy consumption [Inventory Period]: 71.82% increase, averaging at 18% annually

Trend in fuel consumption [Inventory Period]:

- **Diesel:** 46.42% increase, averaging at 11.6% annually
- **Furnace oil:** 210.41% increase, averaging at 52.6% annually

Trend of GHG emissions [Inventory Period]: 72.68% increase, averaging at 18.2% annually



Share of fuels in stationary energy use and GHG emissions in industrial sector [Year]

Diesel accounts for largest energy share and GHG emissions

Percentage share of Energy Consumption (outer graph)

Percentage hare of GHG Emissions (inner graph)

Figure 14: Share of fuels in stationary energy use and GHG emissions in the industrial sector [Year]

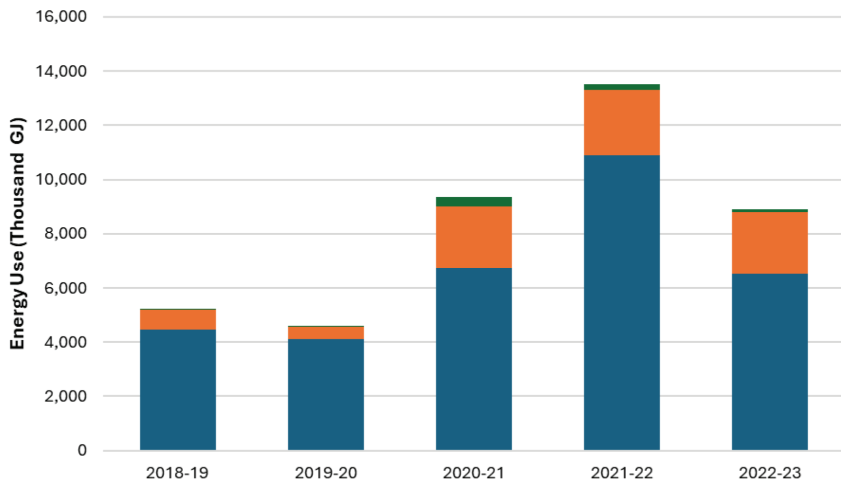


Figure 15: Trend in energy use from stationary fuel consumption in the industrial sector [Inventory Period]

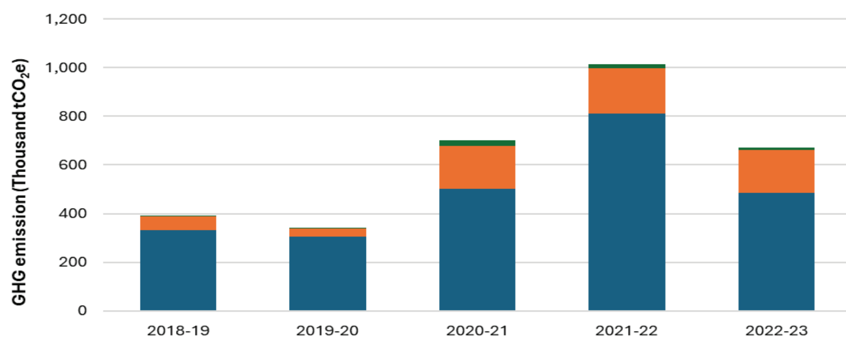


Figure 16: Trend in GHG emissions from stationary fuel consumption in the Industrial Sector [Inventory Period]

3.3.3 GHG Emissions from Transportation

Highlights - Example

GHG emission share by mode [Year]: On-road Transport (89.73%), Aviation (7.25%), Railways and Metro[19] (3.02%)

Trend of GHG Emissions [Inventory Period]: 9.61% increase at 2.4% annually

Table 7: GHG emissions from Transportation [Inventory Period] (Example)

Sub-Sector	GHG Emissions (Million tCO2e)				
2018-19		2019-20	2020-21	2021-22	2022-23
On-road Transportation	4.50	4.54	3.31	3.98	4.89
Railways and Metro	0.02	0.13	0.08	0.13	0.16
Aviation	0.44	0.45	0.21	0.29	0.40
Total	4.97	5.13	3.60	4.39	5.45

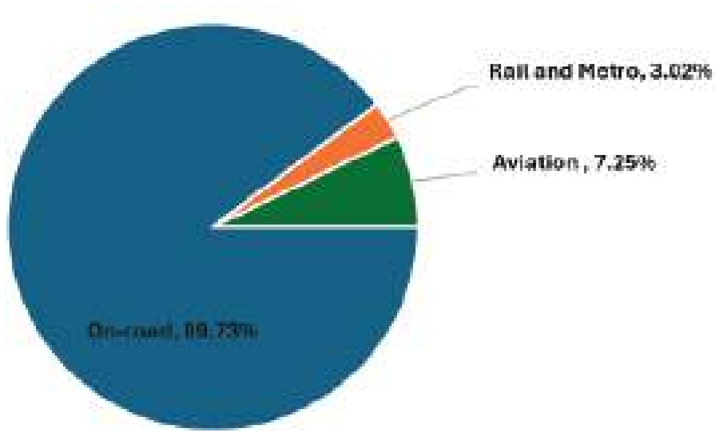


Figure 17: GHG Emissions by Mode of Transport [Year]

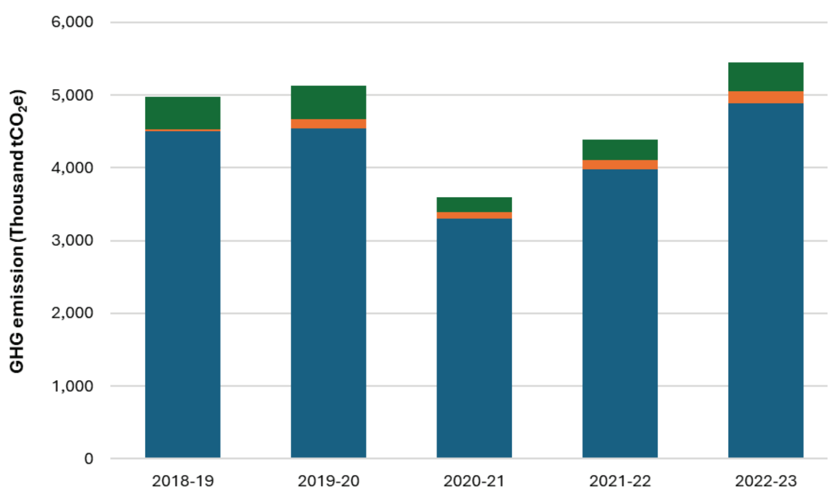


Figure 18: Trend of GHG emissions from Transportation [Inventory Period]

3.3.3.1 GHG Emissions from Fuel Consumption in On-Road Transportation

Highlights - Example

Energy consumption [Year]: 68.1 million GJ

GHG emissions [Year]: 4.88 million tCO2e

Trend of energy consumption [Inventory Period]: 9.14% increase at 2.28% annually

Trend of fuel consumption [Inventory Period]:

- Auto-LPG: 19.55% decline at 4.89% annually
- Petrol: 26.12% increase at 6.53% annually
- Diesel: 4.08% decline at 1.02% annually
- CNG: 199.12% increase at 49.78% annually

Electricity (EV charging stations): 109.05% increase at 36.35% annually

Trend of GHG emissions [Inventory Period]: 8.38% increase at 2.09% annually

[19] In mid-2018-19 TGSPDCL integrated Metro consumption with rail sector.

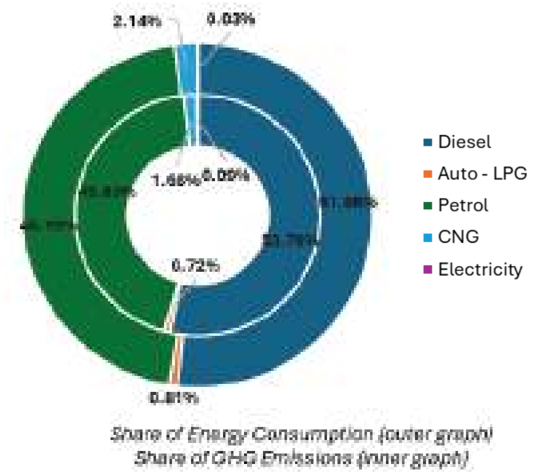


Figure 19: Share of fuels in on-road transportation energy use and GHG emissions [Year]

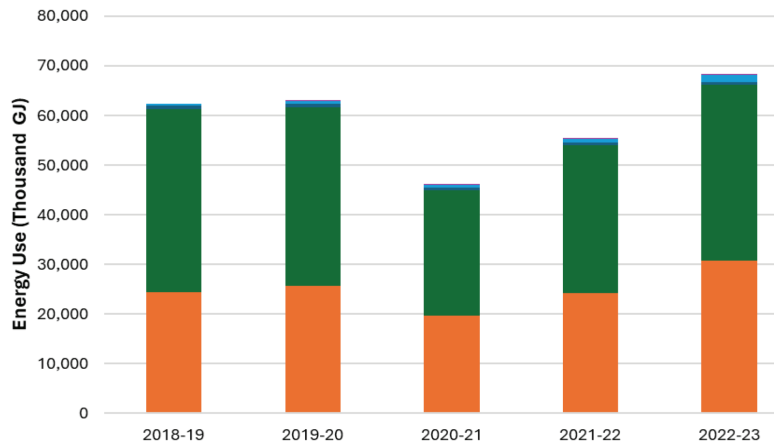


Figure 20: Trend in energy consumption in on-road transportation [Inventory Period]

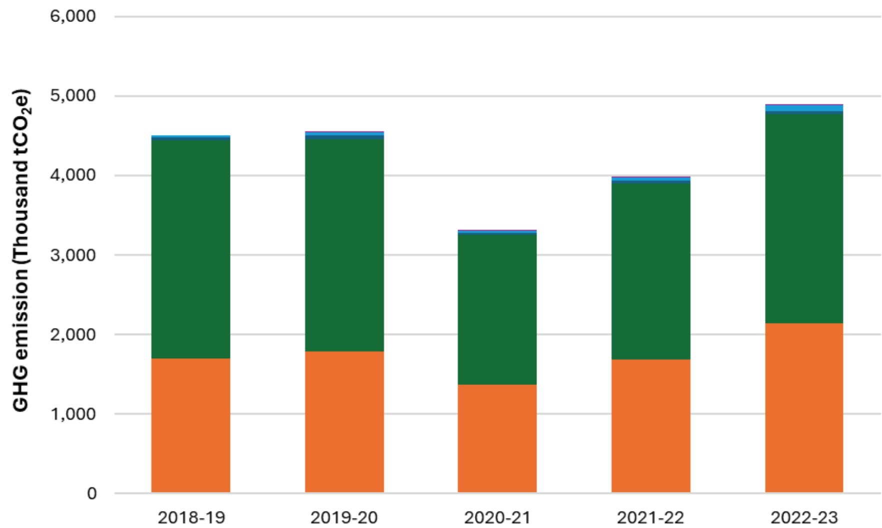


Figure 21: Trend in GHG emissions in on-road transportation [Inventory Period]

3.3.4 GHG Emissions from Waste Sector

Highlights - Example

GHG emissions from waste sector [Year]: 4.12 million tCO2e

Contribution to GHG emissions: Solid Waste (63.16%), Domestic Wastewater (36.84%)

Trend in GHG emissions [Inventory Period]: 11.71% increase, averaging at 2.9% annually

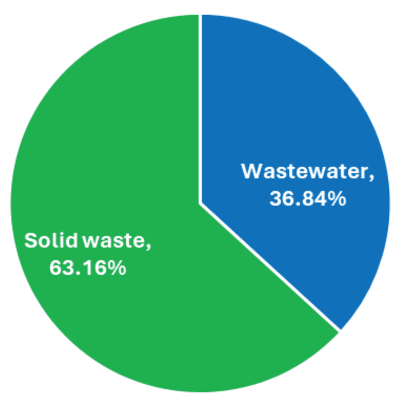


Figure 22: GHG emissions from the waste sector [Year]

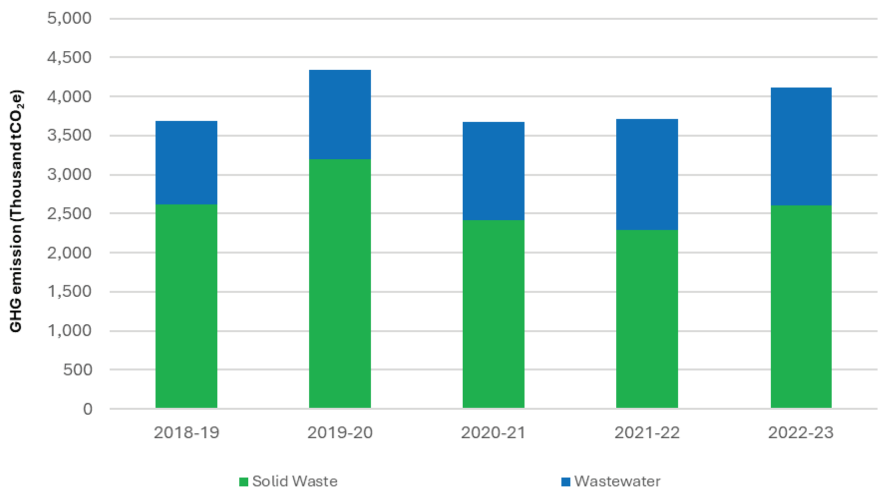


Figure 23: Trend in GHG emissions from waste sector [Inventory Period]

3.3.4.1 GHG Emissions from Solid Waste

Highlights - Example

Waste generation [Year]: 6981 TPD

Waste composition [Year]: Food Waste (52%), Gardens and Parks (4%), Paper & Cardboard (13%), Textiles (3%), Rubber & Leather (2%), Plastic (15%), Metal (0.8%), Glass (0.8%) and Inert (9%)

Waste collection: 100% of generated waste

Waste quantity undergoing processing [Year}:

Composting: 3520 TPD (50.42% of waste generated)

Waste to energy: 1180 TPD (16.9% of waste generated)

RDF: 9.44 TPD (0.14% of waste generated)

Waste collected and not processed [Year]: 1096.56 TPD

Waste disposed at Landfill [Year]: 2272.98 TPD (32.56% of the waste generated)[20]

GHG emissions from solid waste disposal [Year]: 2.18 million tCO2e

GHG emissions from biological treatment of solid waste (composting and bio-methanation) [Year]: 0.22 million tCO2e

GHG emissions in Waste to Energy /Incineration [Year]: 0.2 million tCO2e

GHG emissions trend in solid waste[21] [Year]: 0.63% decrease at 0.16% annually

Methane gas captured at SLF facility: 146.81[22] tons in 2022-23

GHG emissions from solid waste disposal at landfill sites show a variable trend (increasing, then decreasing, then increasing again), as waste generation and processing capacities in the city have gradually increased over time, and source segregation remains limited.

The design capacity of composting treatment facilities has increased from 3300 TPD in 2018-19 to 4400 TPD in 2022-23, while waste-to-energy capacity expanded from 415 TPD in 2020- 21 to 1475 TPD by 2022-23.

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[20] Includes untreated waste, process rejects from various facilities (20% of composting input, 20% of Waste to Energy facility input, 15% of MRF input)

[21] Some amount of GHG emissions generated from processing facilities including composting, bio methanation and waste to energy facilities which are accounted herein. These emissions are lower than GHG emissions that would result from disposal of waste. It is to be noted that waste fractions recovered as RDF are not accounted for as utilization of RDF in co-processing avoids emissions from use of conventional fuel.

[22] Density of Methane at 20° C, 0.667 kg/m^3 (Gautam Dutt, 2003)

GHG emissions from processed waste are lower than emissions from the same amount of waste being disposed of. Increasing waste processing capacity with a proportionally higher volume of process rejects due to mixed waste input, has resulted in a higher quantum of waste being sent to landfill in subsequent years, thereby contributing to GHG emissions.

Overall, GHG emissions decreased by 0.16% per year, from 2018-19 to 2022-23, despite significant improvements in processing facilities. The small decline is attributed to the gap between processing capacity and annual waste generation.

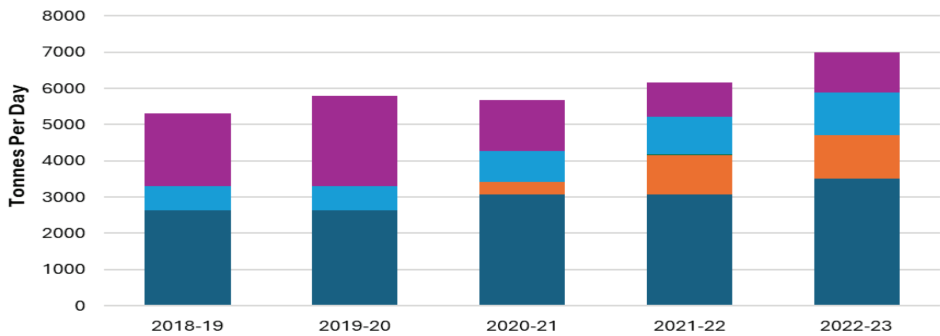

Figure 24: Trends in quantum of waste processed at different processing facilities [Inventory Period]

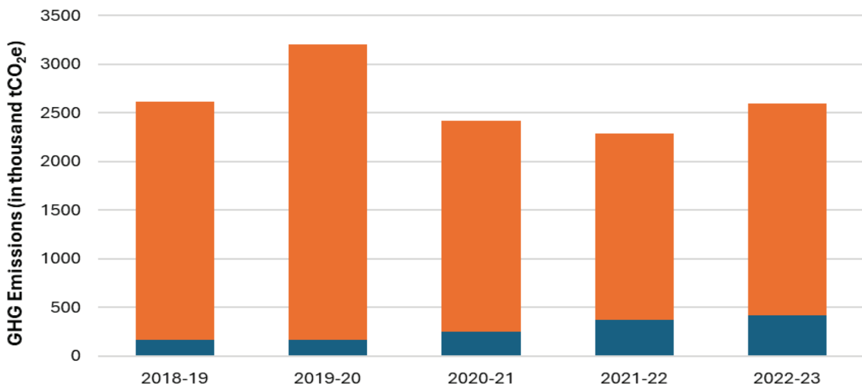

Figure 25: Trend in GHG emissions from the solid waste sector [Inventory Period]

3.3.4.2 GHG Emissions from Wastewater Treatment and Discharge

Highlights - Example

GHG emissions from wastewater [Year}: 1.52 million tCO2e

Trend in GHG emissions [Inventory Period]: 41.91% increase, averaging at 10.48% annually

Predominant contributors to GHG emissions: Wastewater collected in network and undergoing Anaerobic Treatment (61.21%); and Wastewater collected in network and not treated (30.05%); Wastewater collected in network and undergoing Aerobic Treatment (8.68%)

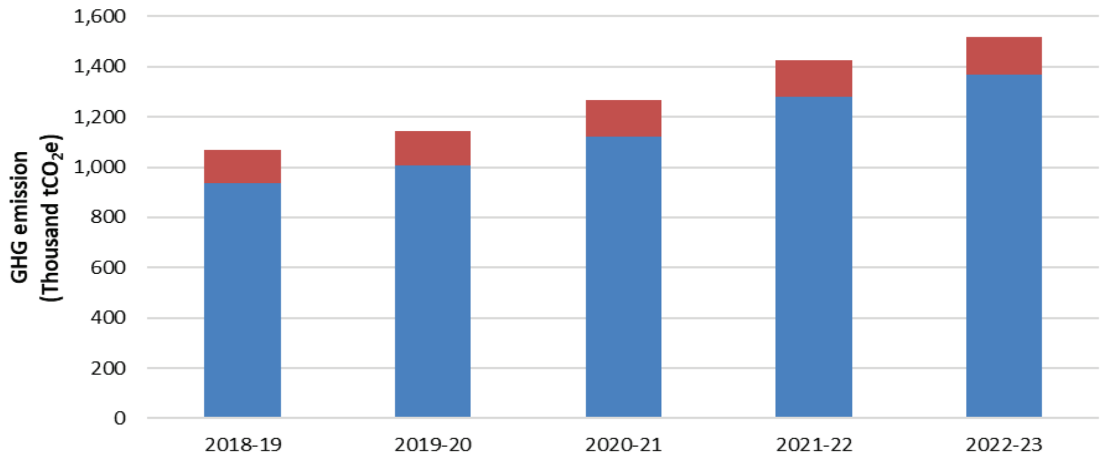

Figure 26: Trend in GHG emissions from wastewater [Inventory Period]

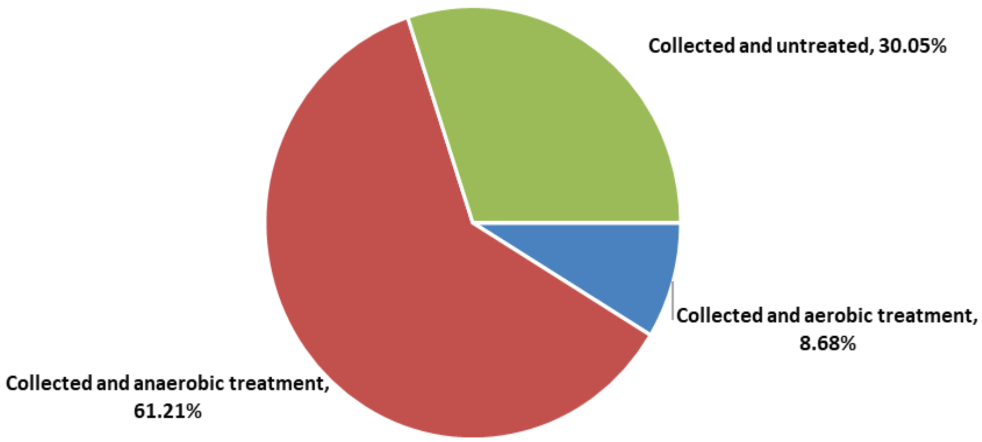

Figure 27: GHG emissions by type of discharge/treatment pathway [Year]

3.3.5 Municipal and Public Services Operations: Energy Consumption and GHG Emissions

Highlights - Example

Predominant electricity consumers: Water Supply (89.11%), Street Lighting (8.49%) and Wastewater Treatment (2.16%)

Trend in electricity consumption [Inventory Period]: 11.76% increase at 2.9% annually

Main contributors to GHG emissions: Water Supply (88.08%), Street Lighting (8.39%) and Wastewater Treatment (2.14%)

Trend in GHG emissions [Inventory Period]: 7.02% increase, averaging 1.75% annually[23]

Proportion of transport sector GHG emissions from overall ULB emissions: 1.15%

The Water Supply sector contributes the highest share of GHG emissions

[23] Overall Municipal services GHG emissions

Table 8: Fuel and Electricity consumption and associated GHG emissions from municipal operations [Year]

Sector	Electricity consumption (Million kWh)	Fuel Consumption (kilo-litres)	GHG Emissions (tCO_2e)
Buildings	3.32	-	2,380.08
Wastewater Treatment	30.24	-	21,651.84
Water Supply	1,244.97	-	8,91,398.52
Street Lighting	118.65	-	84,953.4
Municipal Vehicles (Diesel)	-	4,068	11,601.18
Total	1,397.18	4,068	10,11,985.01

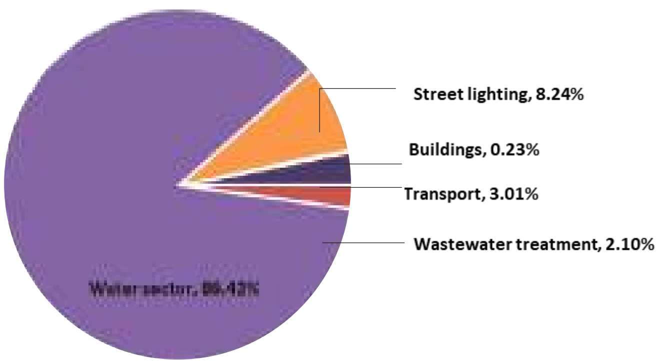

Figure 28: Energy consumption from municipal and public services' operations [Year]

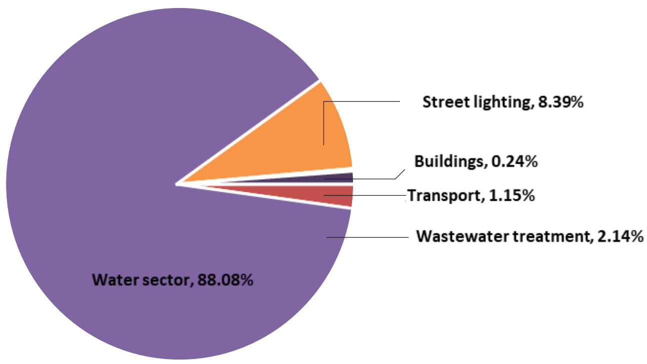

Figure 29: GHG emissions from municipal and public services' operations [Year]

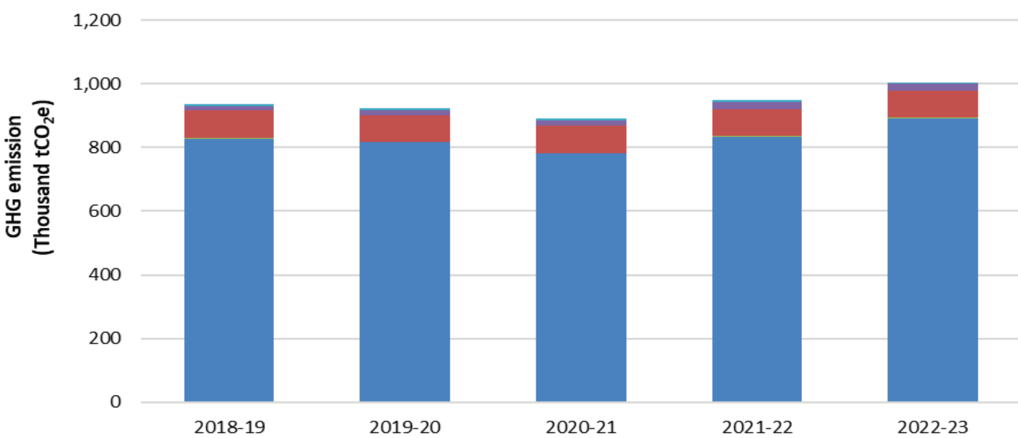

Figure 30: Trend of GHG emissions from municipal and public services' operations [Inventory Period]

Annexure I

Data Gaps and Assumptions

Gaps in available inventory data for the specific period, and assumptions considered for data estimation and calculations, should be included in this annexure.

Annexure II

GPC Reporting Format

The GPC Reporting Format provides a standardized structure for reporting city-level GHG emissions in line with GPC guidelines. Completing this table ensures that emissions are reported consistently across sectors, gases, and scopes, and that the inventory meets international requirements for transparency, completeness, and comparability. The reporting table format is provided below.

GPC ref No.	GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tons CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
I	**STATIONARY ENERGY**				
I.1	Residential buildings				
I.2	Commercial and institutional buildings and facilities				
I.3	Manufacturing industries and construction				
I.4.1/2/3	Energy industries				
I.4.4	Energy generation supplied to the grid				
I.5	Agriculture, forestry, and fishing activities				
I.6	Non-specified sources				
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal				
I.8	Fugitive emissions from oil and natural gas systems				
SUB-TOTAL	(city induced framework only)				
II	**TRANSPORTATION**				
II.1	On-road transportation				
II.2	Railways				
II.3	Waterborne navigation				
II.4	Aviation				
II.5	Off-road transportation				
SUB-TOTAL	(city induced framework only)				
III	**WASTE**				
III.1.1/2	Solid waste generated in the city				
III.2.1/2	Biological waste generated in the city				
III.3.1/2	Incinerated and burned waste generated in the city				
III.4.1/2	Wastewater generated in the city				
III.1.3	Solid waste generated outside the city				
III.2.3	Biological waste generated outside the city				
III.3.3	Incinerated and burned waste generated outside city				
III.4.3	Wastewater generated outside the city				
SUB-TOTAL	(city induced framework only)				
IV	**INDUSTRIAL PROCESSES and PRODUCT USES**				
IV.1	Emissions from industrial processes occurring in the city boundary				
IV.2	Emissions from product use occurring within the city boundary				

GPC ref No.	GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tons CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
SUB-TOTAL	(city induced framework only)				
V	**AGRICULTURE, FORESTRY and OTHER LAND USE**				
V.1	Emissions from livestock				
V.2	Emissions from land				
V.3	Emissions from aggregate sources and non-CO_2 emission sources on land				
SUB-TOTAL	(city induced framework only)				
VI	**OTHER SCOPE 3**				
VI.1	Other Scope 3				
TOTAL	(city induced framework only)				

It is recommended that notation keys be used to report any limitations, exclusions, or variations in emission sources. Detailed guidance on the use of notation keys is provided in **Tool 3.2A: Preparation and Management of GHG Emissions Inventory.**

Annexure III: GCoM - Common Reporting Framework (CRF) Format

Emission Sources and Emission							
Sector	Sub-Sector	Direct (fuel combustion) or Indirect (grid energy) or Other	Total tCO_2e (2024) or Notation Key	Type of Energy/ Source/Activity	Activity data		
					Amount	Unit	Data source
Stationary Energy	Residential	Indirect		Electricity			
		Direct		Stationary Fuel			
	Commercial	Indirect		Electricity			
		Direct		Stationary Fuel			
	Institutional	Indirect		Electricity			
		Direct		Stationary Fuel			
	Industry	Indirect		Electricity			
		Direct		Stationary Fuel			
	Agriculture	Indirect		Electricity			
		Direct		Stationary Fuel			
	Fugitive	Direct		-			
Transport	On-road	Indirect		Electricity			
		Direct		Mobile Fuel			
	Rail	Indirect		Electricity			
		Direct		Fuel Consumption (Diesel)			
	Waterborne	Indirect		Electricity			
		Direct		Mobile Fuel			
	Aviation	Direct		Aviation Fuel			
		Indirect		Landings and Take-Offs			
	Off-road	Indirect		Electricity			
		Direct		Mobile Fuel			
Waste	Solid waste disposal	Direct		Solid Waste Disposal			
	Biological treatment	Direct		Composting/ Biomethanation/Bio-CNG			
	Incineration and open burning	Direct		Incineration and open burning			
	Wastewater	Direct		Not Applicable			
IPPU	Industrial Process			Not Applicable			
	Product Use			Not Applicable			
AFOLU	Livestock			Not Applicable			
	Land Use			Not Applicable			
	Other AFOLU			Not Applicable			

Emission Sources and Emission										
Emissions (CO_2 Gas)			Emissions (CH_4 Gas)			Emissions (N_20 Gas)			Notation keys (if no data to report)	
Amount	Unit	Method	Amount	Unit	Method	Amount	Unit	Method	Notation key	Explanation

Emission Credits																	
Category	Sold or purchased	Total tC_2Oe or Notation Key	Allocation to sector	Sub-category	Date of sale/ purchase	Activity data			Emissions (CO_2 Gas)			Emissions (CH_4 Gas)			Emissions (N_2O Gas)		
						Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source
Offset credits generated in the city	Sold																
Credits purchased from outside	Purchased																
Purchase of certified green electricity	Purchased																

Energy Generation																		
Sector	Inside or outside city boundary (in separate rows)	Total tCO_2e	ETS or non-ETS (in separate rows)	Type of Energy	Activity data			Emissions (CO_2 Gas)			Emissions (CH_4 Gas)			Emissions (N_2O Gas)			Notation keys (if no data to report)	
					Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source	Notation key	Explanation
Electricity-only generation	Inside city boundary																	
	Outside city boundary																	
CHP generation	Inside city boundary																	
	Outside city boundary																	
Heat/cold generation	Inside city boundary																	
	Outside city boundary																	
Local renewable energy generation	N/A																	

It is recommended that notation keys be used to report any limitations, exclusions, or variations in emission sources. Detailed guidance on the use of notation keys is provided in Tool 3.2A: Preparation and Management of GHG Emissions Inventory. For detailed guidance on CRF Reporting, kindly refer here.

Tool 3.2F

GHG Emissions Inventory Verification

This tool helps cities to verify and validate their greenhouse gas (GHG) emissions inventory to ensure it meets globally accepted standards and guidance on carbon accounting. Verification helps cities demonstrate that their inventories are accurate, transparent, complete, and align with international standards, such as the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).

A verified inventory increases stakeholder confidence in the reported emissions, enhances the credibility of the city's climate action plan, and ensures that goals and progress are based on reliable data. Verification also improves the city's ability to compare its climate performance internationally. Detailed guidance on verification of city-level GHG emissions inventories is outlined in the GPC.

Section A

Why Verification Is Important?

Verification is a crucial step in ensuring that a city's GHG emissions inventory is reliable and accurate. As cities increasingly rely on their inventories as an evidence base to establish climate goals and plan for long-term net-zero emissions, and to report to national and global platforms, it is essential to confirm that reported emissions are precise, transparent, and aligned with the GPC standards and requirements.

Verification provides the city with confidence that its GHG emission inventory accurately reflects emission levels, helping it better understand the scientific basis for climate change mitigation strategies and measures, and assess against the baseline established by the inventory.

Additionally, verification helps cities identify areas where they can improve their data systems, assumptions, documentation, or methodologies. Whether conducted internally or by an independent third party, verification encourages continuous improvement in inventory practices and improves the accuracy of future GHG emission estimates.

Section B

What Does Verification Involve?

Verification criteria for a GHG emissions inventory should include the following:

- Determine that accounting principles are adhered to
- Assess the completeness, accuracy, and reliability of reported data
- Determine any material discrepancies between reported data and the data generated through proper application of standards and methodologies
- Determine if reporting requirements have been met
- Verify if the GHG emissions calculations are correct, and that data sources are reliable.

The verification process should also include reviewing broader data management practices, including how data are collected, processed, reviewed, and stored, as outlined in Tool 3.2D: GHG Emissions Inventory Data Collection and Management. Adherence to accounting and reporting principles, along with transparent and well-documented data, forms the basis of successful verification.

Section C

Types of Verification

There are typically two forms of verification:

- **Self/Internal Verification** - conducted internally by staff who are independent of the inventory development team. This helps improve internal systems, identify errors, and strengthen data management, especially in the early years of reporting
- **Third-Party Verification** - carried out by an independent organization with expertise in GHG accounting and familiarity with the global protocols and standards (such as GPC)

Both forms of verification make the inventory much more credible for external stakeholders and public reporting. They follow similar procedures and require clear documentation and an audit trail, as outlined in Section D below.

Cities are encouraged to conduct both self-verification and third-party verification. Self-verification helps ensure compliance, methodological consistency, and the accuracy of calculations, but it does not offer internationally recognized assurance on its own. Third-party verification by independent, external experts provides formal validation of the inventory, improving its credibility, and is crucial if the city intends to use carbon market mechanisms or earn carbon credits.

Section D

Verification Process

Verification is usually an iterative process that includes the following steps:

- **Initial Review** – verifiers check for compliance, identify inconsistencies, and flag elements requiring clarification or correction.
- **Documentation Check** – cities must submit all supporting evidence, such as raw data, assumptions, calculation sheets, and methodology notes. Data sets lacking documented support are not verified.
- **Revision and Clarification** – cities respond to the findings, update calculations if necessary, and resubmit the revised inventory.
- **Final Verification Assessment** – verifiers determine whether the inventory complies with GPC guidelines, principles, and requirements.

If all requirements are met, the city can claim compliance with global protocols, such as the GPC. If significant issues remain unresolved, the city cannot claim compliance. Verification may be carried out during the reporting period (allowing for corrections before finalization) or after the GHG emissions inventory has been completed.

Section E

Using Verification for Continuous Improvement

Cities should consider verification as a process of constant improvement. Even when cities achieve complete compliance, the verification results often provide useful guidance on how to strengthen them through,

- Data collection and management
- Documentation and archiving
- Quality control procedures
- Institutional roles and review systems

Tool 3.3

Preparation of Baseline Synthesis Report

This tool provides guidance on synthesising and consolidating findings from Step 2.1 – Assess country context to Step 3.2 – Develop GHG Emissions Inventory into a Baseline Synthesis Report. The objective of the tool is to bring together, in a structured manner, information on the city profile, gaps in urban systems, climate risks, vulnerabilities, and related greenhouse gas (GHG) emissions from urban systems to support integrated climate action planning. The consolidated findings provide a comprehensive overview and city snapshot, helping urban local bodies (ULBs) identify the most vulnerable and highest-emitting urban systems and prioritise strategies and actions accordingly.

Bringing It All Together

Cities are encouraged to develop the Baseline Synthesis Report that consolidates the findings from Steps 2.1 to 3.2. The report establishes a baseline against which future progress can be assessed and will feed into the Climate Action Planning section. It also helps to inform adaptation and mitigation strategies and actions, decision-making and administrative review.

The report should capture key elements of the country context, city profile, climate commitments, priorities, goals, and policies, institutional arrangements, urban systems assessment, climate fragility and risk assessments, baseline emissions for each urban system in the city, and GHG emissions inventory, among several others, to support climate action planning.

It is important to note that, for certain urban systems, GHG emissions may not be directly estimated or accounted for in the GHG inventory process (Step 3.2) due to the absence of standard methodologies or measurable activity data. For example, emissions from stormwater drainage systems are generally not accounted for in a city's inventory, as most systems are gravity-based and do not involve energy use or direct emission sources. For such urban systems, cities should clearly explain the rationale for not capturing emissions in the synthesis report.

The following steps can be used to compile the Baseline Synthesis Report by aggregating the findings from Step 2.1 through Step 3.2.

Step 1

Identify key elements from the country profile that will facilitate subsequent analysis and the development of the synthesis report.

Step 2

Develop an understanding of the city's political commitment, targets, goals, institutional and technical capability and its readiness for climate action. Identify existing initiatives and targets that can guide the development of climate resilience strategies and actions.

Step 3

Identify key elements from the city profile that will facilitate subsequent analyses and the development of the synthesis report.

Step 4

List the fragile urban systems for the city, such as water, wastewater, transport, energy, and buildings.

Step 5

Present the corresponding climate fragility statements for each urban system, along with findings on exposure and vulnerability of urban actors, infrastructure, and systems. Cities are also encouraged to include hazards, exposure and climate risk hotspot maps.

Step 6

Document the GHG emissions associated with each urban system.

Step 7

Summarise the consolidated findings.

Consolidate findings from Steps 2.1 to 3.2

Assessing the country context in **Step 2.1** will help the cities summarise national climate policies, targets, goals, international commitments, and national regulatory frameworks that support alignment of local net-zero scenarios, policies and targets. By identifying various climate zones, trends, hazards, and vulnerable areas, the tool will establish the broader regional climate context and assist cities in understanding how the country's global engagements and commitments influence its national policies, missions, schemes, and net-zero and climate targets. This process will provide a foundational reference for cities as they formulate their own climate action plans.

In **Step 2.2,** the climate readiness review offers a structured self-assessment of the city's climate ambitions, and administrative, technical, and institutional capacity to lead climate action. It evaluates the city's long-term vision and political commitment, as well as existing and forthcoming climate action initiatives, policies, and programmes. This assessment also examines governance and monitoring frameworks, including how different departments collaborate and the specific roles of each in advancing mitigation, adaptation, and inclusivity goals. It reviews current capabilities, identifies main challenges and opportunities for improvement, and considers available financial resources. These findings help identify the roles of different city actors, clarifying who can prioritise and implement resilience efforts.

Step 2.3 focuses on assessing the local context and the urban systems. In this step, developing a city profile helps gather information on demographic indicators such as population, population density, number of households, and average household size, which are essential for developing a GHG emissions inventory, projecting future emissions and assessing future growth and mitigation scenarios. Land use and zoning indicators facilitate the analysis of urban expansion trends, including changes in built-up areas, permeable surfaces, and blue-green infrastructure. Indicators reflecting the financial health of the urban local body, including municipal budget trends and sectoral investments, support the assessment of ongoing and planned projects and help ensure that proposed adaptation and mitigation actions are aligned with local development priorities and implementation capacities. **Table 1** below presents a template to highlight the key findings from Step 2.3.

Table 1: Summarise Key Points from City Profile – Sample Template

Category	Unit	Data/ Information/ File Name (Please Mention NA for Data that is not Available)	Time Period for Which Data is Available	Use of Indicators in Subsequent Stages
Demographics				
Total population	Number			**Example:** • Population projection • GHG emissions calculation
Sex Ratio	Number			**Example:** Identification of impacted population (CRVA)
Population by age group	Number (by age categories)			
Population distribution (ward/zone/ area-wise)	Persons per sq. km			**Example:** Identification of impacted wards/zones/areas (CRVA)
Number of households	EWS, LIG, MIG, HIG			**Example:** • Population projection • GHG emissions calculation
Average household size	Number			
Population living in slums / informal settlements / EWS housing	Number (gender-wise)			**Example:** Identification of impacted population (CRVA)
Land Use				
Total city area	Sq. km			**Example:** • Population projection • GHG emissions calculation
Zoning/land use	Area by land use category with maps of existing and proposed land use			**Example:** • Identification of impacted areas (CRVA) • Adaptation and mitigation strategies
Change in built-up area	Percentage (%) and sq. km			
Institutional Structure and Municipal Budget				
Number of Zones	Number			**Example:** Identification of impacted wards/zones/areas (CRVA)
Number of Wards	Number			
Baseline Year	Number			**Example:** • Population projection • GHG emissions calculation
Annual Government Operational Budget for the last three years	Number			**Example:** • Identification of critical gaps and issues (Urban Systems Gap Analysis) • Adaptation and mitigation strategies
Annual Expenditure (sector-wise)	Number			

Table 2: Synthesis of Urban Systems Gap Analysis – Sample Template

Urban System	Climate Fragility Statements	Population /Assets Exposed	Gap Analysis	Vulnerable Areas	Supporting Actors
Water Supply	Rising temperatures may increase water demand, placing additional pressure on groundwater resources where the water supply coverage is inadequate.	45% of the city's population is vulnerable to urban heat and has limited access to water	Inadequate service coverage in newly added areas Groundwater overexploitation and contamination from industrial activities Saltwater intrusion into aquifers Increased incidence of waterborne diseases due to water body contamination	Wards 5 and 6	Urban Local Body Private sector Water Authority Resident Welfare Association NGOs
Transport	Increasing temperatures may increase demand for quality public transport; inadequate provision may lead to greater dependence on private vehicles.	44% of the city's population is exposed due to urban heat and limited access to quality public transport	Increasing dependence on private vehicles is causing traffic congestion Increased chances of road accidents, with cyclists and pedestrians being particularly vulnerable Public transport fleet size remains below recommended service levels (recommended: 6 per 1000 people; existing: 0.12 per 1000 people) Insufficient parking facilities and encroachment of road space by vendors	Wards 5, 7, 12, 23 and 27	Urban Local Body Department of Transport State Transport Corporation Development Authority NGOs
Stormwater Management	High-intensity rainfall may increase the incidence of waterlogging, especially in low-lying areas. Unlined drains carrying greywater lead to groundwater contamination. For instance, the soil in the city is highly permeable with high infiltration and percolation rates.	41% of the population is vulnerable to stormwater management issues exacerbated by urban flooding	Encroachment of major and minor drains within the network Increased waterlogging in several areas during heavy rainfall Diversion of wastewater into stormwater drains during heavy rainfall events is an environmental hazard.	Wards 8, 11, 12, 22 and 23	Urban Local Body Drainage Department Public Works Department Urban Development Authority

Urban System	Climate Fragility Statements	Population /Assets Exposed	Gap Analysis	Vulnerable Areas	Supporting Actors
Solid Waste Management	Increased rainfall may clog drains already affected by indiscriminate waste disposal, leading to waterlogging and health risks.	57% of the population is vulnerable due to solid waste management-related issues exacerbated by urban flooding	Increased risk of vector-borne diseases Increased stormwater and sewerage network blockages Increased groundwater contamination by untreated leachate, also leading to unhygienic conditions for workers No segregation of waste at the collection level Non-functional treatment plants resulting in open dumping of waste	Wards 11, 15, 22 and 23	Urban Local Body Residents Slum Dwellers (including people engaged in informal economic activities and ragpickers) Educational Institutions NGOs Tourists
Wastewater Management	Rising temperatures may create favourable conditions for water-polluting bacteria (such as E. coli), increasing health risks.	62% of the total population is vulnerable to wastewater issues exacerbated by urban heat	Groundwater contamination, especially in areas with a high water table Increased incidence of sewage backflow due to blocked/ pressurised sewerage network Increased health and hygiene issues due to the use of contaminated water or backflow of sewage into households Compromised sewerage treatment due to dilution with rainwater	Wards 11, 15, 16, and 24	Urban Local Body Public Works Department Urban Development Authority
Urban Greening and Biodiversity	Increasing frequency and intensity of high-intensity rainfall events may accelerate soil erosion, degrade green spaces and water bodies, and impact the availability of drinking water[1]	Not applicable	Inadequate and uneven spread of green cover, making some areas and wards of the city vulnerable to heat Poor maintenance reducing usability and accessibility of parks and gardens Increased risk of vector-borne diseases during the monsoon season Encroachment of wetlands resulting in habitat loss and increased flood risk Increased runoff resulting from an increase in paved surfaces	Water bodies and green areas of the city	Urban Local Body Urban Development Authority Forest Department, Educational Institutions Local NGOs Welfare Associations Communities

[1] Assessed only in cases such as urban flooding, flooding caused by sea-level rise, drought, extreme rainfall-induced landslides, riverine flooding due to excess rainfall, flooding caused by glacial lake outburst, and/or structural failure.

In Step 2.3, urban systems are assessed through the Urban Systems Gap Analysis (USGA), which offers a structured framework for assessing the performance of critical urban systems and evaluating service delivery levels across sectors such as water supply, wastewater management, stormwater management, solid waste management, transportation, urban greening and biodiversity, fire and emergency services, health, the built environment, and energy. The analysis is based on data collected through sector-specific templates completed by the ULB, complemented by a review of grievance redressal records, departmental consultations, and other relevant sources. This process helps identify service delivery gaps, vulnerable wards and localities, infrastructure deficiencies, and sector-specific challenges affecting urban resilience and sustainability.

The findings generated through the USGA provide a critical evidence base for subsequent stages of the Net-Zero Climate Resilient Cities (CRC) methodology. In particular, they inform the Climate Risk Assessment, GHG emissions projections, the identification and prioritisation of climate resilience interventions, and their integration into the city's local plans and schemes. This helps ensure that the proposed interventions are responsive to local needs, vulnerabilities, and development priorities. **Table 2** provides a template for summarising the key findings, gaps, and opportunities identified during the USGA.

In Step 3.1, the climate risks faced by the city, its urban systems and population groups are assessed. The process begins with an assessment of historical climate trends and extreme weather events affecting the city. Historical data on key climate variables, including air temperature, precipitation, relative humidity, and sea-level rise (where applicable), are collected from relevant meteorological and scientific agencies to analyse long-term climatic changes and emerging trends. The assessment enables cities to understand how local climate conditions have evolved over the past decades, identify the frequency and intensity of climate-related hazards, and recognise patterns that may indicate increasing climate risks in the future. These insights provide a critical evidence base for understanding the city's climate vulnerabilities and resilience needs. The findings from the assessment help ensure that the proposed interventions are informed by observed climate trends and projected future risks. **Table 3** provides a template for summarising the findings from the assessment of climate trends, historical events, climate projections and scenarios.

After assessing the climate trends, projections and climate change scenarios, the climate risk assessment (CRA) is undertaken to develop an analytical foundation for identifying, quantifying, and prioritising climate-related risks across urban systems and city populations. By integrating climate hazard information with spatial and vulnerability analyses, the CRA enables cities to evaluate the exposure, sensitivity, and adaptive capacity of different sectors, communities, and geographic areas, thereby developing a comprehensive understanding of the nature and magnitude of climate risks. The assessment helps identify climate risk hotspots, vulnerable populations, and critical urban systems requiring priority attention. The findings also facilitate the prioritisation of climate resilience actions and the mainstreaming of climate risk considerations into urban planning, policies and projects. This ensures that adaptation and mitigation interventions are targeted, evidence-based, and aligned with local needs, vulnerabilities, and national climate adaptation objectives. **Table 4** provides a template for summarising the findings from the Climate Risk Assessment.

Table 3: Summary of Climate Trends and Projections – Sample Template

Changing Climate Condition	Assessments	Projected Change (include baseline and planning horizon years)	Level of Confidence	Source(s)
Change in Maximum Temperature	Local Assessment	*Increase by 0.3°C*	*High*	*Analysis of 50 years of Indian Meteorological (IMD) Department data, Government of India (GoI), for the urban local body (ULB)*
Change in Average Temperature	Local Assessment	*Increase by 0.75°C*	*High*	*Analysis of 50 years of IMD data for the ULB*
Change in Minimum Temperature	Local Assessment	*Increase by 1.3°C*	*High*	*Analysis of 50 years of IMD data for the ULB*
Change in Number of Hot Days	Regional Assessment	*Increase by 12 to 18 days*	*High*	*Analysis conducted under the State Action Plan on Climate Change (SAPCC) using IMD data*
Change in Number of Hot Nights	Regional Assessment	*Increase by 18 to 24 nights*	*High*	*Analysis conducted under SAPCC using IMD data*
Change in Number of Cold Days	Regional Assessment	*Decrease by 0 to 4 days*	*High*	*Analysis conducted under SAPCC using IMD data*
Change in Number of Cold Nights	Regional Assessment	*Decrease by 8 to 12 nights*	*High*	*Analysis conducted under SAPCC using IMD data*
Change in Heatwave Events	Regional Assessment	*Increase by 4 heatwave events per year*	*High*	*Analysis conducted under SAPCC using IMD data*
Change in Precipitation	Local Assessment	*Increase by 100 mm to 200 mm*	*High*	*Analysis of 50 years of IMD data for the ULB*
Extreme Rainfall Events	Regional Assessment	*Increase by 3 to 4 events*	*High*	*Analysis conducted under SAPCC using IMD data*
Change in Extreme Wet Events	Regional Assessment	*Increase by 1 to 2 events*	*High*	*Analysis conducted under SAPCC using IMD data*

Table 4: Summary of Areas and Population Impacted by Climate Risks and Fragile Urban Systems – Sample Template

Criticality	Critical Ward/ Area Name	Fragile Urban Systems	Climate Risk Level	Population Impacted	Population Impacted with Respect to the Total Population (%)	Slum Population Impacted	Slum Population Impacted with Respect to the Total Slum Population (%)
Extreme *(Critical wards with four or more fragile urban systems)*	*Ward 06*	• Water Supply • Wastewater • Stormwater • Transport • Solid Waste Management	Low / Moderate / High / Extreme	1,338,154	18.63%	254,848	30.56%
	Ward 12	• Water Supply • Wastewater • Stormwater • Transport • Solid Waste Management • Health	Low / Moderate / High / Extreme				
	Ward 15	• Water Supply • Wastewater • Stormwater • Transport • Health	Low / Moderate / High / Extreme				
	Ward 18	• Water Supply • Wastewater • Stormwater • Transport • Solid Waste Management • Health	Low / Moderate / High / Extreme				
	Ward 29	• Water Supply • Wastewater • Transport • Solid Waste Management • Health	Low / Moderate / High / Extreme				
	Ward 37	• Water Supply • Wastewater • Stormwater • Transport • Solid Waste Management • Health	Low / Moderate / High / Extreme				

Criticality	Critical Ward/ Area Name	Fragile Urban Systems	Climate Risk Level	Population Impacted	Population Impacted with Respect to the Total Population (%)	Slum Population Impacted	Slum Population Impacted with Respect to the Total Slum Population (%)
High *(Critical wards with three fragile urban systems)*	Ward 09	• Wastewater • Stormwater • Transport • Solid Waste Management	Low / Moderate / High / Extreme	2,820,902	39.28%	246,317	29.31%
	Ward 16	• Water Supply • Wastewater • Stormwater • Solid Waste Management	Low / Moderate / High / Extreme				
	Ward 17	• Water Supply • Wastewater • Solid Waste Management • Health	Low / Moderate / High / Extreme				
	Ward 24	• Water Supply • Stormwater • Health	Low / Moderate / High / Extreme				
	Ward 31	• Wastewater • Solid Waste Management • Health	Low / Moderate / High / Extreme				
Moderate *(Critical wards with one or two fragile urban systems)*	Ward 03	Stormwater	Low / Moderate / High / Extreme	1,354,819	18.86%	150,836	17.95%
	Ward 19	Stormwater Solid Waste Management	Low / Moderate / High / Extreme				
	Ward 36	Water Supply Solid Waste Management	Low / Moderate / High / Extreme				
	Ward 38	Solid Waste Management Health	*Low / Moderate / High / Extreme*				
Low *(Wards without urban fragile systems)*	Ward 02		*Low / Moderate / High / Extreme*	*1,667,898*	23.22%	186,501	22.19%
	Ward 14		Low / Moderate / High / Extreme				
	Ward 22		Low / Moderate / High / Extreme				
	Ward 34		Low / Moderate / High / Extreme				

In Step 3.2, cities establish a transparent and consistent framework for preparing, managing, analysing, and reporting community-wide GHG emissions inventories. This enables them to quantify baseline GHG emissions, trends, identify major emission sources and contributing sectors, and develop an evidence base for climate action planning. The resulting inventory serves as a key input for subsequent stages of the Net-Zero Climate Resilient Cities (CRC) methodology, including GHG emissions projection, GHG emissions-reduction scenario planning, and mitigation-target setting. By highlighting sectoral emission trends and key drivers, it also supports the evaluation of mitigation opportunities and the development of emission-reduction targets and climate resilience actions. **Table 5** provides a template for summarising the findings from Step 3.2.

Table 5: Summary of the Community and Municipal GHG Emissions Inventory – Sample Template

Community Sector / Data Type	Baseline / Previous Five Years for Trends	Highlights
Total Energy Consumption	*2021-22*	*98.5 million GJ*
Per Capita Energy Consumption	*2021-22*	*13.73 GJ*
Total GHG Emissions	*2021-22*	*15.09 million tCO_2e*
Per Capita GHG Emissions	*2021-22*	*2.1 tCO_2e*
Sectoral Share for Energy Consumption in the city	*2021-22*	*Transport (35%), Manufacturing Industry & Construction (33%), Residential Buildings (24%) and Commercial and Institutional Buildings/Facilities (8%)*
Trend of Energy Consumption in the city for the past five years	*2017-18 to 2021-22*	*13.4% increase at 2.7% annually*
Sectoral Share for GHG Emissions in the city	*2021-22*	*Manufacturing Industry & Construction (45%), Residential Buildings (24%), Transport (16%), Commercial and Institutional Buildings/Facilities (11%) and Waste (4%)*
Trend of GHG Emissions in the city for the past five years	*2017-18 to 2021-22*	*13.4% increase at 2.7% annually*

Municipal Sector / Data Type	Baseline / Previous Five Years for Trends	Highlights
Sectoral Share for Municipal Energy Consumption	*2021-22*	*Water Supply (60%), Wastewater Treatment (17%), Streetlighting (13%), Buildings (8%) and Municipal Vehicle Fleet (2%)*
Trend of Municipal Energy Consumption for the past five years	*2017-18 to 2021-22*	*11.2% increase at 2.2% annually*
Sectoral Share for Municipal GHG Emissions	*2021-22*	*Water Supply (57%), Wastewater Treatment (16%), Streetlighting (12%), Buildings (8%) and Municipal Vehicle Fleet (5%)*
Trend of Municipal GHG Emissions for the past five years	*2017-18 to 2021-22*	*9.9% increase at 1.99% annually*

GHG Emissions Projections

Tool 4.1A

This guidance tool is designed to help cities estimate future greenhouse gas (GHG) emissions under a Business-as-Usual (BAU) scenario, guiding them through estimating future activity data, selecting the appropriate modelling approach, and estimating expected BAU emissions.

The BAU projection of GHG emissions supports long-term climate planning by outlining the expected level of emissions if current practices continue and no emission reduction efforts are implemented. It provides a baseline condition that helps determine the scale of effort required to shift to net-zero or low-carbon development trajectories with much lower levels of GHG emissions.

The starting point for forecasting future GHG emissions is the city's base-year GHG emissions inventory. Modelling GHG emission scenarios of a city to forecast future emissions typically relies on population and economic growth factors, along with other locally relevant sector-specific drivers of activity.

By utilizing structured approaches, cities can: i) identify a clear baseline trajectory for GHG emissions and assess where emissions are headed without additional mitigation efforts; ii) identify which sectors and activities are driving future GHG emissions; and iii) develop alternative GHG emission scenarios with a mix of future emission reduction strategies under different development pathways such as net-zero, ambitious or progressive action pathways, and compare the potential GHG emission reductions that can be achieved under different pathways.

SECTION A

Understanding BAU GHG Emissions

The BAU emissions projection represents the city's expected level of future GHG emissions if existing practices continue and no additional policies, programs, or actions to reduce GHG emissions are introduced. It reflects the "status quo" of development, in which existing infrastructure, technologies, and behaviors remain stable without substantial change.

This projection provides decision-makers with insights into demographic and economic growth trends that will influence future GHG emissions and helps identify the interventions and actions needed to reduce emissions relative to the BAU trajectory.

ICLEI's BAU Projections Planning Tool can support cities in BAU forecasting. It uses a combination of the Intergovernmental Panel on Climate Change (IPCC)'s Shared Socio-economic Pathways (SSPs) (which chart out different scenarios for future GHG emission projections based on population, economy, technology, lifestyle, and policies) and projections of future urban utility service demand to estimate BAU emissions.

Figure 1 illustrates the estimated trend in BAU GHG emissions for future timeframes based on current emission levels.

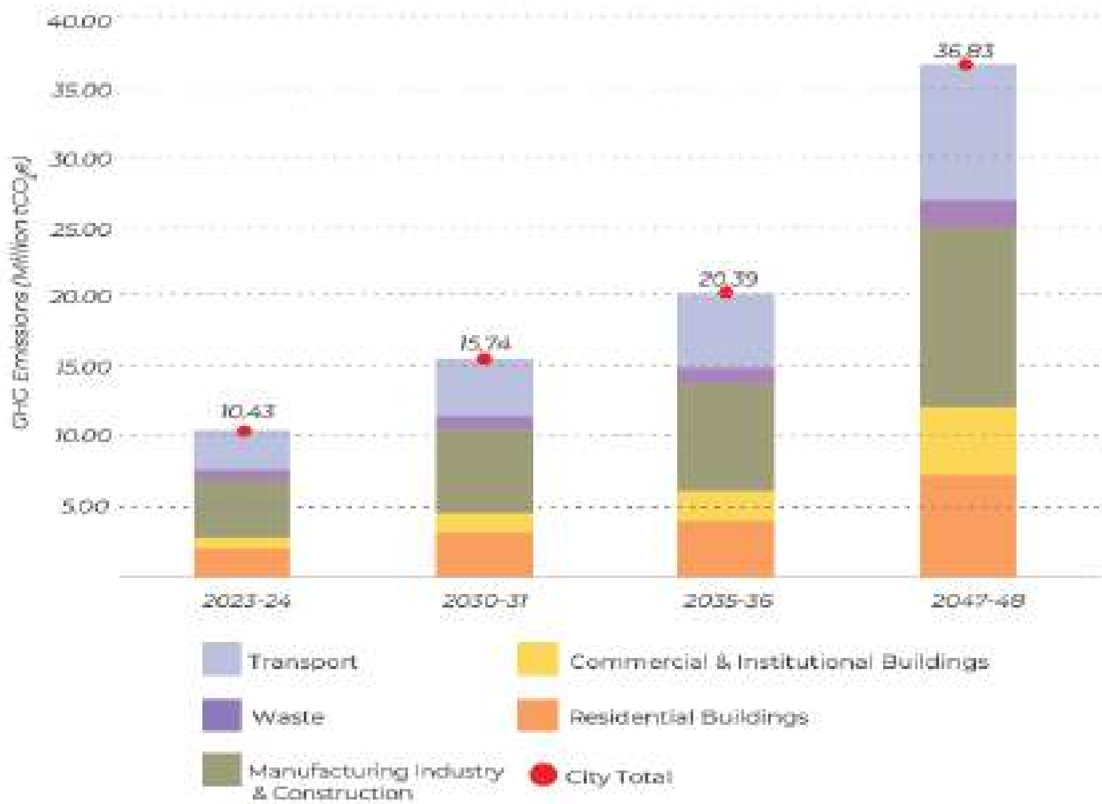

Figure 1: Illustrative depiction of BAU Emissions Projection Trend

SECTION B

Steps for Developing BAU Emissions Projections

Estimating BAU emissions projections is a step-by-step modelling process that ensures transparency, consistency, and replicability.

Step 1

Establish a Base Year GHG Emissions Inventory

The process begins with a complete and reliable base-year GHG emissions inventory. This includes accounting for city-wide GHG emissions from stationary energy, transport, and waste. The GHG emissions baseline anchors activity and emission trends to a specific reference year and provides the foundation for all future emissions projections. The guidance for developing, managing, and reporting a GHG emissions inventory is available in **Tools 3.1A to 3.1E.**

Step 2

Define the Drivers of Future Activity

Cities should identify long-term drivers of sector-specific activity that lead to GHG emissions. These drivers can typically include:

- Population growth
- Economic growth (real gross domestic product (GDP) at constant prices)
- Other locally relevant factors such as urban expansion and service delivery requirements

These drivers form the basis for projecting future activity data over the target timeframe (e.g., from baseline year 2024 to end-target year 2050).

Step 3

Select the Population and Urbanisation Pathway or Trajectory

The process begins with a complete and reliable base-year GHG emissions inventory. This includes accounting for city-wide GHG emissions from stationary energy, transport, and waste. The GHG emissions baseline anchors activity and emission trends to a specific reference year and provides the foundation for all future emissions projections. The guidance for developing, managing, and reporting a GHG emissions inventory is available in **Tools 3.1A to 3.1E.**

BAU emissions projections are usually based on long-term assumptions about the city's population and economic/GDP growth.

For population and economic growth assumptions, the tool uses the population projection method used in the IPCC Sixth Assessment Report's Shared Socioeconomic Pathways (SSP) methodology. SSPs integrate demographic change, economic development, technological progress, policy direction, and resource use.

What are Shared Socioeconomic Pathways (SSPs)

The 2000 Special Report on Emissions Scenarios (SRES) was the first attempt to identify future climate change possibilities based on GHG emissions. It became less relevant due to societal and economic changes. Two branches emerged:

i. Representative Concentration Pathways (RCPs), which analyzed GHG concentrations under four scenarios, and

ii. Shared Socioeconomic Pathways (SSPs), which examined societal and economic transformations under five scenarios.

The scientific community, particularly the IPCC, prefers SSPs over RCPs, as SSPs offer a more comprehensive and integrated framework for climate analysis that includes both socio-economic factors and GHG concentrations, while RCPs focus solely on the latter.

The SSPs approach the concept of sustainability from the perspective of rate of urbanization and economic growth, both of which are dependent upon several interdependent factors such as the rate of industrialization, education levels, birth and death rates, life expectancy, migration, technological innovation, socio-economic policy and reforms, human resource development, food-water-energy nexus, health investments, access to health facilities, water and sanitation, gender equality, equity, social cohesion, societal participation and lifestyle changes. These factors and their interdependencies are segregated across countries based on their income and fertility levels as defined by the World Bank, namely, high-income countries, middle-income countries and low-income countries, which have varying levels of fertility (Jones & O'Neill, 2016).

These factors form the basis of five different SSP scenarios:

i. SSP1: Sustainability - Gradual shift towards inclusive and environmentally conscious development, with improved global cooperation

ii. SSP2: Middle of the road - Continuation of historical trends with slow progress towards sustainable development and some environmental improvements

iii. SSP3: Regional rivalry - Focus on regional energy and food security, increased authoritarianism, and regulated economies

iv. SSP4: Inequality - Growing human capital, economic opportunity, and political power disparities increase inequalities

v. SSP5: Fossil-fueled development - Emphasis on economic and social progress coupled with intensive fossil fuel use and resource-intensive lifestyles

Contextualizing SSPs for Cities

While SSPs provide detail at national and global scales, the information on these pathways is not readily available at the local or regional levels. To address this gap, the SSP methodology needs to be contextualized for cities. This exercise rests on the premise that the quantum of emissions is closely linked to the pace of urbanization. In turn, urbanization has a direct and positive relationship with population growth rate and economic growth rate, represented by the growth of GDP at constant prices, i.e., real GDP.

The urbanization and population growth rates in the SSP scenarios, provided by IPCC at the country scale, often have an inverse relationship. However, when contextualizing it to the city scale, it is essential to acknowledge that the term "urbanization" inherently implies *growth in urban centers in geographic area and population*, driven by shifts in *economic activity*. Consequently, it has been assumed that *higher urbanization corresponds to higher population and economic growth*. Thus, the population and economic growth rate projections can be derived by adapting the methodologies of UN's World Urbanization Prospects (WUP), IPCC endorsed SSPs, and Global Cities Institute at the University of Ontario Institute of Technology to arrive at three emission forecasting scenarios that correspond to the rapid rate of urbanization (Scenario 1), moderate rate of urbanization (Scenario 2) and slow rate of urbanization (Scenario 3).

For scenario planning, cities are required to project population for the selected planning horizon (e.g., 2024 to 2050) using SSP-informed growth trajectories. Cities can choose the path (rapid, moderate, or slow) best suited to their own urban development context or examine a variety of growth trajectories to determine whether a particular outcome is possible.

Economic Projections

After completing the population projections, the next step is to develop economic projections to estimate future economic growth, expressed as real GDP growth at constant prices. It is recommended that the most appropriate localised GDP data or projections (city, metropolitan, or district) be used to estimate city-level economic growth. In case city-level GDP projections are not available, the city's economic growth can be modelled as a function of state and national GDP trends. In such cases, the state's real GDP is treated as the dependent variable, and the country's real GDP is used as the independent variable. Using a linear regression equation supported by time-series analysis, real GDP growth can then be projected and applied to estimate city-level economic growth. These projections are then categorized into mean growth rates for use in estimating sectoral activity growth and, subsequently, BAU emissions.

Step 4

Estimating Growth Factors

The next step in developing BAU emission projections is to estimate growth factors for each sector. Growth factors determine how activity levels and resulting future GHG emissions will evolve over time and can be developed through three approaches, depending on the sector characteristics and the city's development context.

1. Composite Growth Factors:

For community-wide activities in sectors such as transportation, residential, commercial and industrial sectors, activity data such as electricity and fuel consumption are projected using a composite growth factor that reflects both population and GDP growth. Within each sector, weightings are assigned to both population and economic growth factors based on their level of influence or impact on sectoral activity and emissions. The weighted average of these composite growth factors is then used to estimate sectoral growth rates for GHG emissions over the forecasting period. **Table 1** below shows an example of composite growth factors estimated for each sector based on population and economic growth factors.

Table 1:

Type	2024-2030	2031-2040	2041-2050
Economic Growth Rate	**3.40%**	**2.53%**	**2.29%**
Population Growth Rate	**3.96%**	**3.55%**	**2.73%**

Annual Average Growth Rate						
Sector / Sub-Sector	**Growth Factor**	**Weightage of Population Growth Factor**	**Weightage of Economic Growth Factor**	**2024 - 2030**	**2031 - 2040**	**2041 - 2050**
Residential Buildings	Composite	75%	25%	3.82%	3.30%	2.62%
Commercial Buildings	Composite	25%	75%	3.54%	2.79%	2.40%
Industrial Buildings	Composite	25%	75%	3.54%	2.79%	2.40%

2. Service Demand Assessment for Future Years:

For urban services and utilities such as water supply, solid waste, and domestic wastewater, a service demand-based approach can be used for future projections. This approach assumes that anticipated population changes will be the primary driver of future requirements for urban utility services. It estimates the demand for urban utility services (e.g., million litres of water supply, tonne of solid waste generated) based on population growth factor and applies appropriate service metrics (e.g., per capita water requirement, per capita waste generation) to the projected population. Based on the estimates of service demand, the anticipated energy consumption and GHG emissions related to the service (e.g., total electricity consumption to supply the future quantum of water, GHG emissions from the future volume of wastewater generated and treated) are in turn calculated to arrive at BAU GHG emissions for urban services and utilities.

Table 2: Service Demand Projection – Example

Projection Year	Projected Population	Water Supply Projections						
	Moderate	Network Coverage (%)	NRW (%)	Water Supply (LPCD)	Water Supply (MLD) (LPCD * Population)	Sanctioned Water Supply Quota (MLD) - if applicable	Gap (MLD) if applicable	
2023	**78,77,642**	94%	19%	166	1,555	NA	-	
2024	82,67,472	94%	19%	166	1,632	NA	-	
2025	86,75,103	94%	19%	166	1,712	NA	-	
2026	91,02,836	94%	19%	166	1,797	NA	-	
2027	95,51,662	94%	19%	166	1,885	NA	-	

Water Supply Projections						
Required Per Capita Water Supply (LPCD)	Projected Water Demand (MLD)	Projected Water Demand for Domestic Sector	Specific Electricity Demand -Water Supply (Million kWh / Water Supply)	Electricity Consumption for Water Supply (Million kWh)	Specific Fuel (Diesel) Demand - Actual Water Supply (Million kWh/ Water Supply)	Fuel Consumption (Diesel) for Water Supply (kL)
165.85	1,554.8	1,078.1	0.10	154.76	0.64	1,000.0
165.85	1,631.7	1,131.4	0.10	162.42	0.64	1,049.5
165.85	1,712.2	1,187.2	0.10	170.43	0.64	1,101.2
165.85	1,796.6	1,245.7	0.10	178.83	0.64	1,155.5
165.85	1,885.2	1,307.1	0.10	187.65	0.64	1,212.5

3. Custom Growth Factors:

Custom growth factors are applied where composite growth factors may not accurately represent future trends. These factors reflect local plans, sector-specific changes, or patterns observed in the baseline inventory. For instance, if a city expects limited industrial growth due to zoning changes and regulations, a lower custom growth factor (based on baseline energy use/emissions) can be used.

Step 5

Projecting Activity Data and Estimating BAU Emissions

Once the growth factors have been established, the next step is to project future activity data for each sector. This is done by applying the relevant growth factor to the most recent activity data available:

Projected activity data(year x)=Last reported activity data x Composite/Custom/Service—Demand Growth Factor

These projections reflect how energy consumption, transport activity, waste generation, and demand for urban services are expected to change over time based on population and economic growth. After projecting the activity data, BAU emissions are estimated by multiplying the projected activity levels by the emission factors used in the baseline GHG emissions inventory:

Projected BAU Emissions= Projected Activity Data x Baseline Emission Factor.

Baseline emission factors can be kept constant across all future years to ensure that the BAU trajectory remains consistent with the baseline inventory. This allows cities to compare future emissions directly with the baseline year; calculate mitigation impacts relative to a stable and transparent reference; and assess how far current practices will drive emissions in the absence of new policies.

Table 3: Activity Data and Emissions Projections based on Composite/Custom Growth Factor

Sectors	Energy Source/ Activity	Baseline Emissions (tCO_2e)		Growth Rate (Decadal AAGR) (%)	Projected Activity Data (Activity Data in Previous Year * AAGR)		Emission Factor	Projected Emissions (tCO_2e)	
		Unit	2023-24		2024-25	2025-26		2024-25	2025-26
Commercial Buildings	Electricity	Million Units (MU)	753.1	9.1%	821.4	895.9	727 (tCO_2e/ MU)	5,97,179.7	6,51,373.3
Transport	Petrol	kilo-liters (kL)	4,07,181	6.27%	4,32,717.7	4,59,855.9	2.29 (tCO_2e/kL)	9,94,109.2	10,56,455.5

SECTION C

Applying BAU Results in Climate Action Planning

BAU emissions projections are a critical part of long-term climate planning. They form the reference trajectory against which all climate strategies and GHG emissions-reduction impacts are assessed.

BAU emissions projections help cities:

1. Understand long-term risks of high-emission growth
2. Prioritize high-emitting sectors/sub-sectors
3. Communicate the implications of inaction and the benefits of climate measures

The BAU emissions projections are to be used to develop future mitigation scenarios (refer to **Tool 4.1B: GHG Emissions Reduction Scenario Planning**), with the BAU emission outputs feeding directly into the calculations for those scenarios.

Tool

4.1B

GHG Emissions Reduction Scenario Planning

This tool provides guidance for designing long-term greenhouse gas (GHG) emission-reduction pathways and establishing a net-zero scenario or trajectory for cities and local governments. aims to help cities understand how evidence-based actions, policies, technologies, and investments can shape their emissions profile over time.

Tool 4.1: GHG Emission Forecasting provides guidance on estimating future Business-as-Usual (BAU) emissions, assuming no significant additional emission-reduction interventions are undertaken. This tool enables cities to model city-wide GHG emissions and understand how they can be reduced compared to the forecasted BAU trend through different combinations and scales of interventions or measures.

This tool provides guidance to cities on identifying sector-wise GHG emission reduction opportunities, defining future activity levels under targeted interventions (e.g., renewable energy-generated electricity, trips made using electric vehicles or EVs), and calculating the corresponding GHG emission reductions. The tool also enables cities to compare multiple modeled future scenarios and determine the timeline, scale, and combination of interventions required to transition from current emissions pathways towards a net-zero emissions future.

ICLEI's Net-zero GHG Emissions Tool supports cities in modelling different scenarios and estimating GHG emission reductions across sectoral climate actions. It contains sectoral actions, technology options, and associated emission reduction potential metrics that cities can adopt or adapt. This tool also aligns with the target-setting process described in Tool 4.2C: Target setting for climate resilience interventions, enabling cities to set city-wide mitigation targets and determine corresponding quantified GHG emissions reduction potential.

SECTION A

What does Scenario Planning mean for local climate action planning?

Scenarios refer to packages of potential climate strategies and interventions. Scenario planning is a structured approach to assessing how different levels of climate action can influence future GHG emissions. It helps cities compare the impact of policy choices, technology adoption, infrastructure investment, and behavioral change in an informed manner.

Scenario planning enables cities to develop evidence-based targets and strategies for GHG emissions reduction and supports decision-making by ensuring that the most significant emission sources are prioritized. Cities can develop multiple scenarios to explore and compare the impact of different strategy choices. Scenarios are developed based on the city's base-year GHG emission inventory and other relevant data and information.

Cities can model multiple GHG emission reduction scenarios based on local context and climate ambitions. However, it is recommended that cities model at least two scenarios, as described below, that reflect increasingly ambitious levels of climate action, in addition to the projected BAU emissions trajectory.

Progressive Action Scenario – represents the level of GHG emissions resulting from increased levels of climate action being implemented at the city scale compared to the BAU scenario. It considers national and state government policies and programs, while reflecting local conditions, current status, and levels of adoption of solutions, resources, and capacities.

Net-zero Pathway Scenario – represents a higher level of ambition, building on the Progressive Action Scenario to further reduce emissions and close the remaining gap to move towards a net-zero emission pathway. It involves identifying additional strategies and targets that go beyond existing measures, scaling up current actions, and addressing uncovered emission sources.

These scenarios help determine the combination and scale of action required across sectors, the potential mitigation impact, and the cumulative emissions reductions achievable by the target year. Cities can explore additional emission reduction scenarios as required, to asses strategy impacts and identify actions required for higher ambition based on local priorities, policy commitments, sectoral strategies, and target timelines.

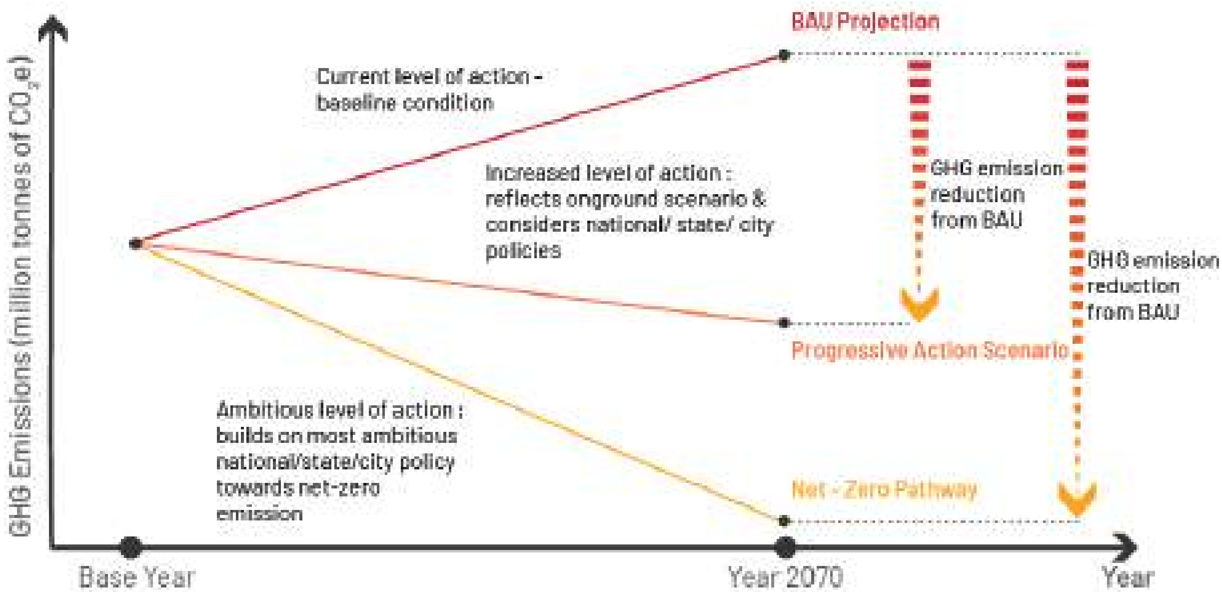

Figure 1: Illustrative depiction of Progressive Action Scenario and Net-Zero Pathway compared to the BAU Emission Projection

SECTION B

Carrying Out Scenario Planning

GHG emission mitigation scenarios are developed using a combination of information and data from the baseline GHG emissions inventory, BAU projections, and sectoral strategies. The following approach, which encompasses other climate action planning processes such as preparing a baseline GHG emissions inventory, describes the steps to develop different GHG emission reduction scenarios. The approach is structured into three phases: baseline GHG emission estimation, forecasting of GHG emissions in the BAU scenario, and planning for multiple GHG emissions reduction scenarios.

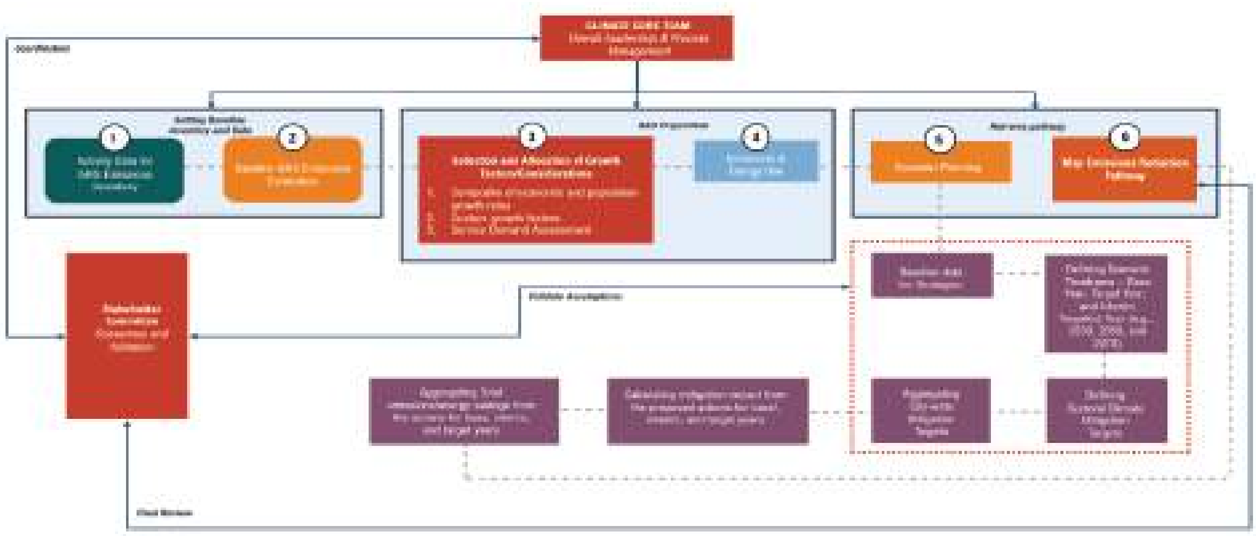

Figure 2: ICLEI's Scenario Planning Approach

Phase 1: Establishing Baseline GHG Emissions through Inventory Development

The first phase of scenario planning involves compiling sector-wise activity data and estimating the baseline GHG emissions to develop the GHG emissions inventory. Establishing a robust baseline dataset and emission estimates is critical, as these serve as the reference point for estimating BAU emissions projections, which form the subsequent and essential phase of this scenario planning approach.

Step 1: Compiling Activity Data for GHG Emissions Inventory

The first step in scenario planning involves compiling activity data required to prepare the city-wide GHG emissions inventory and selecting an appropriate base year. The base year should be selected based on data availability (refer to Tool 3.2A: Preparation and Management of GHG Emissions Inventory). The base-year GHG emissions provide the starting point for future emission projections and scenario planning assessments.

Cities should ensure that activity data are available across all relevant sectors and sub-sectors (stationary energy, transport, waste, wastewater, and municipal services). The Climate Core Team should oversee this step to ensure consistency with other planning processes and alignment with reporting frameworks.

Step 2: Baseline GHG Emissions Estimation

The second step in scenario planning is to estimate the GHG emissions for the baseline year using activity data and appropriate emission factors and calculation methodologies (refer to Tool 3.2A: Preparation and Management of GHG Emissions Inventory, Tool 3.2B: GPC Standards, and Tool 3.2C: HEATplus Manual). The base-year GHG emission inventory is a critical input for scenario planning, as it establishes the city's emissions profile and helps identify key high-emitting sectors and sources. In addition, it also serves as the reference against which future emissions growth and reductions are measured.

It is important to verify the baseline emission estimates for completeness and accuracy before proceeding with scenario planning, as inconsistencies may impact the BAU emissions projections and subsequent mitigation estimates. It is recommended that cities should undertake a two-tier verification approach, comprising internal checks by the Climate Core Team and external verification by independent or accredited verification agencies.

Phase 2: Estimating BAU Projections for future GHG emissions

Once baseline activity data and GHG emission estimates are established, the next phase is to estimate BAU emissions projections. These projections serve as the reference against which all GHG emissions mitigation scenarios are evaluated. They should be reviewed and validated by the Climate Core Team to ensure consistency with local development trends and trajectories.

Step 3: Selection and Allocation of Growth Factors

Once base-year emissions are established, cities must determine how emissions are expected to grow under BAU conditions. This is done by selecting and allocating appropriate growth factors. Detailed guidance on establishing growth factors for population and economic development and their sector-wise impact and other necessary considerations are provided in Tool 4.1A: GHG Emissions Projections.

Step 4: Develop BAU Emissions Projections

BAU emissions projections are a crucial input for modelling emission reduction scenarios, since they serve as the reference against which all mitigation actions and emission reductions are assessed. Detailed guidance is available in Tool 4.1A: GHG Emissions Projections.

Phase 3: Undertaking GHG Emissions Reduction Scenario Planning

After establishing baseline emissions and BAU projections, cities can begin scenario planning. This phase involves defining and modelling alternative emissions pathways based on identified mitigation actions and targets. The key components of this phase are detailed in the sections below.

Step 5: Compiling Sector-wise Baseline Data

Sector-wise baseline data should be compiled and validated before scenario planning begins, as it provides the foundation for mitigation calculations. This dataset typically includes:

- **Energy:** Number of buildings by typology (e.g., residential, commercial, institutional), overall energy use, end-use share of appliances, trends in growth of building stock or built-up area over recent years, etc.
- **Transportation:** Transport fuel demand, modal share, number of vehicles on road disaggregated by vehicle type (two-wheelers, cars, buses, freight vehicles, etc.), vehicle growth trends (increase in registration), etc.
- **Waste:** Total solid waste generation, waste composition, existing processing percentage and technologies, etc.
- **Wastewater:** Domestic wastewater generation, treatment capacity, treatment technology, fecal sludge generation and treatment capacity, BOD and COD levels for both wastewater and fecal sludge, etc.
- **Municipal Services:** Number of streetlights, electricity consumption for water and wastewater pumping, non-revenue water (NRW) levels, the number of municipal vehicles and their type, etc.

Baseline data is typically sourced from municipal departments, utilities, parastatal agencies, and service providers such as DISCOMs, transport departments, and water and sanitation utilities. Where city-level data is incomplete or unavailable, cities may use state-level or national datasets, sector benchmarks, or proxy indicators (such as per capita or per household figures). Any assumptions, scaling approaches, or secondary data sources used should be clearly documented to ensure transparency and allow future refinement of the baseline dataset.

Step 6: Defining Scenario Planning Timeframe

Cities must clearly define and set the planning timeframe for the scenarios, including:

- the base year,
- one or more interim target years
- a long-term target year that is aligned with national or state commitments

At this stage, cities should also determine how many scenarios they intend to develop (e.g., Progressive, Net-Zero, or additional sector-specific pathways) and ensure that each scenario follows the same timeframe for comparability. Setting interim target years is important for cities undertaking long-term climate action planning, as it provides clear milestones to be achieved at different points in time. These interim targets help cities track progress and remain aligned with their long-term goals.

For example, Ahmedabad, in its Net-Zero Climate-Resilient City Action Plan, identified 2070 as the target year, in line with India's national Net-Zero commitment. The city identified 2021 as the base year. The plan comprised two scenarios, a Progressive Action Scenario and a Net-zero Pathway Scenario, and included the interim target years of 2030 and 2050, with specific targets established for each timeframe.

Step 7: Identifying Sectoral Mitigation Interventions and Setting Targets

A key step in scenario modeling is to identify potential mitigation actions across key sectors, including buildings and energy, transport, solid waste, domestic wastewater, and municipal services. Cities are advised to prioritize actions with large-scale mitigation impacts, such as renewable energy in buildings and utilities, a switch from conventional fuels to EVs in transportation, and biomethanation facilities for organic waste treatment. Detailed guidance on selection and prioritization of interventions is available in Tool 4.2B: Prioritisation of Climate Resilience Interventions.

ICLEI's Net-Zero GHG Emissions Tool includes an indicative action list aligned with the Net-Zero Scenario tool. This covers:

- Buildings & Energy: high efficiency appliance adoption, efficient pumps, fuel switch, green buildings, cool roofs, rooftop solar, carbon decarbonization, distributed and grid-connected renewable energy, etc.
- Transport: EV adoption, modal shift, improved public transport, increased non-motorized transport (NMT)
- Solid Waste: biomethanation, composting, refuse-derived fuel (RDF), waste-to-energy, recycling, methane capture
- Wastewater: fecal sludge treatment, anaerobic digestion, performance improvement of the sewage treatment plants, treated wastewater reuse
- Municipal Services: energy-efficient streetlighting, SCADA (supervisory control and data acquisition), NRW reduction, municipal EV fleet
- Urban green cover and biodiversity: carbon sequestration

GHG emissions reduction measures for implementation in cities are not limited to the indicative list of actions mentioned above. The Net-zero GHG Emissions tool is flexible and can incorporate any additional mitigation actions relevant to the city's context and planning needs.

Once mitigation strategies and actions are identified, cities need to determine, for each action, the reduction targets that reflect the level of ambition. These could range from moderate improvements (for the Progressive Action scenario) to high ambition and full-scale adoption (for the Net-zero pathway). The targets should be based on relevant state and national targets, plans, and policies. Defining the targets clearly enables the tool to estimate the extent to which each action can reduce emissions compared to BAU. Detailed guidance on target setting is available in Tool 4.2C: Target setting for climate resilience interventions.

After the identification and prioritization of climate resilience interventions and the setting of targets, the sector-level established targets are aggregated to define the overall citywide mitigation ambition for each scenario.

Step 8: Calculating Aggregated Emissions/Energy Savings

Cities can then start with the mitigation calculations for the scenarios. These scenarios should be modelled in a stepwise manner, with each successive scenario building on the previous one by including additional actions and increased targets.

In the Progressive Action Scenario, cities typically include actions that are already planned, under implementation, or considered feasible. For example, a city may target 30–40% rooftop solar coverage on municipal buildings by 2030, or 60% of waste processing by 2030. In contrast, in the Net-Zero Scenario, these same actions are scaled up further and supplemented with additional measures; for example, 100% renewable electricity for municipal operations by 2070, or 100% processing and scientific disposal of waste by a target year. This stepwise layering of actions and targets allows cities to understand how increasing ambition translates into deeper emissions reductions over time. Examples of targets established under different scenarios are provided in Table 1:

Table 1: Example of Target setting for Emissions Reduction Pathway

Sector	Action	Target Parameter	Progressive Action Scenario			Net-Zero Scenario		
			2030	2050	2070	2030	2050	2070
Buildings	Scaling up use of renewable energy to meet energy demand	Share of building electricity consumption to be met by renewable energy	20%	50%	60%	40%	60%	80%
Solid Waste	Deploy waste to energy plants	Estimated capacity/size	500 TPD	900 TPD	1000 TPD	800 TPD	1200 TPD	2000 TPD

Calculating Emissions Reduction from Mitigation Actions: For each action, the cities need to estimate the expected reduction by comparing projected BAU emissions with estimated emissions after the planned implementation of the intervention. Emissions reductions are estimated by comparing projected BAU emissions against the GHG emissions resulting from proposed mitigation interventions. The general formula for estimating emissions reduction for each action under a scenario is given below.

In addition to absolute reductions, cities are encouraged to estimate percentage reductions to better communicate ambition and progress:

For example, if BAU emissions from the buildings sector in 2030 are projected at 100,000 tCO_2e, and emissions under the Progressive Action Scenario are estimated at 75,000 tCO_2e, the absolute reduction would be 25,000 tCO_2e, corresponding to a 25% reduction from BAU. Under the Net-Zero Scenario, if emissions further reduce to 10,000 tCO_2e, the reduction would be 90,000 tCO_2e, representing a 90% reduction from BAU.

Aggregating emission reductions / energy savings from actions for base, interim, and target years: After estimating emissions reductions from all actions, cities then need to aggregate reductions across all sectors to develop the overall emissions-reduction impact and trajectory for each scenario. This aggregation needs to be carried out separately for the Progressive Action and Net-Zero scenarios, and for each assessment year (base, interim, and target years). This final output, post-aggregation, illustrates how the city can move from BAU conditions to progressively lower emissions, ultimately approaching net-zero emissions in the long term.

The ICLEI's Net-zero GHG Emissions Tool supports this step and includes built-in calculators for each action identified in step 7. It automatically estimates the GHG emissions reduction for each intervention (based on input targets and scale of implementation) and also estimates additional benefits and indicators, such as electricity and fuel savings, intervention costs, and potential job creations.

Step 9: Mapping the GHG Emissions Reduction Pathway

After calculating sector-wise emission reductions, users should map the overall emissions trajectory for the modeled scenarios. This helps cities visualize how emissions change over time, compare sector contributions, and identify periods where accelerated action may be required. The pathway also indicates how closely the city aligns with long-term climate goals. ICLEI's Net-zero GHG Emission Tool generates these trajectory graphs, including BAU vs Progressive vs Net-Zero trajectories, sector-wise mitigation potential, future activity projections, and reduction pathways.

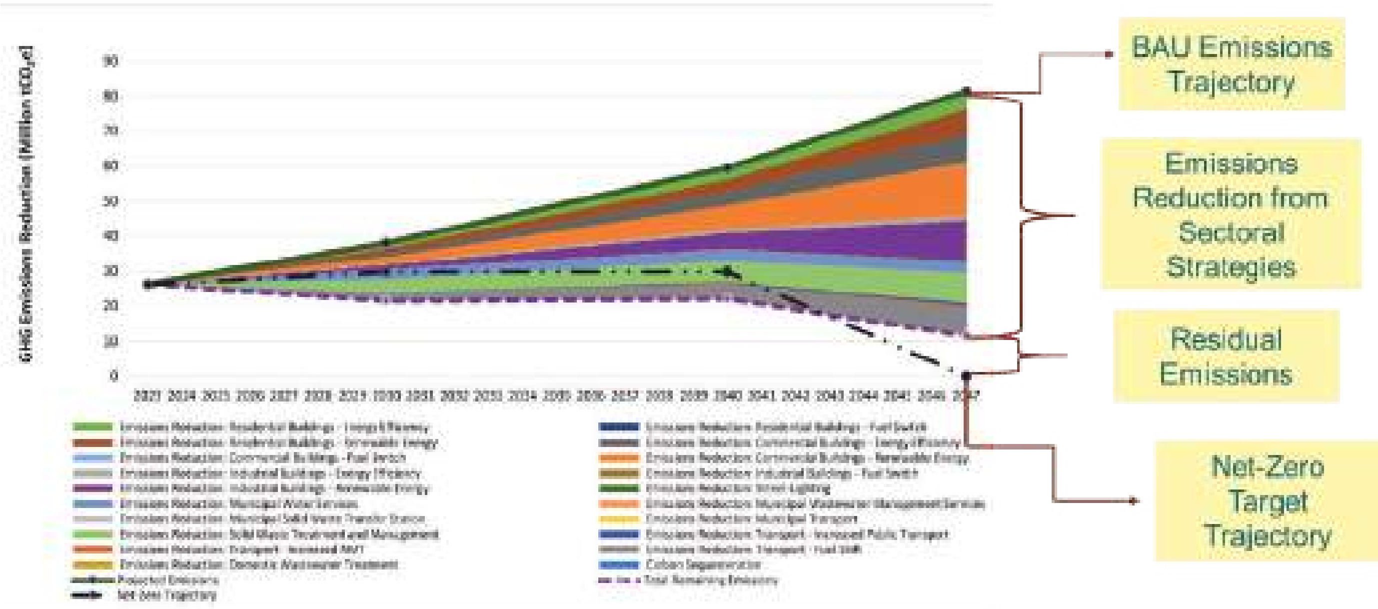

Figure 2: Example of Net-zero Trajectory

SECTION C

Residual GHG emissions

Even under an ambitious net-zero pathway scenario, certain GHG emissions may persist and remain unmitigated by the target year due to technological, economic, or institutional constraints. These residual emissions typically result from sectors or activities where low-carbon alternatives are currently unavailable or not commercially viable, or not deployable at scale based on current information and technologies. Cities must identify and track such residual emissions as part of their scenario planning and, in future revisions of their net-zero action plans, adopt actions to reduce them based on technological advancements and practicality.

Recognizing residual emissions allows cities to plan for their progressive reduction over time. As technologies evolve and policy frameworks strengthen, cities should periodically reassess these emissions and incorporate new mitigation alternatives in subsequent inventory cycles and scenario updates. Addressing residual emissions also requires sustained stakeholder engagement. Cities should work closely with relevant departments, utilities, state and national agencies, private sector actors, and technology providers to enable long-term solutions. Engaging stakeholders early helps align sectoral plans, mobilize investments, and support the adoption of progressive policies and actions.

Tool 4.2A

Net-zero Vision, Sectoral Goals, and Resilience Interventions

This tool provides guidance for cities to develop a climate vision that describes the city's aspirations for becoming an inclusive, low-carbon, and climate-resilient economy, and to identify an initial reference list of climate resilience interventions across sectors, for further prioritisation and target-setting using Tools 4.2B and 4.2C. Climate resilience interventions are identified from a sector-wise reference list based on findings from baseline assessments in Steps 2 and 3, such as the urban systems gap analysis, greenhouse gas (GHG) emissions inventory, and climate risk assessment. This tool is the first step in the climate action planning and target-setting process for developing the Net-zero Climate Resilient City Action Plan (CRCAP).

From Baseline to Climate Vision and Goals

Once the baseline assessments are completed (Steps 2 and 3), the city will have a clear understanding of its major sources of GHG emissions, as well as the locations, urban systems, and communities most vulnerable to climate hazards. Using this information, the city can develop a climate vision, a long-term statement that describes its aspirations for becoming a more inclusive, low-carbon and climate-resilient city.

The city's climate vision guides the Net-zero CRCAP development process and cascades into a structured hierarchy:

Vision → Goals and Targets → Strategies → Interventions in the CRCAP.

- **City Vision and Priorities:** Cities develop a broad climate vision, identify priority sectors, and set city-wide climate resilience goals and targets to guide inclusive climate action.
- **Sector-wise Goals and Targets:** Cities identify resilience goals, and mitigation and adaptation targets that guide the sectoral interventions.
- **Sector-wise Strategies:** Cities develop sector-wise mitigation and adaptation strategies that comprehensively state how the interventions will achieve the sector-wise goals and targets.
- **Interventions and Targets:** Cities develop strategy-wise interventions aligned with the sectoral goals and targets. Each intervention can, where possible, be linked to mitigation targets and adaptation goals to track progress and implementation.

The sectoral goals, targets, and interventions are aggregated into city-wide goals and targets, setting a clear long-term vision and goal for the city.

What are climate resilience interventions?

Climate resilience interventions are specific actions a city can implement across sectors to reduce its GHG emissions and strengthen its ability to adapt to or deal with the impacts of climate change. These interventions should also be inclusive and address the impacts of climate change on vulnerable groups such as low-income population, elderly, children, differently-abled, women, and outdoor workers.

Climate resilience interventions fall into two broad categories:

Climate Adaptation Interventions: Actions that help communities and systems build resilience to climate hazards by reducing vulnerability and enhancing their capacity to cope. Examples of intervention areas for climate adaptation include flood mitigation and protection, climate-resilient urban infrastructure upgrades, disaster response and management, and heat mitigation (e.g., cool roofs).

Climate Adaptation interventions are identified based on the urban systems gap analysis and climate risk assessment, and can further be organised by implementation timeframe as:

- **Short-term:** Immediate measures to manage climate risk
- **Medium-term:** Infrastructure upgrades and building the resilience of actors and systems
- **Long-term:** Systemic transition and the wider adoption of climate resilience solutions

Climate Mitigation Interventions: Actions that reduce or prevent GHG emissions and support the transition to low-carbon systems. Examples of intervention areas for climate mitigation include clean energy (e.g., rooftop solar), energy efficiency (e.g., brushless direct current fans in buildings), sustainable mobility (e.g., electrification of public or private transport), and sustainable waste management (e.g., biomethanation plants).

Climate Mitigation interventions are identified based on the urban systems gap analysis, GHG emissions inventory, and scenario planning undertaken in Steps 2.3, 3.2, and 4.1, and can be organised by implementation timeframe as:

- **Short-term:** Quick-win sustainable energy transition and mobility interventions
- **Medium-term:** System-wide scale-up of low-carbon interventions
- **Long-term:** Transformational interventions that enable a net-zero transition and enhanced carbon sinks

Action Planning and Target-Setting Process

The climate action planning process follows four steps that help identify, prioritise, and detail climate resilience interventions with targets:

1. **Identify Sector-wise Mitigation and Adaptation Interventions:** Sector-wise interventions are identified based on the baseline climate assessments — the urban systems gap analysis, GHG emissions inventory and climate risk assessment — and stakeholder consultations. This is the focus of this tool (Tool 4.2A).
2. **Prioritise Climate Resilience Interventions:** Interventions are prioritised for short-, medium-, or long-term implementation, considering their climate resilience potential, implementation timeframe, and feasibility (refer to Tool 4.2B: Prioritisation of Resilience Interventions).
3. **Target Setting for Climate Resilience Interventions:** Targets and goals are set for mitigation and adaptation interventions and then aggregated as sector-wise and city-wide targets, goals, and vision (refer to Tool 4.2C: Target Setting for Resilience Interventions).
4. **Detail Climate Resilience Interventions and Integrate into City Plans:** Sector-wise detailing of climate resilience interventions and targets, and their integration into local plans and schemes (refer to Tool 4.3A: Detailing of Climate Resilience Actions and Integration into City Plans / Schemes).

Sector-wise Interventions

The following reference table provides a sector-wise catalogue of climate resilience interventions. For each intervention, four progressive steps that a city can take to move from initial readiness to full-scale delivery are outlined. Cities should use this list alongside their urban systems gap analysis, GHG emissions inventory, climate risk assessment, and scenario planning outputs to select and sequence interventions that are contextually relevant, technically feasible, and aligned with national and state priorities.

Intervention	Progressive Steps to Achieve the Intervention			
	1	2	3	4
Built Environment and Energy				
Energy management in existing public buildings	Conduct energy audits for existing public buildings and facilities, and prepare energy consumption and GHG emissions profiles.	Identify and prioritise potential energy-efficiency (EE) and renewable-energy (RE) interventions, and prepare cost estimates.	Secure the budget to implement prioritised EE and RE interventions.	Implement prioritised EE and RE interventions across building typologies and monitor impacts.
Green building standards for public buildings and social housing projects	Prepare and adopt green building standards for public buildings and social housing in accordance with the National Building Code (NBC 2016) and/or the Energy Conservation Building Code (ECBC) 2017.	Prepare green building plans for identified public buildings and/or social housing schemes and commence construction.	Submit applications for green building certifications, such as Green Rating for Integrated Habitat Assessment (GRIHA), Leadership in Energy and Environmental Design (LEED), and Indian Green Building Council (IGBC), for constructed or renovated public buildings and/or social housing projects.	Progressively increase the proportion of total built-up area of public buildings and social housing projects developed as green buildings.
Energy management in existing private buildings	Adopt an EE and RE programme to advise private building owners, and prepare programme guidance on technical aspects and financial incentives.	Develop communication strategies and conduct IEC activities to promote the programme and advise private building owners.	Implement the EE and RE programme.	Monitor and document the programme's impact, including the number of existing private buildings benefiting from it.
Implementation of green building standards in private buildings	Prepare green building norms for inclusion in the City's Development Control Regulations, incorporating elements from the NBC 2016, ECBC 2017, and other green building rating systems such as GRIHA and LEED.	Develop a programme to implement green building norms, including incentives, implementation process for private owners, and the establishment of a Green Building Committee/Cell within the municipal corporation.	Operationalise the Green Building Cell/Committee to oversee the implementation of the green building scheme, and maintain records of green building certifications obtained from private builders.	Increase the built-up area completed during the current financial year that complies with green building norms to more than 10%.
Dissemination of best examples (public buildings and social housing)	Coordinate with local architects, engineers, and builders to evaluate and report on the best examples from green building projects.	Identify and list green- and energy-efficient buildings, with analytical support from the city or other reputable organisations.	Disseminate lessons and good practices, including environmental and financial benefits, to raise awareness	Regularly showcase exemplary green and energy-efficient buildings.
Public lighting	Convert all public lighting to LED-based smart lighting systems.	Conduct a detailed feasibility study, including technical and financial aspects, and submit it to the City Council for approval, and secure budget allocation.	Engage with energy service companies (ESCOs) or other private contractors to implement the smart LED-based public lighting system, and establish a monitoring, verification, and reporting (MRV) system.	Expand smart LED lighting across the city through ESCO or city/state funding.

Intervention	Progressive Steps to Achieve the Intervention			
	1	**2**	**3**	**4**
Municipal energy consumption from renewable sources	Assess the rooftop solar and RE potential of public buildings and facilities, urban service infrastructure and street lighting, and evaluate the feasibility of net metering, open access, or renewable energy service company (RESCO) / ESCO models.	Install rooftop solar photovoltaic systems on a limited number of priority municipal buildings (e.g., municipal offices, schools, and hospitals) and/or sign initial power purchase agreements (PPAs) or open-access arrangements to supply a portion of municipal electricity demand.	Expand rooftop and ground-mounted solar installations across the majority of municipal buildings and facilities; scale up open-access/PPA-based RE procurement for street-lighting and water-pumping loads; explore third-party investment models (RESCO/ESCO) to accelerate deployment.	Mandate RE sourcing for all new municipal infrastructure; integrate RE targets into municipal budgeting and capital investment plans; and sign long-term PPAs or green tariff contracts covering the majority of municipal electricity demand; and monitor performance through the city's MRV framework
District Energy Systems for Cooling	Assess the district cooling potential, including existing and future cooling demand.	Conduct pre-feasibility studies and identify suitable locations for implementation.	Prepare detailed implementation plans, secure financing, and commence implementation.	Expand district cooling systems to progressively meet the majority of the city's cooling demand.
Transport and Mobility				
Transport and mobility planning for the city	Decide whether to update the Comprehensive Mobility Plan (CMP), Low Carbon Mobility Plan (LCMP), or Comprehensive Traffic and Transportation Plan (CTTP) based on evolving transport conditions in the city and stakeholder consultations.	Prepare a comprehensive transport and mobility plan, aligned with relevant Master Plan considerations, and supported by technical partners.	Develop annual work plans to implement the CMP/LCMP/CTTP, identify budgets, implementation frameworks, and revenue streams.	Allocate budgets to implement actions/interventions identified in the mobility plans; establish a monitoring framework, and monitor implementation using transport-sector KPIs.
Non-motorised transport network	Assess the existing NMT network and prepare the NMT infrastructure network plan as part of the LCMP/CMP/CTTP aligned with the city Master Plan. Include dedicated footpaths and cycle lanes (painted, demarcated, or segregated) along with user-friendly features such as shading.	Include NMT interventions in annual work plans, secure budgets, and commence implementation of NMT infrastructure.	Monitor and report on existing NMT routes and activities; promote use of newly constructed NMT infrastructure, and track usage to assess increases in modal share.	Implement the NMT projects identified in the annual work plan, and monitor resulting improvements in modal share.
Public Transport infrastructure	Prepare a feasibility study/strategy/action plan for public transport, covering buses, metro, suburban rail coaches, and ferries, and allocate a budget for implementation.	Complete the tendering process and commence implementation of the public transport system.	Integrate the public transport system with last-mile connectivity, to achieve a fleet size of at least 0.6 buses per 1,000 people.	Transition the public transport fleet to low-carbon technologies (CNG, LPG, Hybrid, Biofuels, Electric), implement an Integrated Ticket Management System (ITMS) across public transport services, intermediate public transport (IPT) and NMT; and monitor ridership and impacts.

Intervention	Progressive Steps to Achieve the Intervention			
	1	2	3	4
Intermediate Public Transport	Assess and document various modes of IPT in the city. Integrate IPT planning with the city Master Plan/CMP/CTTP/LCMP to complement the existing/proposed PT system.	Prepare an IPT policy covering the types of IPT vehicles (electric and/or clean-fuel), tariff structure, designated routes, maintenance norms, and dedicated parking spaces and obtain City Council approval.	Prioritise infrastructure, planning, and policy-level IPT interventions in annual action plans and allocate budget for implementation.	Implement IPT interventions, operate IPT running on designated routes, and integrate them with the PT system to provide first- and last-mile connectivity.
Clean mobility and development of electric vehicle charging infrastructure	Develop a roadmap/strategy for electric mobility deployment in line with state and national targets.	Prepare a city-level electric mobility policy/plan in line with the roadmap and state and national action plans, addressing e-mobility infrastructure, including charging systems.	Obtain approval from the City Council or relevant authority, and allocate a budget for implementation.	Implement interventions proposed under electric mobility action plan/policy, and monitor and report climate benefits in terms of GHG emissions reductions.
Urban freight movement	Monitor urban freight movement and introduce restricted entry on certain routes and/or during designated time periods.	Prepare an Urban Freight Management Plan that includes mapping of freight activity, freight routes, emissions, parking areas, restricted areas, and allowed vehicle types.	Allocate budget for strategies proposed in the Urban Freight Management Plan, and initiate implementation.	Monitor and report on the impact of implemented strategies and interventions, including records of emissions reductions.
Intelligent traffic and transport system	Prepare a plan to use information technology to improve people's mobility and reduce traffic congestion, as prioritised in the Master Plan/LCMP.	Establish a city transport committee/authority comprising officials from relevant departments to oversee transport planning.	Implement a pilot using information technology for traffic management, online applications, and user awareness.	Scale up intelligent traffic management systems city-wide, secure funding, and monitor their contribution to low-carbon targets and pollution reduction.
Pollution management	Monitor and analyse air pollution levels across the city and report the findings to decision-makers.	Allocate a budget and initiate preparation of a clean air action plan.	Prepare and obtain approval for a clean air action plan with short- and long-term goals, including measures to reduce pollution levels over the next five years.	Implement more than 50% of the prioritised actions identified in the annual action plan, and monitor and report the phased implementation of the clean air action plan.
Parking policy	Assess parking demand and parking availability through field studies and consultations.	Implement paid parking facilities in pilot locations and assess their suitability for city-wide scale-up.	Prepare a parking policy that includes minimum parking charges to promote public transport, car rentals, car sharing, carpooling, and Park-and-Ride facilities.	Implement the parking policy across identified locations and monitor its impact on modal shift and parking demand.
Solid Waste Management				
Solid Waste Management (SWM) Action Plan	Conduct a waste quantification and characterisation study, and develop a holistic SWM Action Plan.	Prepare a holistic SWM Action Plan, with clearly defined short- and long-term goals, and identify and cost actions covering collection, transport, processing/treatment, and disposal.	Obtain city approval for the holistic SWM Action Plan, and allocate budgets for implementation.	Implement the SWM Action Plan and monitor progress.

Intervention	Progressive Steps to Achieve the Intervention			
	1	2	3	4
Waste collection systems and infrastructure	Develop infrastructure, including separate collection and transfer vehicles for dry and wet municipal solid waste, to initiate collection of the MSW generated in segregated form.	Expand the collection infrastructure for segregated MSW (dry and wet), e-waste, plastic waste and construction and demolition waste across the entire city in line with the holistic SWM Action Plan (including waste transfer stations).	Establish segregated collection systems for MSW (wet and dry), e-waste, plastic waste, and C&D waste collection, and implement an MRV system to monitor collection.	Implement and manage multi-stream waste collection systems (covering MSW, plastic waste, e-waste, and C&D), and monitor coverage to ensure at least 95% of the generated waste is collected.
Waste recycling and processing plants	Prepare a holistic Waste Management Plan for waste treatment plants that covers all major waste streams (dry, wet, plastic, and construction and demolition [C&D]) and commence phased installation.	Expand waste treatment and processing plants to treat more than 50% of the city's MSW in accordance with the holistic SWM Action Plan.	Establish waste-processing facilities for plastic waste management, C&D waste processing, and safe disposal of dead animals.	Process and treat at least 95% of the total waste generated (dry/wet, C&D, and plastic) and monitor and report processing efficiency.
Scientifically managed disposal infrastructure	Plan dumpsite closure or biomining and identify sites for construction of a scientific landfill.	Complete closure of old dumpsite, including methane recovery (where landfill gas is present) or biomining.	Secure budget for landfill site construction and construct a scientifically managed landfill for inert waste management.	Restrict landfill disposal to inert waste only; complete closure or biomining at legacy dumpsites and maintain and monitor records of inert waste disposal.
Water and Sewage				
Water resource management strategy and action plan	Prepare a water resource management strategy and action plan that considers climate resilience aspects and addresses current and future water demand, source assessment, management and augmentation, water treatment, and potable water quality management.	Secure budgets for phased implementation of the action plan, prioritising strategies based on the city's immediate needs.	Implement prioritised interventions, such as water-source augmentation, groundwater recharge systems, groundwater quality protection, and water treatment.	Complete implementation of the short-term water resource management plan, monitor intervention outcomes, and initiate implementation of long-term interventions.
Water treatment and distribution systems	Assess water supply connection coverage, per capita water supply, and progress in implementing the water resource management strategy and action plan. Conduct an energy audit of water pumping stations and water treatment plants.	Conduct Non-Revenue Water (NRW) analysis and prepare an action plan that includes strategies to reduce water losses and energy consumption.	Secure budget to implement strategies and infrastructure in a phased manner, measures to reduce illegal connections and leakages, EE improvements and RE integration.	Monitor the impact of implemented interventions and expand water supply coverage to more than 95%, reduce NRW to 20% or less, and increase per capita water supply to above 130 litres per capita per day (LPCD).

Intervention	Progressive Steps to Achieve the Intervention			
	1	2	3	4
Stormwater management	Prepare a stormwater management plan based on annual rainfall, hydrology, flood-prone areas, flood risk assessment, and hotspots. Include measures for water augmentation and groundwater recharge.	Develop strategies to restore water bodies, including desilting lakes, removing encroachments, and enhancing biodiversity.	Allocate annual budgets for phased implementation of strategies and interventions.	Implement short-term stormwater management actions, establish a monitoring framework, and expand stormwater drainage coverage to more than 80% of the city area.
Sewage management	Prepare a sewage management strategy and action plan with annual targets, addressing current and future wastewater generation and collection, coverage of the sewerage network, the efficacy of existing treatment plants, and the requirement for new sewage treatment plants (STPs).	Conduct energy audits of wastewater pumping stations and STPs. Allocate budgets to replace energy-inefficient pumps and integrate RE.	Secure budgets to implement the sewage management strategy, implement an annual action plan, prepare a monitoring framework, and expand the sewage collection network to more than 70%.	Expand the wastewater collection network to achieve full coverage, phase out reliance on septic tanks, and ensure that more than 90% of the total sewage generated is treated efficiently and disposed of in accordance with the Central Pollution Control Board standards.
Wastewater Recycling and Reuse	Develop strategies for reusing treated wastewater for various permissible applications based on the level of treatment (secondary or tertiary).	Identify stakeholders and hold consultations on the reuse of treated wastewater. Prepare a pricing policy for the reuse of treated wastewater in construction, industry, gardening and other sectors.	Develop a socially acceptable pricing policy for treated wastewater, with more than 30% reused.	Mandate the reuse of treated wastewater in accordance with applicable quality standards — and increase reuse to more than 80% of the total treated water.
Faecal sludge/septage management	Establish faecal sludge or septage collection and transport through authorised agencies and provide sufficient number of mechanised suction emptier machines for desludging septic tanks/pit latrines.	Quantify faecal sludge or septage collected by authorised agencies and ensure it is transported in a safe, contained manner.	Establish treatment facilities for faecal sludge/septage with resource recovery, including methane recovery, reuse of treated wastewater, and production of manure or soil conditioners.	Ensure that residual products from faecal sludge and wastewater treatment are safely disposed of in compliance with pollution control and quality standards.
Urban Greening and Biodiversity				
Local Biodiversity Strategy Action Plan implementation	Initiate preparation of a Local Biodiversity Strategy and Action Plan (LBSAP) and establish a city-level Biodiversity Management Committee in accordance with national norms.	Conduct a baseline biodiversity assessment, including the City Biodiversity Index (CBI), and the People's Biodiversity Register in accordance with the Biological Diversity Act, 2002.	Prepare the LBSAP and identify measures to enhance urban biodiversity in line with National Biodiversity Targets. Allocate budget for implementing the LBSAP.	Implement annual action plans, monitor implementation progress, and update the CBI every five years.
Increasing natural areas in the city	Assess and map the city's existing natural areas through field surveys and establish a baseline.	Conduct a tree-cover study and identify strategies and species to increase tree cover.	Expand tree cover through plantation drives, avenue plantations, planting along water bodies, Miyawaki urban forests, and other greening measures.	Expand and protect natural areas to achieve and maintain more than 0.9 hectares of natural area per 1,000 people.

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Tool 4.2B

Prioritisation of Climate Resilience Interventions

This tool provides guidance for cities to assess and prioritize the initial list of proposed climate resilience interventions identified across sectors, based on development priorities, climate ambitions, and the list of interventions suggested in Tool 4.2A: Net-zero Vision and Sectoral Goals, and Resilience Interventions. It helps prioritize interventions based on their potential climate resilience benefits, feasibility of implementation, and the time required to achieve intended impacts. The tool can be used to assess both climate change adaptation and mitigation interventions across sectors.

The proposed interventions are first evaluated for their contribution to enhancing the climate resilience of the city using a defined set of resilience indicators. Subsequently, each intervention is assessed for feasibility (technical, political, and financial) and the timeframe required to achieve climate resilience impacts. This assessment can be conducted collaboratively by the Climate Core Team and the Stakeholder Committee.

Qualitative Assessment for Prioritization of Climate Resilience Interventions

The priority of climate resilience interventions can be assessed using qualitative criteria assessing climate resilience potential, feasibility and timeframe for realising impacts. The qualitative indicators are then assigned numerical scores to calculate the cumulative prioritization score for each intervention. The criteria for assessment and the scoring approach is explained in the following 4 steps.

STEP 1

Determine the Climate Resilience Potential of Interventions

This step helps in determining the potential climate resilience benefits or impacts of interventions based on the following aspects:

- **Redundancy**: A resilient system or sector can function and achieve results through multiple pathways or nodes when one fails, and when performance is critical. In contrast, a "single best solution" is not resilient, as failure of that option may lead to system collapse. Backup systems, or decentralized nodes for service delivery in a linked network, are preferable.

  Example: *Water demand for a city should be met through multiple sources so that if one source or network fails or malfunctions, others can supplement the supply.*

- **Flexibility and diversity**: Essential systems should be able to work under a variety of conditions and should not be rigid or designed only for a single situation. Systems may fail if overloaded beyond their capacity, but should do so in a *safe* and *predictable* manner, rather than suddenly and catastrophically.

  Example: *Tree species that can adapt to local climate extremes such as extreme temperatures and flooding.*

- **Re-organization and responsiveness:** Systems should be able to respond and adapt to unexpected shocks. This requires flexible institutions, access to different kinds of resources (information, skills, equipment, knowledge and experience), and strong coordination mechanisms.

  Example: *Hospitals and resting shelters equipped with passive cooling measures, rather than relying solely on active cooling systems.*

- **Access to information**: Resilient systems learn from past experiences and integrate lessons from other cities into planning. This requires monitoring systems, evaluating performance under stress, and multiple sources of knowledge and documentation (strengthening "corporate memory").

  Example: *Government agencies sharing a common system to monitor groundwater quality and extraction during frequent droughts.*

- **Energy saving and GHG emission mitigation potential**: Resilient systems should contribute to energy efficiency and GHG emissions reduction, integrated into planning processes. This requires mechanisms for periodic monitoring and evaluation, supported by multiple sources of knowledge and documentation.

  Example: *Rainwater harvesting and groundwater recharge will build community resilience and reduce dependence on long-distance water transport, thereby reducing energy use and emissions. The local government should conduct and document periodic monitoring of energy savings.*

Sub-step 1: Identify an initial list of proposed climate resilience interventions addressing GHG emissions reduction and/or strengthened resilience to climate risks, using Tool 4.2A: Net-zero Vision and Sectoral Goals, and Resilience Interventions.

Sub-step 2: Each intervention is evaluated against resilience indicators that reflect the benefits described above. The overall potential for climate resilience is determined based on the number of indicators for which the intervention generates positive impacts. For each intervention, a score of 1 is assigned for each indicator that the intervention is perceived to fulfill, and 0 is considered as the score for indicators that are not positively impacted by the intervention. Based on the sum of scores for the 5 indicators, the intervention is assessed as very high, high, medium, average or low.

Example: If an intervention meets two criteria of improved redundancy, and enhancing the urban system's or sector's capacity to learn, but does not meet three other criteria of responsiveness, flexibility or robustness, and GHG emissions reduction, then it gets an overall score of 2/5 and is categorized as having 'Average' level of climate resilience potential (**refer Table 1**).

Table 1: Determining Climate Resilience Potential of Interventions (Example)

Potential Climate Resilience Interventions	Resilience Indicators (*Yes* is scored as 1 and *No* is scored as 0)					Resilience Potential 5/5: Very High 4/5: High 3/5: Medium 2/5: Average 1/5: Low
	Redundancy (yes/no)	Flexibility (yes/no)	Responsiveness/ Re-organization (yes/no)	Access to Information (yes/no)	Energy Saving and GHG Emission Mitigation Potential (yes/no)	
Example: Rooftop water harvesting to be made mandatory to deal with water stress due to anticipated increasing temperatures and decreasing precipitation	***Yes (1)*** *Supports a higher degree of self-sufficiency at the household level*	***Yes (1)*** *System allows for water to be channelized towards recharging groundwater as well*	***Yes (1)*** *In case of shutdown of the city's water supply system, households have stored rainwater for use*	***No (0)*** *City helplines exist, but responsibility lies with individual households*	***Yes (1)*** *Reduction in electricity consumption and GHG emission mitigation potential due to reduced pumping requirement*	**High (4)**

STEP 2

Determine the Feasibility of Interventions

This step assesses the feasibility of implementing the proposed resilience interventions. Feasibility is determined by availability of accessible and affordable technology, access to funding, and political and social support. The criteria include:

Technical – availability of expertise, or access to required skills in the city

Political – alignment with city priorities and acceptability to leaders and the community

Financial (reflective of cost-benefit) – whether the city can afford the cost, has the capacity to implement, can access the required funds, and whether the anticipated benefits justify the cost

The feasibility of implementing each intervention should be evaluated using a scoring method similar to Step 1, based on technical, political, and financial criteria. Based on qualitative assessment each intervention having high, medium or low feasibility under each criterion is scored a 3, 2 or 1 respectively. The overall feasibility score of each intervention is calculated by adding the scores across the 3 criteria (**refer Table 2**).

Table 2: Determining Feasibility of Interventions (Example)

Potential Climate Resilience Interventions	Feasibility (High – 3, Medium - 2, Low - 1			Overall Feasibility High: 8-9 Medium: 6-7 Low: 3-5
	Technical (high/ medium/low)	Political (high/medium /low)	Financial (high/medium /low)	
Example: Rooftop water harvesting to be made mandatory to deal with water stress due to anticipated increasing temperatures and decreasing precipitation	*High (technology is easily available)* ***(3)***	*Medium* *(would require a change in building bylaws and building codes)* ***(2)***	*High* *(not an expensive option to implement with substantial benefits)* ***(3)***	*High* ***(8)***

STEP 3

Determine the Timeframe to Achieve Impacts from Interventions

It is important to assess how quickly interventions can deliver measurable benefits or impacts. Interventions with short timeframes to realise impacts may be prioritized higher on the cities and communities' climate agenda. For each intervention, identify the expected timeframe short, medium, or long for achieving climate resilience impacts and assign scores as 3, 2 or 1 respectively (**refer Table 3**)

Table 3: Determining Timeframe for Impacts (Example)

Potential Climate Resilience Interventions	Time Required to Achieve Impacts Short – 3 Medium – 2 long term – 1
Example: Rooftop rainwater harvesting to be made mandatory to deal with water stress due to anticipated increasing temperatures and decreasing precipitation	*Short term* ***(3)***

STEP 4

Determine Prioritisation of Climate Resilience Interventions

The overall prioritisation of climate resilience interventions is based on results from Steps 1-3, combining resilience potential, feasibility, and timeframe for realising impacts. For instance, interventions with high resilience benefits, high feasibility, and shorter impact timelines, especially those supported by readily available technology and financing options, may be prioritized in the Net-Zero CRCAP for implementation in the short-term. Using **Table 4**, list interventions and their scores to develop a final prioritised list.

Table 4: Determining Priority of Interventions

Potential Climate Resilience Interventions	**Resilience Potential** (From: Table 1) A	**Feasibility** (From: Table 2) B	**Time Required to Achieve Impacts** (From: Table 3) C	**Priority score: (A/5) + (B/9) + (C/3)** **0 to 1: Low** **1 to 2: Medium** **2 to 3: High**
Example: Rooftop water harvesting to be made mandatory to deal with water stress due to anticipated increasing temperatures and decreasing precipitation	*High **(4)***	*High **(8)***	*Short **(3)***	*High **(2.68)***
Example: Rejuvenation of natural drainage network and water bodies in the city	*High*	*Medium*	*Long*	*High*
Example: Clear, revitalize and make stormwater network encroachment free	*Medium*	*Medium*	*Medium*	*Medium*
Example: Large-scale deployment of EV charging stations (EVCS) and integration within bylaws	Very High	High	Medium	High

This approach to determining a recommended list of interventions can be adapted to the city's decision-making processes and local context. Some key considerations include:

1. Interventions with high climate resilience potential, high feasibility and short timeframe for realising impacts should be prioritised for short-term implementation, while all other interventions must be implemented in the medium or long term.
2. This prioritisation approach may oversimplify decision-making, however, low-scoring interventions can also be prioritised as per the discretion of the city government based on local context and priorities as there may be other valid reasons to select an intervention that does not score as highly as others.
3. Interventions that significantly enhance climate resilience and have high impact, such as enabling policies and regulations, may be considered high priority, even if their score is lower.
4. The City Climate Core Team or its members may lead initial assessments and validate results with the rest of the team and/or Stakeholder Committee. The team may also identify any additional considerations that may support shortlisting.
5. Share the proposed list of interventions with city decision-makers and incorporate inputs from the city's regular budget prioritization process.

Target Setting for Climate Resilience Interventions

This tool provides guidance on how cities can set ambitious yet practical targets as part of their Net-zero Climate Resilient City Action Plan (CRCAP). Well-defined targets provide specific, measurable outcomes, and timeframes that can help drive climate action and enable progress tracking. This tool will help cities develop:

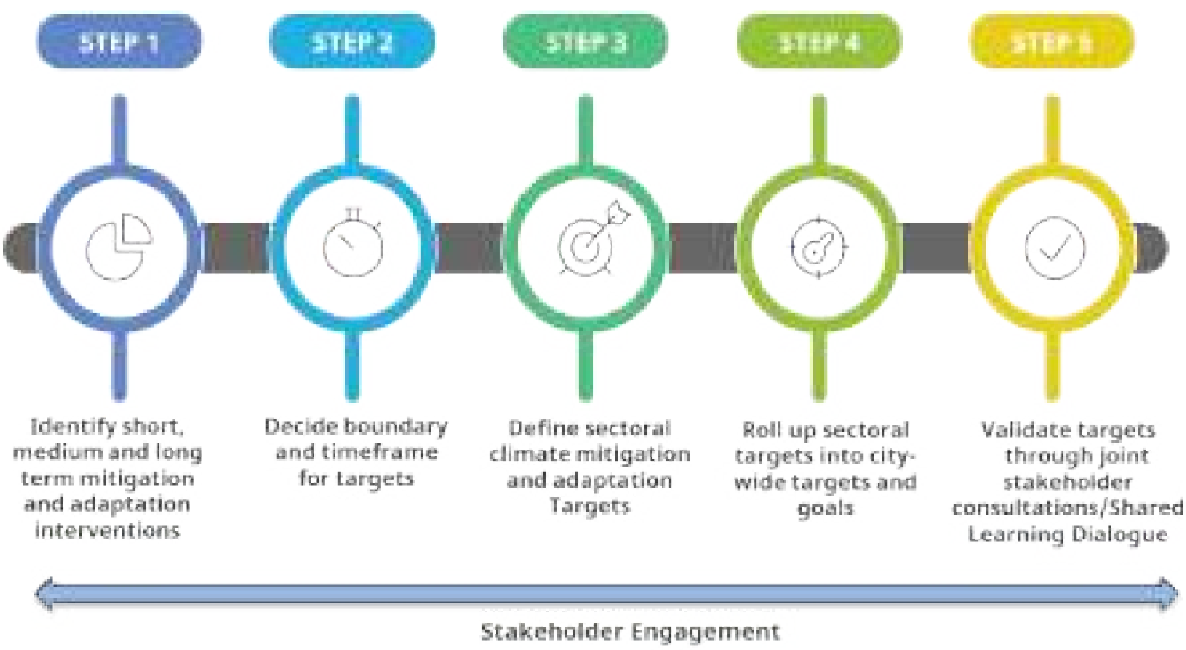
- A list of priority interventions for climate mitigation and adaptation across sectors
- Sectoral climate mitigation targets (to reduce or avoid emissions of greenhouse gas [GHGs] and adaptation targets/goals (to improve resilience to climate risks and vulnerabilities)
- City-wide mitigation and adaptation targets and a climate vision statement.

When implementing climate resilience interventions, it is also important to capture co-benefits and associated indicators that reflect socio-economic and environmental improvements (e.g., improved public health, economic opportunities, air quality, water and energy security).

Set Climate Resilience Targets

The Climate Core Team leads the target-setting process along with the Stakeholder Committee (see Tool 1.2: City Climate Core Team and Tool 1.3A: Stakeholder Engagement). Stakeholder participation is crucial for gathering input, validating targets, and building ownership and consensus.

The steps for setting climate resilience targets are outlined below



STEP 1

Identify Priority Mitigation and Adaptation Interventions

Identify priority sectors (e.g., energy, transport, solid waste, green cover and biodiversity) and the priority list of interventions for each sector (e.g., preservation and protection of lakes or natural ecosystems) with potential impacts on GHG emissions reduction, enhanced climate resilience, and co-benefits (refer Tool 4.2B: Prioritisation of Climate Resilience Interventions). The urban system gap analysis, GHG emissions inventory, and climate risk assessment from Steps 2 and 3 of Phase 1 of the Net-zero CRCAP methodology provide the evidence base for this process. Depending on the local context, the Net-zero CRCAPs may address interventions across the following sectors:

- Energy and Buildings
- Water Supply
- Wastewater
- Stormwater
- Transportation
- Solid Waste
- Urban Green Cover and Biodiversity
- Health
- Air Quality

STEP 2

Decide Boundary and Timeframe

The target boundary can be defined in terms of geographic coverage and sectors or scope. Targets are usually set using the same geographic boundary (e.g., city-wide or area under municipal jurisdiction) as the baseline climate assessments (GHG emissions inventory and climate risk assessment).

Determine the scope of coverage, such as sectors (from Step 1 above), emission sources (refer to Tool 3.2E: GHG Emissions Inventory Analysis and Synthesis), and climate hazards and risks (refer to Tool 3.1C: Climate Risk Assessment) to reflect key drivers, vulnerabilities, and resilience improvement or impact potential.

If boundaries differ from the GHG emission inventory or the climate risk assessment, any additions or exclusions should be specified when stating the city's climate targets. For example, certain local governments may exclude emission sources or city areas outside their jurisdiction or opt for climate targets limited to municipal operations or select sectors.

Define timeframe

Identify the target timeframe with a base year and target year.

- Base Year: The base/starting year should have high-quality, reliable, and representative data reflecting the baseline situation, GHG emissions, and climate risk profile.
- Target Year: The target year may align with national, state, or local commitments such as Nationally Determined Contributions, net-zero targets, state/provincial climate and sustainability commitments or local pledges or aspirations.
- Interim Targets: Choose intermediate milestones, such as short-term and medium-term timelines (e.g., 2030 and 2050), leading up to long-term targets (e.g., 2070).

STEP 3

Define Sectoral Targets

For each priority sector, identify targets for the priority list of high-impact climate-mitigation and adaptation interventions. Targets may be identified by aspirational (showing leadership and ambition), political (aligned with local or national policies and priorities), and technical (based on calculations of GHG emission-reduction potential or estimates of climate resilience improvement) considerations.

Targets should align with national, state, and city policies and programs, while also reflecting local context and feasibility, current adoption levels, technical capacities, and availability of financial resources, among others.

The Target setting process should take into consideration the:

- National climate commitments, policies, flagship programs, and missions (e.g., NDCs, missions for urban infrastructure, programs for climate and urban sustainability, sectoral policies)
- State-level urban, climate, and sectoral visions, policies, schemes, guidelines (e.g., state climate change action plans, policies, and regulations on energy, buildings, electric vehicles, waste, water)
- City-level master plans, infrastructure development plans, sector policies and strategies, ongoing and planned projects/programs, and investments (e.g., city building regulations, mobility plan, sanitation master plan, stormwater drainage improvement program)

3.1 Set Sectoral Mitigation Targets

Define clear and quantitative targets for prioritized resilience interventions in each identified sector. The targets should be time-bound, measurable, and aligned with national, state, and city policies.

Sectoral mitigation targets are derived by aggregating GHG-emissions-reduction estimates. Examples are provided in **Table 1**.

The Common Reporting Framework of the Global Covenant of Mayors requires that local targets be as ambitious as the country's NDC, and ideally more ambitious.

3.2 Set Sectoral Adaptation Targets and Goals

Generally, climate adaptation targets include more qualitative elements than mitigation targets, as adaptation addresses multi-dimensional risks and vulnerabilities that are not fully quantifiable. Use a combination of qualitative and quantitative indicators to define resilience outcomes across communities, governance, infrastructure, and ecosystems.

Where quantitative targets are not feasible, define qualitative targets initially (e.g., developing a heat action plan or ensuring that critical infrastructure, such as major hospitals, water supply systems and power facilities, meets climate-proofing standards against flood and storm events by 2030). These can be appropriately quantified over time (e.g., number of infrastructure facilities with climate-proof structures) as data availability improves.

Targets and goals should be identified based on the city's climate hazard and risk assessment, and should reflect adaptation needs over the defined timeframe. Outcome-based targets (e.g., reductions in flood-prone areas; decreases in heat-vulnerable wards; improved community awareness of safe practices in emergency situations) and output-based targets (e.g., number of cool roofs installed or properties with rainwater harvesting) can be used to reflect reduced vulnerability and enhanced resilience.

At the sector level, adaptation targets identified for different resilience interventions can be consolidated into overarching targets or goals. The quantitative targets for specific interventions serve as measurable, time-bound signposts to help achieve the overarching sectoral targets or goals. Examples are provided in **Table 2**.

Table 1: Setting Sectoral Mitigation Targets - Example

Sector	Resilience intervention	Target Parameter	Target by milestones (2030 to 2050)	Key policy and program alignment for target setting	Aggregate sectoral GHG emission reduction (tons of CO_2e)	Sectoral GHG emission reduction target from business-as-usual emissions
Energy and Buildings	Renewable energy adoption in residential buildings	Share of residential electricity consumption met by renewable energy	**2030:** 15% **2040:** 30% **2050:** 70%	National rooftop solar program; state renewable energy policy; state renewables master plan	**2030**:250,000 **2040:** 660,000 **2050:**1,400,000	**2030:** 24% **2040:** 52% **2050:** 78%
	Improving energy efficiency in commercial buildings	Percentage of commercial buildings with LED lights and high efficiency appliances	**2030:** 15% **2040:** 30% **2050:** 70%	State energy conservation policy, city building bylaws		
	Adoption of green and energy-efficient public buildings	Percentage of public buildings with green building certification and/or ECBC-compliance	**2030:** 50% **2040:** 100% **2050:** 100%	National building energy codes; state notification on green public buildings		
Transport	Transition to clean, electric mobility	Percentage of private electric cars	**2030:** 25% **2040:** 50% **2050:** 80%	National electric mobility scheme, state electric vehicle policy	**2030**:110,000 **2040:** 350,000 **2050:** 800,000	**2030:** 25% **2040:** 55% **2050:** 85%
	Promote non-motorized mobility	Modal share of non-motorized transit (walking and cycling)	**2030:** 18% **2040:** 22% **2050:** 25%	City Mobility / NMT Plan		
Solid Waste	Augment scientific waste processing using low-carbon solutions	Percentage of waste processed in bio-methanation and bio-CNG facilities	**2030:** 10% **2040:** 20% **2050:** 40%	Solid waste management rules; city integrated solid waste management plan	**2030**: 45,000 **2040:** 120,000 **2050:** 250,000	**2030:** 30% **2040:** 65% **2050:** 90%
	Switch to low-carbon waste collection vehicle fleet	Share of electric vehicles in municipal waste collection fleet	**2030:** 50% **2040:** 100% **2050:** 100%	National electric mobility scheme; state electric vehicle policy		

Table 2: Setting Sectoral Adaptation Targets - Example

Sector	Climate Hazard	Resilience intervention	Target Parameter	Target by milestones (2030 to 2050)	Key policy and program alignment for target setting	Sectoral adaptation targets/ goals
Buildings	Heat stress	Adopt cool roofs in homes	Percentage of low-income households with cool roofs	**2030:** 15% **2040:** 30% **2050:** 70%	National cooling action plan; state heat action strategy	Reduce climate risk-impacted buildings in the city by 2050, with at least 70% of low-income households using cool roofs and 60% of plots incorporating on-site rainwater management
	Urban flooding	Integrate flood-resilient design in building plots	Percentage of plots with recharge pits, permeable paving, and rainwater harvesting systems	**2030:** 10% **2040:** 25% **2050:** 60%	State flood management plan, city building bylaws	
Stormwater Drainage	Urban flooding	Improve the stormwater drainage network, prioritizing areas susceptible to urban flooding	Extent of flood-prone city areas	**2030:** 25% **2040:** 15% **2050:** 10%	State flood management plan, city stormwater drainage plan	By 2050, minimize urban flood risk with flood-prone areas reduced to 10% of the total city area, and all vulnerable communities having access to early warning systems
	Urban flooding	Implement a network of early flood warning systems	Vulnerable communities covered by early warning systems	**2030:** 50% **2040:** 100% **2050:** 100%	District disaster management plan	
Health	Heat stress	Implement measures to reduce heat-related impacts on public health, such as early warning systems and cooling shelters	Percentage reduction in heat-related hospitalizations	**2030:** 15% **2040:** 35% **2050:** 60%	State heat action plan; urban health mission	Strengthen heat preparedness and heat health resilience by 2050, ensuring formulation of heat action plans and 60% reduction in heat-related hospitalizations
Urban Green Cover and Biodiversity	Heat stress	Increase urban green cover using native species	Share of city area with green cover	**2030:** 10% **2040:**15% **2050:**30%	National urban design guidelines, State Tree Policy, city biodiversity, and greening plan	Develop a connected, city-wide network of green and blue spaces to reduce heat stress, facilitate drainage, and support urban biodiversity, with a 30% increase in urban green cover by 2050

3.2 Set Sectoral Adaptation Targets and Goals

Generally, climate adaptation targets include more qualitative elements than mitigation targets, as adaptation addresses multi-dimensional risks and vulnerabilities that are not fully quantifiable. Use a combination of qualitative and quantitative indicators to define resilience outcomes across communities, governance, infrastructure, and ecosystems.

Where quantitative targets are not feasible, define qualitative targets initially (e.g., developing a heat action plan or ensuring that critical infrastructure, such as major hospitals, water supply systems and power facilities, meets climate-proofing standards against flood and storm events by 2030). These can be appropriately quantified over time (e.g., number of infrastructure facilities with climate-proof structures) as data availability improves.

Targets and goals should be identified based on the city's climate hazard and risk assessment, and should reflect adaptation needs over the defined timeframe. Outcome-based targets (e.g., reductions in flood-prone areas; decreases in heat-vulnerable wards; improved community awareness of safe practices in emergency situations) and output-based targets (e.g., number of cool roofs installed or properties with rainwater harvesting) can be used to reflect reduced vulnerability and enhanced resilience.

At the sector level, adaptation targets identified for different resilience interventions can be consolidated into overarching targets or goals. The quantitative targets for specific interventions serve as measurable, time-bound signposts to help achieve the overarching sectoral targets or goals. Examples are provided in **Table 2**.

3.3 Co-benefits and Inclusivity

As climate action is multi-sectoral and multi-dimensional, it helps deliver multiple social, economic and environmental co-benefits. Targets for climate mitigation and adaptation should be designed to support the integration and equitable realization of these co-benefits.

Identify and quantify, where feasible, co-benefits such as improved public health, enhanced access to urban services, energy access, improved air quality, job creation and livelihood benefits, inclusion of vulnerable communities, including links to the Sustainable Development Goals (SDGs).

To strengthen equity considerations, prioritize climate interventions and targets that benefit vulnerable groups and low-income communities, informal settlements, women, children, the elderly, and persons with disabilities.

Cities can define a set of co-benefit indicators (e.g., the number of green jobs, particulate matter concentration, and the share of households with improved services in informal settlements) and link them to specific climate interventions and targets.

Several interventions can deliver both GHG emissions reduction and climate resilience benefits. For instance, sustainable building materials or cool roofs can improve thermal comfort and reduce heat stress for occupants, while also reducing building energy consumption and GHG emissions. Prioritizing such interventions and defining specific targets and indicators to track their multiple impacts is important for concurrently addressing mitigation and adaptation outcomes.

The sectoral mitigation and adaptation targets set in step 3 are the building blocks for city-wide targets. These targets should be combined or rolled up to establish city-wide mitigation and adaptation goals.

By aggregating sector-level GHG reduction estimates and synthesizing sector-level adaptation goals, overarching city-wide mitigation and adaptation targets and goals can be identified. This step provides a coherent direction for the city's pathway toward net-zero emissions and enhanced climate resilience.

Co-benefits and considerations for inclusivity identified at the sector level in Step 3 should be carried forward during the city-wide roll-up of targets. Key performance indicators (KPIs) should be developed for city-wide and sectoral targets to monitor progress (refer to Tool 6.3: Tracking of CRCAP Implementation).

At least one KPI should be defined for each city-wide and sectoral target, including the indicator, unit of measurement, baseline year value, and target year value, responsible department, and frequency of data collection and reporting.

4.1 Aggregating City-wide Mitigation Targets

Combining sector-level GHG emissions reduction estimates to understand the cumulative impact across the city. Sum the sectoral emissions-reduction estimates or values from Step 3 to determine the total reduction.

Calculate the overall percentage reduction in emissions by comparing total reductions with either projected business-as-usual (BAU) emissions for the target year or baseline emissions for the base/starting year.

Use the result to frame a clear, measurable city-wide mitigation target, specifying either the intended percentage reduction or emissions level for the target year. For consistency, ensure that city-wide and sectoral mitigation targets align on the target year and interim milestones.

Example:

City X aims to achieve city-wide Net-zero GHG emissions by 2050, in line with the State's net-zero commitment.

GHG emissions reduction target:

- • GHG emissions in 2030: 18% lower than projected BAU emissions
- • GHG emissions in 2040: 57% lower than projected BAU emissions
- • GHG emissions in 2050: 88% lower than projected BAU emissions

The city will periodically update its targets to further reduce residual emissions through emerging technologies and additional strategies, aiming to achieve net-zero emissions by 2047.

4.2 Aggregating City-wide Adaptation Targets and Goals

Combine sectoral adaptation targets to frame overarching city-wide adaptation goals and targets. These should clearly reflect the city's reduced climate risks and vulnerabilities over the target timeframe.

The adaptation goals should address major risks and hazards, reflect the main vulnerabilities, and show the risk-reduction outcomes achieved through collective sectoral efforts. As with sectoral adaptation goals, city-wide goals may be qualitative, supplemented by quantitative targets and indicators where possible.

Example:

City X aims to become a climate-resilient city by 2050 by adopting climate-resilient infrastructure, climate-smart urban design, resilient health systems, nature-based solutions, and circular economy principles. The city will strengthen climate resilience and address urban flooding, heat stress, and extreme weather events by ensuring comprehensive early warning systems in all high-risk wards, implementing risk-informed spatial planning, and enhancing institutional preparedness.

4.3 City-wide Climate Vision

Develop a vision statement that integrates climate mitigation and adaptation, supported by clear objectives and targets. The vision should define a common understanding of what climate-resilient, net-zero transformation means for the city and community. It should set out commitments for climate mitigation and adaptation, and can be guided by the city's existing visions and strategic goals.

It is recommended that, along with the vision, the city indicates how its climate actions align with and contribute to global (e.g., Paris Agreement), national (e.g., NDCs and net-zero and adaptation targets), and state-level priorities.

Example:

City X envisions transforming into an ambitious net-zero and climate-resilient future by 2050. We aim to safeguard our community and resources from the impacts of climate extremes by adopting sustainable, climate-sensitive, and innovative solutions and infrastructure.

The city wants to inspire and set an example for others by adopting clean, green renewable energy, enhanced energy efficiency, resource efficiency and circularity, climate-sensitive mobility, integrated blue-green networks, and gender and social inclusivity. The city government aims to implement multi-sectoral climate strategies and actions in a community-centric manner.

Our climate vision and efforts support India's 2070 net-zero goal and global action under the Paris Agreement.

STEP 5

Validate Targets through Stakeholder Consultation

Target setting is a participatory process that involves city departments, public institutions, stakeholders, community groups, and sector experts. Stakeholder engagement and consultation are necessary to identify appropriate targets aligned with evolving local and climate conditions, validate feasibility, and build consensus on ambition levels.

The Climate Core Team should lead this process and engage stakeholders through the Stakeholder Committee and, where required, subject-matter experts or state department officials. The stakeholders may be engaged through bilateral discussions and consultation meetings/workshops.

Review and Update Targets

It is recommended that the climate resilience targets should be reviewed and updated every 4 years, based on updated GHG inventories and climate risk assessments.

Tool 4.3A

Detailing of Climate Resilience Actions and Integration into City Plans / Schemes

This tool provides guidance to city governments on detailing each shortlisted and prioritised climate resilience intervention for inclusion in the Net-zero CRCAP document, through two linked exercises. Templates are provided, along with illustrative examples, to guide cities in preparing sector-wise summaries of interventions and their linkages to existing plans and programs, as well as detailed briefs of strategies and actions. This supports the development of the Climate Resilience Actions and Targets chapter, which details the sector-wise goals, strategies, and actions in the Net-zero CRCAP document. This should be undertaken and coordinated by the Climate Core Team, in collaboration with the Stakeholder Committee as needed, to ensure that cross-departmental linkages, coordination, and feasibility are effectively integrated into the Net-zero CRCAP.

Linking Resilience Interventions to Ongoing Plans and Programs

Local governments typically operate through a comprehensive set of statutory plans and policies and may already be implementing several departmental work programs and ongoing projects. To ensure practicality and ownership, CRCAP-recommended climate resilience actions should, wherever possible, be integrated into existing plans, programs, and projects rather than introduced as standalone initiatives. The intention of the Net-zero CRCAP is to climate-proof existing city plans and strengthen climate resilience, rather than increase workload by introducing only standalone interventions. Cities should follow the steps below to link resilience actions with existing plans and programs:

Step 1: For each resilience intervention identified and prioritized using Tool 4.2A and Tool 4.2B, identify the relevant plans and programs of the city government into which the intervention can potentially be incorporated.

Step 2: Check the existing programs' timelines to ensure they align with the proposed timelines for the climate resilience intervention under consideration.

Step 3: Assess if the existing programs and plans can include the climate resilience interventions without requiring additional resources or with minimal extra resources, compared to implementing the intervention as a stand-alone initiative.

Once linkages between climate resilience interventions and the city's upcoming/ proposed/ongoing programs/schemes have been identified, a sector-wise summary table of all resilience actions and their linkages with existing plans and programs may be prepared. Table 1 provides a template to summarise the recommended interventions, target areas, and actors, and opportunities to link and leverage interventions with existing city plans and programs.

Table 1: Linking Resilience Interventions to Ongoing Programs

Resilience Interventions	Relevant Programs	Ongoing/upcoming/ planned	Can the program be leveraged – yes/no; if yes, how?
Example: Mandatory rooftop rainwater harvesting to deal with water stress arising from increasing temperatures and decreasing precipitation	Housing Scheme for the Urban Poor	Upcoming (next financial year)	Yes. The design of buildings can be modified to include rooftop rainwater harvesting and safe storage systems

Detailing Climate Resilience Interventions

For each sector, following the summary table of climate resilience actions, the report should present detailed descriptions of all strategies and actions, along with specific targets for a Net-zero scenario or another climate scenario for which the CRCAP is being developed. The template below, with an example (in italics) from the Energy and Built Environment Sector, provides guidance on developing sector-wise, detailed briefs for each strategy and action to be included in the Net-zero CRCAP document.

Table 1: Example for strategy-wise summary of actions and targets

Strategy 1: Enhance Renewable Energy Adoption in Commercial, Municipal, and Residential Buildings			
Target Parameter	Net-zero Scenario Targets		
	2030	2040	2047
Share of electricity consumption in residential buildings to be met by renewables	15%	28%	46%
Share of electricity consumption in commercial and institutional buildings to be met by renewables	27%	48%	64%

The corresponding actions for each strategy detailed in the strategy summary table should be listed with their respective sub-actions, covering potential locations, implementing agencies, scale, indicative costs, financing modes or sources, the type of action, timelines, climate resilience benefits, monitoring indicators, and relevant good practices. Similar detailed information will be prepared for all actions and sub-actions across all sector-wise strategies.

Table 3: Example for Detailing Actions and Sub-actions for each strategy

	Action 1.1 Enhance city-wide solar water heater adoption
	Action details: Briefly describe the action and its importance Solar water heaters can meet hot water demand in facilities such as hospitals, hotels, student accommodation, and residential apartments. Hyderabad experiences hot water demand for nine months or more each year. About 86% of the households in the city are permanent constructions, making them suitable for installing solar water heating systems. This highlights the need for GHMC to assess the current adoption level and promote solar water heating systems.
	Sub Actions: List specific activities required to implement the action. • The ULB can conduct a baseline survey to document the use of solar water heaters in commercial, municipal, and residential buildings, and identify barriers to their uptake, including lack of awareness and cost. • GHMC can promote its existing 10% rebate for solar water heater installations as per the Telangana Building Rules, and publicize it through the survey. • Mandates for solar water heater (SWH) use can be included as a criterion within GHMC's Development Permission Management System for new building permissions, particularly for hospitals, hotels, and institutional buildings.
	Potential locations: Identify priority areas for implementation based on risk levels, service gaps, or resource stress. Locations may be specified as wards, zones, clusters, or localities. If the action is applicable across the entire city, indicate "City-wide", and additionally indicate any high-priority areas or clusters for focused implementation. *Example: Hospitals, hotels, academic hostels, large residential complexes, and government guest houses.*
	Implementation agency **Lead:** Name the primary organization responsible for overall implementation, coordination, and accountability. • *GHMC* **Supporting:** List other agencies, departments, institutions, or organizations that will provide technical, financial, or operational support. • *TGSPDCL, Telangana Renewable Energy Development Corporation, Manufacturers, NGOs, survey agencies, RWAs*
	Estimated targeted scale: Mention the planned magnitude of implementation, ideally linked to milestone years • *Number of residential houses with SWH: 1,37,938 (2030), 3,25,796 (2040), 7,27,365 (2047)* • *Number of commercial units with SWH: 927 (2030), 2,190 (2040), 3,667 (2047)*
	Indicative cost: Provide indicative financial information. Where possible, include ballpark costs or total estimated costs by phase or target year. If such estimates are unavailable, include unit costs (e.g., per building, per m^2, per kW) where applicable. • *SWH in residential buildings (million INR): 2,345 (2030), 5,539 (2040), 12,365 (2047)* • *SWH in commercial buildings (million INR): 16 (2030), 37 (2040), 62 (2047)*

Action 1.1 Enhance city-wide solar water heater adoption	
	Financing modes/sources: List possible funding sources and instruments, such as municipal or state budget, national schemes (energy efficiency, renewable energy, housing, etc.), development or multilateral banks, climate funds, corporate social responsibility (CSR) and private sector contributions, energy service companies / renewable energy service companies/public private partnership (PPP) models, targeted programs for micro-, small- and medium-sized enterprises or low-income housing, and any other source as per the actions. • *GHMC budget, CSR funds*
	Type of action: Specify whether this is primarily an adaptation or mitigation action
	Timeline: Indicate implementation time period – Short-/ Medium-/ Long term • *Short*
	Climate resilience benefits: Low / Medium / High / Very High. To be filled based on the "Prioritization of Resilience Interventions" exercise in Tool 4.2B: Resilience Intervention Screening.
	Monitoring Indicators: Provide a list of measurable indicators to assess progress and impact. Indicators should allow tracking of implementation, performance, and outcomes. They should include coverage indicators (how much / how many), performance indicators (change over time), and outcome indicators (impact on risk or resilience): • Number of zones or wards surveyed • Category-wise number of properties installed with SWHs • Number of rebates availed annually
	Good practice: Provide examples of successful implementation from other cities or regions, including location, intervention, outcomes, and relevance to this action.

If required, enabling actions may be added for each strategy to support the implementation of the main actions and sub-actions. These are supportive measures that strengthen institutional, financial, technical, and governance capacity to enable effective implementation. These actions may be cross-cutting and support multiple actions within a strategy. They include guidelines, dedicated cells, training programs, financing mechanisms, or monitoring platforms that help scale and sustain implementation across departments and stakeholders.

Enabling Actions
• A "**groundwater cell**" or "**task force**" can be instituted, similar to that planned in Bangalore. The cell can be constituted within the Hyderabad Metropolitan Water Supply and Sewerage Board, with members from GHMC, Groundwater Department (GWD), Hyderabad Metropolitan Development Authority (HMDA), geologists, Telangana Groundwater Department, and the Central Groundwater Board. The cell can establish an inspection and monitoring mechanism to periodically check and verify groundwater management across all properties throughout the year. • AI-based groundwater monitoring systems can be explored for real-time data collection, analysis, and reporting across relevant departments such as GHMC, HMDA, geologists, Telangana Groundwater Department and the Central Groundwater Board.

Tool 4.3B

CRCAP Document Template

This tool is a guidance template that cities can use to prepare the Net-zero Climate Resilient City Action Plan (CRCAP) document. The Action Plan should incorporate the outputs of Steps 1 to 4 of the Net-zero ClimateResilientCities (CRC) Methodology, the inputs, and the analyses carried out using the guidance provided in the various tools supporting the first four steps of the methodology. The Net-zero CRCAP template provided in this tool is structured chapter-wise, with guidance on the analysis and insights to be included in each chapter and is only suggestive in nature. Cities are encouraged to contextualise and adapt the structure and content of the Net-zero CRCAP as per their local context and requirements.

Chapter-wise Net-zero CRCAP Template:

Executive Summary

The Executive Summary, placed at the start of the Net-zero CRCAP, provides a quick overview of its scope, priorities, strategic direction of local climate actions, and major outcomes of the climate action planning process using the Net-zero CRC methodology. This section summarises the city's climate vision, net-zero ambitions, institutional commitment to local climate actions, local context, urban service systems and critical service gaps, climate risks faced by the city and its population, and its greenhouse gas (GHG) emissions profile. It also provides sector-wise adaptation and mitigation goals and targets, projected GHG emission reduction pathways, residual emissions, estimated budget requirements, key takeaways, and the way forward.

Chapter 1

Introduction

This chapter provides an introduction to the global discourses on climate action and resilience, an overview of key national targets and commitments, such as Nationally Determined Contributions (NDCs) and net-zero targets, and highlights existing climate action initiatives, policies, missions, programmes, and schemes that work toward fulfilling national and international commitments. It also provides a comprehensive overview of climate hazards and their impacts in the country, especially in urban areas, underscoring the need to develop and implement city-scale climate action plans.

The chapter should further document the climate action efforts and initiatives undertaken by the state or province in which the target city is located to help understand how national and sub-national efforts influence and enable city-level climate action. It can also highlight the city's intention to develop and implement a Net-zero CRCAP, and to establish the Climate Core Team and Stakeholder Committee to demonstrate political and executive buy-in from the local government and establish accountability and credibility for the Net-zero CRCAP.

Chapter 2

Methodology for Net-zero CRCAP development

This chapter describes the Net-zero CRC methodology, which serves as the overarching framework for preparing the Net-zero CRCAP, a nine-step process structured into three phases: Analyse, Act and Accelerate. It is important to note that not all nine steps of the methodology may be applicable at this stage. Steps 1 through 4 are specifically directed at developing the Net-zero CRCAP; Steps 5 and 6 address its implementation, institutionalisation and monitoring of climate actions, and CRCAP implementation progress; while Steps 7 through 9 focus on collaborating, reviewing, reporting, and scaling up the impacts of the climate actions implemented. This chapter should describe these nine steps and all major components to be developed for preparing the Net-zero CRCAP, explaining their purpose, importance and application. A dedicated set of tools (1.1-4.3C) has been developed as part of the Net-zero CRC toolkit to support the development of the Net-zero CRCAP.

Chapter 3

City Profile

This chapter presents a comprehensive study of the city, including a brief country profile and a detailed city profile covering location, connectivity, demography, city administration and municipal budget, economic activities, physiography, climate profile, land use, and air quality. The intent is to introduce the city's characteristics, geography, economy, and governance, and to provide an understanding of the local context, scale and capacity of the city and its Urban Local Body (ULB). This is vital for urban system gap analysis, identifying locations and population groups vulnerable to climate risks, and developing future growth and emission mitigation scenarios in the subsequent chapters.

Chapter 4

Major Urban Systems and Gap Analysis

This chapter establishes the current baseline status of the city's essential urban systems and services based on a sector-wise assessment of service-level performance, infrastructure and service gaps, and vulnerability of key urban systems that influence the city's transition towards a climate-resilient and low-carbon future.

For each urban service system, this chapter should systematically document the baseline conditions, performance levels, issues, gaps and locations vulnerable to these deficiencies. The analysis can be represented through spatial maps, charts, tables, graphics, and other visual tools to enhance understanding. The chapter should also capture the city's planned and ongoing projects and initiatives to address these deficiencies and enhance infrastructure and service delivery over time. This will inform the development of adaptation and mitigation strategies in subsequent chapters.

The essential urban systems for a city include water supply and distribution, wastewater management, solid waste management, stormwater management, health, urban greening and biodiversity, air pollution, built environment and energy, transportation, and fire and emergency services.

Chapter 5

Climate Risk Assessment

This chapter covers the climate risk assessment undertaken for the city and includes analysis of climate change trends and projections, development of climate scenario statements, and assessment of climate hazards, exposure and vulnerability to climate risks.

The chapter should first present the key findings from the assessment of historical climate data that can provide an overview of climate trends and patterns across key climate variables, including air temperature, precipitation, relative humidity, and sea-level rise, and the changes witnessed in the frequency and intensity of extreme climate events.

The chapter should also highlight the outcomes of climate assessments conducted at the city, metropolitan, or state level, such as the State Action Plan on Climate Change. The climate projections developed, using established pathways such as the Shared Socio-economic Pathways (SSPs), can offer insights into the range of future climate conditions across multiple scenarios. The insights from climate projections can help develop climate scenario statements which guide the development of Progressive and Net-zero Pathways, and long-term adaptation and mitigation actions.

This chapter should further highlight the key outcomes of climate risk assessment that identifies the impacts of various climate hazards on the city, particularly specific areas, wards, and populations. When combined with time-series analysis, this assessment helps identify priority zones that require targeted interventions and informs the development of adaptation and mitigation strategies and actions. The findings should also be integrated with the baseline assessment of urban systems to develop a comprehensive understanding of vulnerable areas, population groups and at-risk critical infrastructure.

Chapter 6

Greenhouse Gas Emissions

This chapter introduces the GHG emissions inventory and the Global Protocol for Community-Scale GHG Emissions (GPC)-compliant methodology. It covers Scope 1 (direct emissions within city limits) and Scope 2 (indirect emissions from grid-supplied electricity, heat, or cooling) emissions. The inventory should be structured into: 1) Community-Level Emissions Inventory (covering emission sources from buildings, commercial and industrial sectors, transportation, solid waste, and domestic wastewater within the municipal boundary); and 2. Local Government Operations Inventory (emissions from municipal operations and services, including municipal buildings, streetlighting, water supply, wastewater treatment, municipal vehicle fleet, and waste management facilities).

The inventory should be prepared for the base year of the Net-zero CRCAP and incorporate data from the previous four to five years to capture emissions trends. These insights will help identify key sectors and fuel types that require targeted interventions and will inform the development of Business-as-Usual (BAU) projections, Net-zero scenarios and the formulation of mitigation targets and strategies in subsequent chapters.

Chapter 7

Scenario Planning for Future Emissions Reduction

This chapter provides an understanding of Scenario Planning, an essential component of the Net-zero CRCAP, as it facilitates mapping various trajectories or pathways for proposing climate resilience and mitigation measures. Generally, three scenarios are developed as part of a Net-zero CRCAP. They are:

Business-As-Usual: Based on the GHG Emission Inventory and population projection, the BAU Scenario illustrates future GHG emission levels if the city maintains its current practices without implementing mitigation actions. It functions as a baseline for evaluating the impact of emissions-reduction scenarios or pathways.

Progressive Action Scenario: This scenario takes into account climate policies and programmes from national and state governments, while reflecting on-ground conditions, including existing urban infrastructure and service delivery, current schemes, policies, and programmes, as well as the level of adoption of climate solutions, resources, and capacity.

Net-zero Pathway: This scenario portrays an ambitious emissions reduction pathway, based on the implementation of challenging climate actions and efforts to fulfil the city's net-zero emissions commitment. The proposed strategies and actions go beyond the targets established by national and state-level plans, policies, and programmes.

Chapter 8

Climate Action Plan

This chapter focuses on the city's goals, targets, and actions concerning climate resilience. It outlines the vision and objectives for each sector, followed by sector-specific goals, adaptation and mitigation targets, and the strategies proposed for their attainment. To support the development of evidence-based targets, strategies, and climate resilience measures, this chapter should present, for each sector, baseline GHG emissions, existing policies, plans, regulatory frameworks, current and proposed projects and investments, associated climate risks and hazards, key issues and gaps, and the BAU and GHG emissions scenarios. This analysis provides a holistic understanding of each sector's current status and future trajectory, supporting the formulation of realistic and ambitious mitigation targets, adaptation strategies, and climate resilience initiatives.

The chapter should also elaborate on the adaptation and mitigation actions identified under each strategy and sector. It should specify the current status of interventions, the sub-actions required for implementation, and any related planning undertaken by the ULB. Each action should also identify the vulnerable and priority areas identified through the climate risk and vulnerability assessment (CRVA), where implementation is proposed.

Each action should also include details on financial requirements, implementation and supporting agencies, and anticipated co-benefits. For clarity, it is essential to include an implementation timeline, estimated emission-reduction potential, alignment with the Sustainable Development Goals (SDGs), and its overall impact on the city's climate resilience and mitigation objectives. Such comprehensive documentation will ensure that each action is well-defined, feasible, and integrated within the broader framework of the city's Net-zero CRCAP.

Chapter 9

Governance and Implementation of the Net-Zero CRCAP

This chapter should outline the institutional, governance, and operational framework required for the effective implementation of the Net-zero CRCAP. It should document the establishment of a dedicated Net-zero Cell within the municipal body, responsible for overseeing the implementation, monitoring, and reporting of climate actions. The chapter should also describe the roles of the Climate Core Team and the Stakeholder Committee, who are responsible for ensuring strategic alignment, interdepartmental coordination, and inclusive decision-making. It should further describe how climate actions will be mainstreamed into the city's Development Plan and Town Planning Schemes, and how sector-wise five-year and annual action plans will be developed to ensure adequate funding and timely implementation.

The chapter also outlines mechanisms for monitoring, tracking, and reporting progress through a robust Monitoring, Reporting, and Verification (MRV) system using Key Performance Indicators (KPIs) aligned with national and international reporting frameworks. It should also describe the supporting actions required to fast-track climate action. These actions include capacity building, green public procurement, community awareness and engagement, and the exploration of diverse climate finance mechanisms such as green bonds, voluntary carbon credits, and partnerships with international agencies.

It should conclude by summarising the city's broader climate goals and its commitment to implementing the Net-zero CRCAP for achieving concrete, measurable, and time-bound outcomes.

Annexures

The annexures will contain supplementary details supporting the Climate Action Plan, including the formation of the Stakeholder Committee and the Climate Core Team, as well as summaries of recorded meetings. It will also include detailed descriptions of the methodologies followed, calculation sheets, maps, tables, baseline data, projections, and summaries of the GHG emissions inventory. Additional components, such as sectoral growth factors used for BAU projections and feasibility assessments in adaptation and mitigation actions, will also be provided. The annexures should also include any other data/details that strengthen or substantiate the content presented in the report or that need further explanation.

Tool

4.3C

Ratify and Adopt Net-zero CRCAP

This tool provides guidance on the ratification and adoption of the Net-zero Climate Resilient City Action Plan (CRCAP) by the city. It helps translate the CRCAP from a strategic vision document into a formally recognized roadmap that has the authority to guide the planning, investment, and implementation of climate action projects at the city level.

Ratification and adoption of the Net-zero CRCAP are critical to moving climate actions from the planning stage to implementation, as they help build political and administrative ownership for the document, enable integration into municipal governance systems, strengthen accountability and coordination, and improve access to climate finance and implementation partnerships. This supports the effective implementation of long-term, sustained climate action in the city.

Once the Net-zero CRCAP is prepared, it should be formally ratified by the local municipal council or the local government to give it official status, enabling its adoption by the city as an approved policy and development planning framework to guide climate change mitigation and adaptation actions.

For ratification, the CRCAP should be formally presented to the Mayor, the Commissioner, and councilors in a City Council meeting. The overall vision, targets, priority actions, and their relevance to the city's development and long-term resilience should be clearly communicated through a summary note, preferably in the local language, to enable informed decision-making at the political council or administrative level. Formal approval of the plan is typically recorded through a council resolution or an official adoption letter issued by the Mayor or Commissioner confirming that the plan has been endorsed.

In cities where a mayor or municipal council is not in place, ratification may be undertaken by a legally recognized decision-making authority or by the city's protocol, such as approval by the municipal commissioner, a special officer, or a standing committee, as applicable.

Following ratification, the Net-zero CRCAP should be integrated into regular municipal planning, budgeting, and investment processes so that the approved actions are implemented through established mechanisms. Council-level adoption enables alignment with annual municipal budgets, infrastructure planning, and relevant state and national government schemes. Refer to

Tool 5.1, 5.2, 5.3A, 5.3B, 6.1A, 6.1B, 67.2, and 6.3 for guidance on funding and financing Net-zero CRCAP implementation, institutionalizing climate action planning and implementation, and the monitoring of the Net-Zero CRCAP.

Public disclosure and dissemination are integral to adoption. Once approved, the Net-zero CRCAP should be made available to the public through the city's official website and other appropriate communication channels. Communication should be clear and accessible, explaining the plan's objectives, expected outcomes, and implications for urban services and infrastructure, thereby strengthening transparency, accountability, and public participation.

Together, ratification of the CRCAP, its institutional adoption, integration into governance processes, especially in annual planning and budgeting, and public disclosure ensure that the Net-zero CRCAP functions not just as a strategic policy document but also as an operational governance framework guiding the city's transition towards a climate-resilient future.

Tool 5.1

Funding and Financing for CRCAP Implementation

This tool provides guidance to cities in translating their Net-zero Climate Resilient City Action Plan (CRCAP) into implementable actions that can be funded through municipal budgets or external financing. Identifying a pipeline of implementable projects and securing sustained financial investments are essential to translate climate targets into on-the-ground actions through pilot projects, institutional systems and long-term at-scale transformational projects. This tool outlines two practical approaches or pathways for implementing the Net-zero CRCAP that cities can choose from.

Implementation Pathways for Funding and Financing CRCAP Implementation

A city's Net-zero CRCAP identifies long-term pathways and priority actions to reduce greenhouse gas (GHG) emissions and enhance climate resilience. However, it is imperative to have a structured approach to implementing climate actions; otherwise, the CRCAP's goals, targets, and strategies will largely remain in the planning stage and not advance to meaningful action and benefits on the ground.

Cities should translate the Net-zero CRCAP into an operational, actionable plan for short-term periods of one to five years, embedded within their governance structures. Cities are at different levels of readiness to implement their Net-zero CRCAPs. They can adopt two complementary implementation pathways based on their governance structure, institutional capacity, policy landscape, and financial readiness.

Cities that are vulnerable to climate risks or with strong political commitment can begin implementing climate actions through Pathway 1, in which a near-term implementation plan and quick-win projects enable their rapid entry into implementation. Cities with strong financial capacity and mature financial systems can adopt Pathway 2, which takes a more strategic approach by developing a Climate Investment Plan (CIP) for medium-term planning. The CIP guides the funding and financing of Net-zero CRCAP implementation, while directly implementing selected climate action projects in parallel.

While Pathway 2 follows a more structured approach for implementing the Net-zero CRCAP, cities following Pathway 1 can immediately move towards CRCAP implementation. However, they should strive to improve their financial systems and develop a CIP, as suggested in Pathway 2, to ensure a structured approach to long-term capital expenditure planning for climate action projects. Notably, the four steps described in each pathway are not necessarily consecutive and can be undertaken in parallel.

As key enablers of climate governance at the local level, cities should establish a dedicated institutional structure, such as a Net-zero / Climate Action Cell within their government to lead and coordinate the implementation of climate actions (refer Tool 6.1: Institutionalising Climate Action Planning and Implementation). It is recommended that the roles and functions of the 'Climate Core Team' (refer Tool 1.2: City Climate Core Team) evolve into a Net-zero / Climate Action Cell, a cross-structural entity within the local government that supports the implementation of the Net-zero CRCAP.

PATHWAY 1 Cities looking to quickly operationalise their Net-Zero CRCAP can develop near-term plans and projects to implement climate interventions	PATHWAY 2 Cities develop a Climate Investment Plan (CIP) for medium-term planning and funding of Net-zero CRCAP implementation while implementing short-term projects in parallel
STEP 1 Develop a Near-term Net-zero CRCAP Implementation Plan (1–5 years)	STEP 1 Develop a Climate Investment Plan (CIP) for Net-Zero CRCAP implementation in the medium-term
STEP 2 Identify climate interventions that require pilot demonstration for scale-up and implement the pilots	STEP 2 Develop pipeline of climate projects in line with CIP's capital expenditure planning and climate investment estimates
STEP 3 Identify quick-win climate projects for implementation and develop a pipeline of bankable projects	STEP 3 Implement short-term climate action projects through near-term planning and municipal climate budgeting
STEP 4 Undertake Climate Budgeting and mobilise external funds for the implementation of multiple climate action projects	STEP 4 Mobilise external Climate Finance for large-scale climate action projects in the medium-term

Pathways for implementation of Net-zero CRCAP

PATHWAY 1

Cities looking to operationalise their Net-zero CRCAPs quickly can develop near-term plans and projects to implement climate interventions

Step 1: Develop a Near-term Net-zero CRCAP Implementation Plan (1–5 years)

Once the Net-zero CRCAP is formally ratified and adopted by the city, and an appropriate institutional mechanism is established at the local level to coordinate and steer climate action, the next step is to prepare a time-bound near-term implementation plan, typically covering a 1- to 5-year period.

This implementation plan should be anchored in the Net-zero CRCAP's long-term net-zero vision, sector-specific goals and targets, and climate resilience priorities. It should prioritise climate actions and policies that are immediately feasible, and aligned with national, state and city development priorities, existing municipal capacities and resource availability, thereby enabling early and tangible climate and development co-benefits.

The near-term implementation plan operationalises the Net-zero CRCAP by translating the recommended climate actions into concrete, high-impact projects aligned with national, state, and city priorities. By using standardised formats, these projects will be supported by indicative climate budgets, financing options, clear targets, defined timelines, expected outcomes, and clearly delineated roles and responsibilities for municipal departments. The output is a time-bound action plan with responsibilities, indicative costs, and implementation modalities.

The plan should also identify city-level policy, regulatory, and institutional measures necessary to enable, support, or accelerate the implementation of prioritised climate action projects outlined in the implementation plan. For regional, state or national policy, regulatory, and institutional measures, the Net-zero Cell / Department should prepare a brief note that identifies challenges and gaps and outlines a clear strategy for structured engagement with relevant regional government agencies to influence policy formulation and regulatory and institutional reforms.

Step 2: Identify Climate Interventions that Require Pilot Demonstration for Scale-up and Implement the Pilots

Climate interventions identified in the Net-zero CRCAP that involve new or unproven technologies, approaches, or business models should be shortlisted for pilot demonstration before scale-up. Pilot projects help cities test these interventions and build institutional confidence by demonstrating proof of concept and economic feasibility to government agencies and funders. Refer to Tool 5.2 for guidance on development and implementation of pilot projects. To develop and implement pilot demonstration projects, cities can mobilise funding under various national or state-level schemes, grants from multilateral organisations and financial institutions, and corporate social responsibility (CSR) funding from the private sector.

Step 3: Identify Quick-win Climate Projects for Implementation and Develop a Pipeline of Bankable Projects

Based on the actions prioritised in the implementation plan, cities should shortlist and implement quick-win climate action projects that have clearly defined technical scope, service delivery model, institutional ownership, CapEx/OPEX estimation and an implementation strategy, to ensure that they quickly transition from "action ideas" in the Net-zero CRCAP to "climate actions with tangible impacts".

Implementing climate actions on a large scale often requires significant investment, multi-stakeholder coordination and long-term institutional support. Identifying and developing bankable projects, based on city priorities and their techno-economic feasibility, enables the development of implementation-ready projects that are both investable and financially viable.

Therefore, where scale is required, cities should advance projects towards bankability through pre-feasibility studies, financial and economic analyses, risk assessment and mitigation, and identification of revenue or savings streams. Such an approach enables attracting funding from state or national schemes, missions or programmes, development finance, public-private partnerships, and climate finance. Refer to Tool 5.2A for guidance on identification and development of bankable projects for large-scale climate actions.

Step 4: Undertake Climate Budgeting and Mobilise External Funds for Implementation of Multiple Climate Action Projects

To support the implementation of multiple climate action projects, cities can initiate climate-responsive budgeting by analysing and tagging climate-relevant expenditures during annual budget cycles, tracking climate mitigation and adaptation-related spending, and mapping CRCAP actions to department-wise CapEx proposals and budget heads. This strengthens institutional ownership for climate action, improves transparency in climate-linked investments, and enables cities to demonstrate climate spending that improves access to external funding opportunities.

Climate budgeting is a governance-led fiscal approach that integrates a city's climate priorities into its core development and financial planning processes. It ensures allocation of municipal funds for climate mitigation and adaptation priorities, systematic tagging of climate-related expenditures, and the monitoring of climate action projects through existing municipal systems and project review mechanisms (refer Tool 5.3B: Municipal Climate Budgeting for more information).

The climate budgeting process, aligned with the annual municipal budget cycles, will build the capacity of departments to identify and prioritise climate actions using standardised formats or frameworks to ensure consistency and clarity. The identified projects linked to CRCAP interventions can be financed through internal municipal funds, state and national government schemes and grants, multilateral and bilateral climate finance, development finance institutions, CSR support, private-sector investments, green bonds, blended finance mechanisms, and public-private partnership models.

PATHWAY 2

Cities develop a Climate Investment Plan (CIP) for medium-term planning and funding of Net-zero CRCAP implementation while implementing short-term projects in parallel

Cities with strong financial capacity and mature financial systems can adopt this pathway by striving to develop a CIP once the Net-zero CRCAP is ratified and adopted. The development of the CIP will help integrate and mainstream priority climate actions into municipal budgets and mobilise state, national, and international climate finance for large-scale climate action projects.

Cities can also readily implement climate actions to meet local targets and showcase impacts by continuing to develop or implement climate action projects directly, in parallel, through climate budgeting and financing from external sources such as state or national grants.

Step 1: Develop a CIP for Net-zero CRCAP Implementation in the Medium Term

CIPs enable cities to develop a strategic implementation framework for CRCAP that provides actionable financial recommendations at local, state, and national levels to help them achieve their climate goals in line with national targets. As Net-zero CRCAPs are citywide vision documents with actions to be implemented by various government agencies and citizen groups, CIPs help allocate the required investment among different city stakeholders and develop a financing strategy for the municipal government's share of climate actions.

The CIP should be embedded in annual municipal budget planning and aligned with the medium-term capital expenditure envisaged under the city's sectoral infrastructure programmes based on its current priorities and needs. This ensures climate action becomes part of routine city expenditure planning, not an external add-on.

Step 2: Develop Pipeline of Climate Projects in line with CIP's CapEx Planning and Climate Investment Estimates

Cities should develop a structured pipeline of climate action projects aligned with the CIP and long-term municipal infrastructure and capital expenditure plans. Integrating climate action projects into municipal planning processes in line with the CIP enables the systematic identification of climate investment needs and the alignment of project proposals with available capital expenditure across budget cycles. Large-scale bankable projects often require phased implementation because of their high investment value and long development timelines. Maintaining a structured pipeline ensures sustained implementation over multiple budget cycles.

Step 3: Implement Short-term Climate Action Projects through Near-term Planning and Municipal Climate Budgeting

Cities can implement short-term climate action projects, identified in the near-term implementation plan, by initiating climate-responsive budgeting – tagging climate-relevant expenditures within annual budgets, tracking mitigation and adaptation spending, linking CRCAP actions to departmental budget heads, strengthening internal ownership, and improving access to external finance.

Climate budgeting is a governance-led approach that integrates a city's climate priorities into its regular planning and municipal financing processes. This ensures that climate actions and projects are systematically planned, funded, implemented, monitored, and reviewed as part of routine municipal decision-making (refer to Tool 5.3B: Municipal Climate Budgeting). It is crucial to align the climate budget process with the municipal budget cycle. Departments should also build capacity to identify and prioritise climate actions and projects by using standardised formats/frameworks to ensure consistency and clarity for further monitoring, as referred to in Tool 5.3B.

Step 4: Mobilise External Climate Finance for Large-scale Climate Action Projects in the Medium-term

Based on the strategies outlined in the CIP, cities can systematically engage with state and national governments for funding under various schemes and programmes, with multilateral and bilateral institutions for climate funds, and with the private sector for public-private partnerships, private finance including CSR funds, and blended finance instruments. The CIP adds credibility and provides clarity to investors and funding agencies on the scale of required investments and the financing strategies to be explored.

Tool 5.2

Near-term Project Prioritisation and Preparation

This tool provides guidance to cities on translating the long-term vision of the Net-zero Climate Resilient City Action Plan (CRCAP) into a time-bound, near-term Implementation Plan and developing climate projects aligned with local development priorities and climate ambitions. It outlines key aspects of the Implementation Plan and the steps that cities can follow to identify, prioritise, and prepare pilot demonstration and bankable projects to build a robust, investable pipeline of climate resilience projects.

Near-term Implementation Plan

Once the Net-zero CRCAP is ratified and adopted by a city, the next step is to develop a time-bound near-term Implementation Plan, typically for a one- to five-year horizon. The plan should be developed based on the Net-zero CRCAP's long-term vision, sectoral goals and climate resilience priorities and should focus on identifying priority actions that are immediately feasible, aligned with the city's development priorities and municipal capacities, and that lead to early climate and development benefits. The institutional structure established within the city government such as the Climate Action / Net-zero Cell to coordinate the planning and implementation of climate actions can lead the preparation of the near-term Implementation Plan (refer Tool 6.1A: Institutionalising Climate Action Planning and Implementation).

The near-term Implementation Plan translates the Net-zero CRCAP's recommended actions into projects, with indicative budgets, timelines, outcomes, and the roles and responsibilities of municipal departments. It should also suggest policy and regulatory measures, at the city or regional level, required to enable or accelerate their implementation.

Using standardised formats covering the aspects mentioned above, climate action projects should be identified and collated into an Implementation Plan that includes clear targets and financing options through municipal budgets, regional and national schemes or missions. External funding options can also be explored and presented based on stakeholder consultations.

For regional policy and regulatory measures, the Net-zero / Climate Action Cell established by the city (Step 6.1) should facilitate the development of a white paper or policy brief that identifies gaps in regional policy and outlines a clear strategy to engage with regional government agencies to influence policies and regulations that enable the implementation of climate actions.

Based on the near-term Implementation Plan, cities can identify, develop, implement, and monitor climate action projects that deliver tangible on-ground outcomes. Approved projects included in the near-term Implementation Plan or climate budget (refer to Tool 5.3B: Municipal Climate Budgeting) may be implemented through existing departmental execution mechanisms. The concerned departments remain responsible for project delivery, while the lead department, Net-zero Cell / Climate Action Cell or a similar coordination unit, supports oversight and coordination. Implementation should follow standard administrative, financial, and procurement procedures to ensure continuity with existing governance systems. It is equally important to monitor the implementation status and progress of climate projects identified in the near-term Implementation Plan and the climate budget.

Cities can deploy pilot demonstration projects to test innovative technologies, approaches, or business models within the local context. Learnings from these pilots, supported by technical and financial assessments and stakeholder engagement, should inform the development of a robust pipeline of investable climate action projects for city-wide or regional scale-up. It is also suggested that cities prepare a comprehensive inventory of climate projects aligned with municipal budgets, state and national priorities and programmes to support effective monitoring and impact assessment.

Near-term Project Preparation

Once priority actions have been identified and detailed in the near-term Implementation Plan, each project needs to be developed with sufficient technical and financial detail to enable funding, approval, and execution through standard contractual arrangements.

Project preparation involves defining the scope and technical parameters, estimating capital and operational costs, identifying suitable financing and delivery mechanisms, and establishing indicative timelines and implementation responsibilities across municipal departments. Depending on the nature and complexity of the intervention, this may include preliminary feasibility assessments, technical designs, and clarity on regulatory or institutional requirements.

Well-prepared projects are better positioned to secure budgetary allocation or external financing, move efficiently through municipal approval processes, and reduce delays or cost overruns during implementation. For interventions involving new or untested technologies and approaches, cities may consider preparing and implementing pilot demonstration projects to validate feasibility before scaling up. The identification and development of pilot demonstration projects and bankable projects are discussed in more detail below.

How to Identify and Implement Pilot Demonstration Projects

The Net-zero CRCAP is developed with a long-term strategic vision and often recommends innovative approaches for urban services, while also encouraging cities to adopt emerging and evolving technologies as they advance climate actions.

Pilot demonstration projects play a critical role in translating these concepts from planning to on-ground action. By testing interventions at a small, manageable scale, pilot projects help validate their technical, economic, environmental, and social feasibility under local conditions. Given that citywide climate interventions often involve high up-front costs and implementation uncertainties, pilot projects serve as an effective mechanism to de-risk large-scale investments, while also building confidence among decision-makers, implementing agencies, and citizens.

The steps outlined below provide guidance for cities to identify, design and implement pilot demonstration projects for climate actions. These steps are indicative in nature and may be adapted to suit specific local and regional contexts, institutional capacities, and priority sectors.

Step 1: Identify and Prioritise Potential Pilot Projects

Based on the city's service delivery gaps and climate priorities (mitigation and adaptation) identified in Net-zero CRCAP, a comprehensive list of potential pilot interventions may be prepared. A screening and prioritising framework should be applied, considering criteria such as national, state, or city priority, expected climate impact, technical and financial feasibility, and scalability and replication potential. Joint consultations may be held with relevant municipal departments to confirm departmental interest, implementation readiness, and clarity on operational ownership and responsibility for the shortlisted/prioritised projects.

Step 2: Develop a Project Concept Note

A Project Concept Note may be prepared to outline the problem statement, project rationale, objectives, expected outcomes, technical requirements, indicative implementation timelines, roles and responsibilities, and resource needs. The concept should be discussed with the city leadership and the concerned implementation departments/agencies, and where relevant, with local stakeholders and community groups. Subject to the city's approval, a pre-feasibility assessment, including technical feasibility, technical design/drawing, financial viability, and institutional readiness, needs to be undertaken.

Step 3: Prepare Technical Design and Implementation Plan

Detailed technical designs, cost estimates, and Implementation Plans may be developed using in-house expertise or external specialists, ensuring compliance with municipal standards, codes and regulatory requirements. Basic assessments of technical feasibility, financial viability, and anticipated climate impacts may be carried out. This stage may also include finalising funding sources, preparing tender documents, securing necessary internal approvals and no objection certificates (NOCs), and completing implementation arrangements.

Step 4: Implement the Pilot Project and Monitor Impacts

The pilot project may be tendered and implemented through approved municipal procurement and execution processes, with adequate arrangements for supervision, quality assurance, and stakeholder coordination throughout. Upon completion, the pilot project should be tested and handed over to the concerned department for operation, maintenance, and monitoring. Key Performance Indicators (KPIs) should be tracked to assess climate, service delivery, and community benefits.

A project-specific Monitoring, Reporting, and Verification (MRV) framework should be developed to monitor its performance and climate impacts. Lessons learned, implementation challenges (technical and institutional), cost and performance variations, and opportunities for improvement should be strategically documented for future implementation and replication.

Step 5: Assess Potential for Scale-up

Based on lessons from the pilot implementation, including performance outcomes, cost-effectiveness, climate and community benefits, and identified improvement opportunities, the potential for city-wide scale-up or regional mainstreaming should be assessed.

Successful pilot projects should be integrated into the city's development plans, annual budgets, and departmental work plans to support scale-up of the project. In addition, standard operating procedures, toolkits or implementation guidelines should be prepared to facilitate replication across multiple locations within the city or to expand the project scope.

How to Identify and Develop Bankable Projects for Large-scale Climate Actions

Implementing climate actions at scale often requires significant investment, multi-stakeholder coordination and long-term institutional support. Identifying and developing bankable projects, based on city priorities and their techno-economic feasibility, enables the development of implementation-ready projects that are both investable and financially viable.

The development of bankable projects requires robust techno-economic assessments, stakeholder engagement, and coordination for statutory financial approvals. The Net-zero / Climate Action Cell established at the city level (refer to Tool 6.1A) should play a facilitative role by supporting internal and external coordination, stakeholder engagement, and alignment with financing and policy requirements throughout the project development process.

The following steps provide indicative guidance for cities on identifying and developing a bankable climate project. These steps may be adapted to suit the local and regional context, institutional capacity, and financing landscape.

Step 1: Identify and Prioritise Potential Bankable Projects

The city should identify potential bankable projects based on local needs, Net-zero CRCAP priorities, and learning from pilot projects, where available. Identified project ideas should be screened using basic criteria such as expected climate and development impacts, technical feasibility, capital and operating costs, availability of land and other required rights and resources, policy and regulatory alignment, and community benefits. From this screening process, a set of priority project concepts should be shortlisted and documented through brief project concept notes. These concept notes should outline the problem statement, the project's rationale, objective, scope, anticipated climate and development outcomes, and indicative cost estimates, and be reviewed internally to obtain in-principle approvals and direction for further development.

Step 2: Assess Techno-economic Feasibility and Prepare Bankability Report

For shortlisted project concepts, the city should conduct detailed techno-economic feasibility assessments and use in-house expertise, or engage external technical and financial experts, as needed. The assessment should evaluate technology options, site suitability, integration with existing infrastructure and systems, required permissions, regulatory compliance, socio-economic and climate benefits, and environmental and social considerations relevant to early-stage project development.

The financial and economic analysis should estimate capital expenditure, operation and maintenance costs, life-cycle costs, and potential revenues or cost savings, where applicable. Key project risks, including technical, financial, regulatory, and institutional, should also be identified.

The feasibility should assess the project's bankability by examining investor appetite, its risk profile, and the city's financial capacity. Suitable financing mechanisms, such as public financing, public-private partnerships (PPP), viability gap funding, grant funding, ESCO/ RESCO models, or blended finance structures, may be explored.

The results of this assessment should be consolidated into a bankability report that summarises the techno-economic feasibility, proposed financial structures, investment options, key risks, mitigation measures, and recommendations on whether and how the project should proceed.

Step 3: Prepare Project Information Notes (PINs) to Mobilise Finance

Based on the techno-economic feasibility assessments and the bankability report, the city should prepare concise Project Information Notes (PINs) to highlight key technical features, cost estimates, financial structuring, proposed risk-sharing arrangements, and the investment case for potential financiers, partners and investors. These PINs can be used to engage with financial institutions, development partners, donors, and private sector entities to mobilise financing. A consolidated set of PINs may be hosted on a digital platform or other appropriate channels and collectively form the city's pipeline of investment-ready climate action projects.

Step 4: Prepare a Detailed Project Report (DPR) and Seek Approvals

Once a project is assessed as technically feasible, financially viable, and bankable, and a potential financing source is identified, a Detailed Project Report (DPR) should be prepared. The DPR should translate the approved project concept into a fully designed project, including final technical designs and specifications, detailed cost estimates, implementation schedules, and a procurement and contracting strategy. The DPR should be reviewed by relevant municipal departments and key stakeholders and will serve as the primary technical and financial document for securing internal approvals and external financing commitments and aligning budgets. This may also be aligned with city priorities and municipal budgets.

Step 5: Prepare Documents and Initiate Procurement

Based on the approved DPR, the city should prepare procurement and bidding documents that clearly define the scope of work, technical performance indicators, qualification and evaluation criteria, payment milestones, and contractual terms and conditions. These documents should be finalised in consultation with the finance and legal departments to ensure compliance with municipal governance and procurement rules, and subsequently issued through a competitive procurement process.

Step 6: Implement and Monitor Bankable Projects

Following bid evaluation and award, the city should implement the project through approved contractual arrangements. Project implementation should be periodically monitored by the Net-zero / Climate Action Cell or the concerned department to ensure adherence to timelines, budgets, and performance benchmarks. Monitoring should also track climate impacts, service delivery outcomes, and financial performance to inform reporting, accountability, and future replication.

Tool 5.3A

Preparation of Climate Investment Plans for Cities

This tool provides step-by-step guidance for cities to prepare a Climate Investment Plan (CIP) that translates a city's Net-zero Climate Resilient City Action Plan (CRCAP) into a multi-year financial strategy. It bridges the gap between climate ambition and financial reality by analysing municipal financial health, allocating costs across stakeholders, and mapping out funding sources to finance the city's climate action projects. This tool, along with an accompanying guidance template, supports cities in developing a CIP.

What is a Climate Investment Plan?

The CIP is a multi-year strategic financial plan that helps an Urban Local Body (ULB) to estimate the additional investment required to implement and operate a portfolio of sustainable infrastructure projects beyond the ULB's Business-As-Usual[1] (BAU) activities and develop a funding strategy with enabling policy measures. It is a medium-term financial planning exercise that estimates total costs and identifies potential funding sources for implementing the climate-resilient interventions outlined in the Net-zero CRCAP.

Why should the city prepare a CIP?

- The CIP will help the city leverage public funds and attract capital from the market and private sources for climate action projects.
- It will support the city in linking its medium-term climate goals, targets, and interventions with a concrete and viable financial resource mobilisation plan.
- It will support the city in strengthening the institutional and policy frameworks needed to unlock climate finance.

When should the CIP be prepared and how is it aligned with the CRCAP?

- The CIP builds upon the portfolio of projects identified in the CRCAP and provides the mechanism to quantify the financial resources required to deliver these actions.
- The CIP should be closely linked to, and prepared alongside or soon after the completion of the Net-Zero CRCAP.
- The city should iterate across both plans by linking actions to their expected impacts and identifying the costs and funding sources for these actions.
- It is a dynamic document that may be updated every 2-3 years to reflect changing local priorities.

[1] Business as Usual (BAU) activities refer to the ULB's routine activities, without considering sustainability or climate interventions.

Who should prepare the CIP?

Preparing and implementing a CIP requires clearly defined institutional roles and coordinated action across multiple stakeholders. The ULB should lead the development of the CIP through existing coordination structures such as the Net-zero Cell, Climate Action Cell, or the Finance Department.

Table 1 suggests an institutional framework for CIP development.

Table 1: Key stakeholders involved in developing a Climate Action Plan (CIP)

Department/ cell	Roles in preparing and implementing the CIP
Net-zero Cell/ Climate Action Cell	The institutional structure coordinating climate action should lead the preparation of the CIP. The formation of such institutional structures is described in Step 6.1. The Cell should facilitate coordination across departments, consolidate sectoral inputs into a coherent investment pipeline, and prioritise projects based on their emissions reduction potential, financial viability, and implementation readiness. The Cell should also maintain an up-to-date project pipeline database, investment tracking system, and impact monitoring framework.
Budget/Finance Department	The city's budget or finance department should provide close support for CIP development and assess potential funding sources for the Net-zero CRCAP. In the absence of the Net-zero Cell/Climate Action Cell, the Budget/Finance Department may lead CIP preparation.
Sector or Line Departments	Municipal departments must provide inputs on project planning, costing, and identification of climate finance sources.

Preparing the Climate Investment Plan

The development of a CIP is a structured, multi-stage process that enables cities to systematically identify, prioritise, and finance investments required to achieve their net-zero targets. The process is iterative and requires close coordination across departments and engagement with external stakeholders. The CIP preparation process follows three key steps outlined below.

Step 1: Assessing the Historical and Current State of Climate Budgeting and Financing in the City

This step assesses the historical and current state of climate budgeting and financing within the city. It establishes a financial baseline, enabling the city to understand its existing fiscal capacity, expenditure patterns, and constraints in mobilising climate finance.

It comprises the following three sub-steps:

1.1: Appraisal of municipal finances

- **Context setting:** This step should begin with an **overview of the city**, including its population, institutional structures, area, primary economic drivers, and the short-, medium- and long-term sectoral climate resilience interventions identified in the Net-zero CRCAP. It should also state the objective of the CIP (e.g., "To develop a five-year financial plan to support low-carbon and climate-resilient growth for the city").
- **Analysis of expenditure:** Analyse the share of revenue and capital expenditure in the total municipal budget and their trends over the previous five years.
- **Analysis of income:** Analyse the share of revenue and capital income over the previous five years and identify key sources.
  - **Revenue income** can include own tax and non-tax revenues, as well as State and Central Government grants and transfers.

- › **Capital income** can include the ULB's own sources, grants and transfers from the State and Central Government, parastatal agencies, borrowings (loans from banks, bond issues), developmental finance from multilateral and bilateral organisations, and other sources, including private finance.

The analysis can be presented through graphs, as illustrated below.

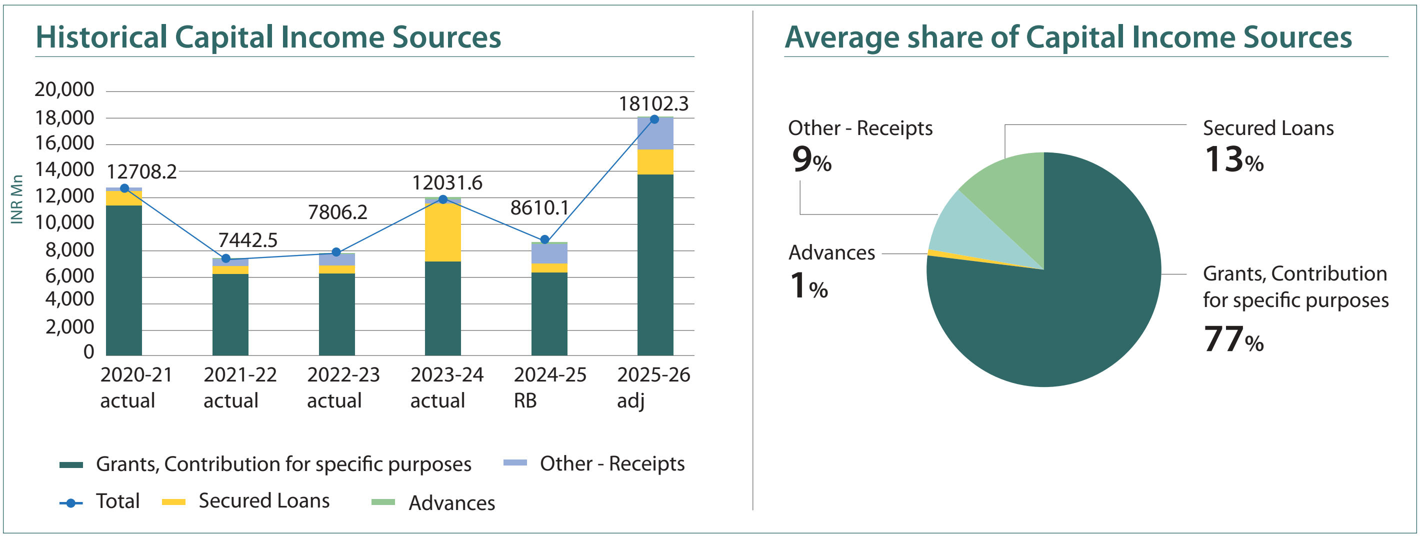


Figure 2: Analysis of capital income sources

- **Analysis of overall surplus or deficit position:** Analyse the ULB's overall surplus or deficit position over the previous five years, based on analysis of income and expenditure.
- **Analysis of debt and borrowing capacity:** This section should analyse the ULB's access to and capacity to raise debt, including its sources of debt finance, outstanding debt, if any, credit rating, and bond issuances, if any. If municipal bonds have been issued, information on the utilisation of bond proceeds, the quantum of issuance, term of the bond, interest rate, credit rating, and the mechanism to ensure debt service payments to investors must be documented.

Table 2: Template for analysing ULB's overall deficit or surplus position

Total Surplus/Deficit	Y 1 (20.. - ..) (Actual)	Y 2 (20.. - ..) (Actual)	Y 3 (20.. - ..) (Actual)	Y 4 (20.. - ..) (RB)	Y 5 (20.. - ..) (BE)
Revenue budget					
Capital Budget					
Total Surplus/Deficit					

1.2: Baseline climate budgeting:

This section should include a review of past budgets through a climate lens to highlight the average share of the municipal budget allocated to climate resilience interventions. The review can be broken down by sectors and sub-sectors (transport, solid waste, wastewater, energy, built environment, urban greening, etc.). A sample template for two sectors is provided below.

Table 3: Sample template for baseline climate budgeting

Sector	Subsector Action	(20.. - ..)	(20.. - ..)	Sources of funding
Transportation	E.g., promoting non-motorised transport, including Walking and cycling facilities			
	E.g., improving public transport facilities and promoting shift to public transport modes			
Built Environment	E.g., adopting Energy Conservation Building Code (ECBC) in public buildings			
	Installing cool roofs in municipal/public buildings			

1.3: Constraints faced by the ULB in mobilising climate finance

This section should identify the barriers the ULB faces in mobilising climate finance. These can be grouped under political, financial, institutional and other areas. An example is provided in Table 4.

Table 4: Constraints faced by ULBs in mobilising climate finance

Area	Description of Barrier
Political barriers	
Setting goals for climate mitigation and adaptation at the city level	Specific goals for urban areas aligned with India's NDCs have not yet been defined at the national and state level.
Institutional barriers	
Interdepartmental coordination with other government departments and agencies	Limited coordination between city departments and between the ULB and other parastatal agencies, delaying planning and budget allocation for climate resilience interventions
Financial barriers	
Project preparation and access to climate finance	Limited technical capacity of municipal staff to prepare bankable projects to leverage climate finance

Step 2: Investment Planning for Climate Actions

This step represents the core of the CIP. It involves estimating future financial needs and available resources under a BAU scenario **and developing an investment plan** to bridge this gap and finance the climate actions identified in the Net-zero CRCAP, up to a target year (for example, 2030).

It comprises the following three sub-steps:

2.1 Estimating total climate investment required

The first step in developing an investment plan is to determine the required total climate investment. The total capital and operational costs (up to five years) for the sustainable infrastructure projects identified in the CRCAP should be summarised in a table. Projects with the greatest potential for emissions reduction or climate resilience impacts per unit cost, as well as those at advanced stages of preparedness and approval, should be highlighted.

2.2 Developing a proposed funding plan to meet the required climate investment

Once the total cost of climate interventions is known, the funding plan can be developed through the following steps.

- Forecasting the BAU municipal budget

Building on past trends and the current budget analysed in Step 1, forecasts of income and expenditure for both revenue and capital accounts until the target year (for example, 2030) should be prepared. This will help identify any surplus cash reserves that can be utilised for climate actions.

Various methods can be used for BAU forecasting of the municipal budget:

1. Projection based on **the average annual growth rate** of the previous five years.
2. Projection based on the **compound annual growth rate (CAGR)** of the previous five years. It may be noted that CAGR is based only on the starting and terminal year data and does not reflect fluctuations in the interim years.
3. Projection based on **linear best fit trendlines** derived from income and expenditure data for the previous five years. These can be easily computed in Microsoft Excel.
4. Projection based on **assumed growth rates** for income and expenditure heads (say 8-15% per annum) that appear realistic considering the financial position of the ULB.

The budget forecasts for revenue, capital, and overall surplus or deficit under different methods should be summarised in a table. The analysis can also be supplemented with graphs and a budget summary.

Table 5: Draft template for BAU municipal budget forecasting

	Y 6 (20.. - ..)	Y 7 (20..- ..)	Y 8 (20.. - ..)	Y 9 (20.. - ..)	Y10 (20.. - ..)	Total
Revenue Account Forecast						
Total Revenue Income						
Total Revenue Expenditure						
Estimated Surplus/Deficit from						
Capital Account Forecast						
Total Capital Receipts						
Total Capital Expenditure						
Surplus / Deficit in Capital Account						
Total Surplus /Deficit						

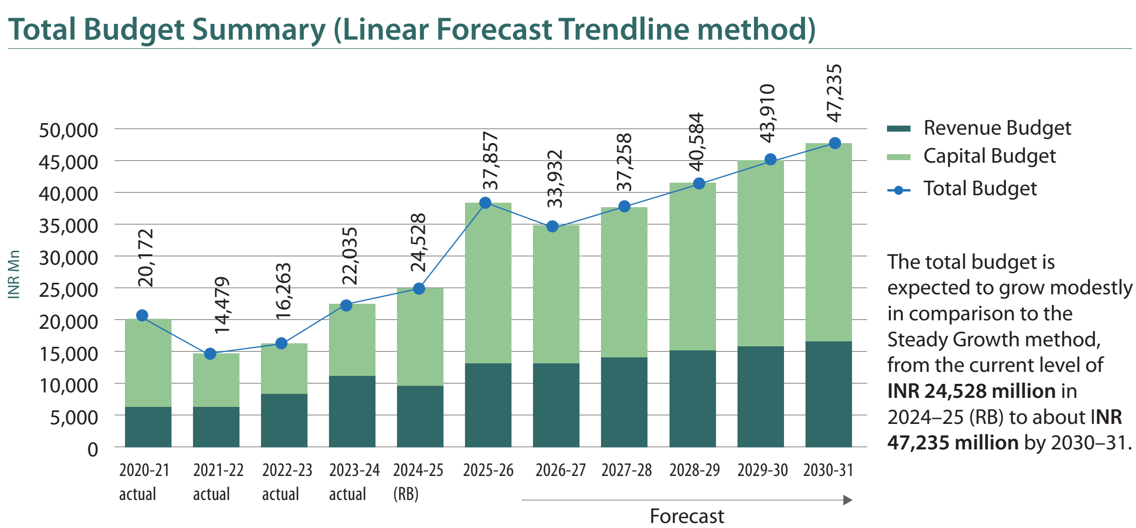


Figure 3: Example of budget forecasting using the linear method

- Apportionment of costs amongst stakeholders

Once the municipal budget has been forecast to estimate potential surpluses or deficits, the next step is to allocate the estimated climate investments among various stakeholders, including the ULB. The majority of a city's GHG emissions can be attributed to activities beyond the direct jurisdiction of the ULB. Thus, the responsibility for mitigating these GHG emissions and the associated costs should be attributed to the respective stakeholders, including the private sector, citizens, commercial institutions, State or Central Governments, and industries.

The following principles may be considered when apportioning the costs of various mitigation and adaptation measures among stakeholders for each sector:

› **Built environment sector:** Costs may be apportioned based on building ownership. For instance, it can be assumed that more than 95% of the buildings in a city are owned by residents and private businesses. Hence, a similar proportion of emissions and the associated costs of mitigation and adaptation actions for this sector can be apportioned between citizens and businesses, with the remainder allocated to ULBs.

› **Transport sector:** Costs may be allocated based on vehicle ownership (for example, municipal fleet projects can be allocated to the ULB, while actions for private vehicles can be allocated to citizens).

› **Energy sector:** Costs may be allocated based on energy consumption and ownership of assets. For example, the ULB is responsible for mitigation and adaptation projects within municipal infrastructure and services.

› **Water supply, wastewater and solid waste management:** The municipal body or the parastatal agency is primarily responsible for this sector, except for emissions generated from captive plants of industries, large private townships, etc. Hence, the majority of the costs associated with climate action in these sectors should be attributable to the ULB.

Cost apportionment must be presented in a table for each project; an example is given below. Each city should include its own apportionment assumptions to supplement the table, where necessary.

Table 6: Cost apportionment of CRCAP costs among stakeholders (example)

Type of Climate Action	ULB	State Govt Schemes	Central Govt Schemes	Parastatal Agencies	Private Citizens, businesses	Infrastructure service providers	Rationale
Use of energy-efficient appliances in buildings	0.5%	0.3%	0.1%	0.1%	89.1%	9.9%	About 99% of the city's total building stock may be considered private; 10% of private buildings may be delivered through Energy Service Companies (ESCOs).
Solid Waste: Legacy waste management, biomining	30%	70 %					May be shared between the ULB and State Govt / Finance Commission grants
Introducing electric buses in public transportation						100%	May be implemented through a PPP, using the Gross Cost Model

Once this is done, the share of the CRCAP investment allocated to the ULB and other stakeholders should be analysed for each sector. This can be supported by graphs, an example of which is shown below.

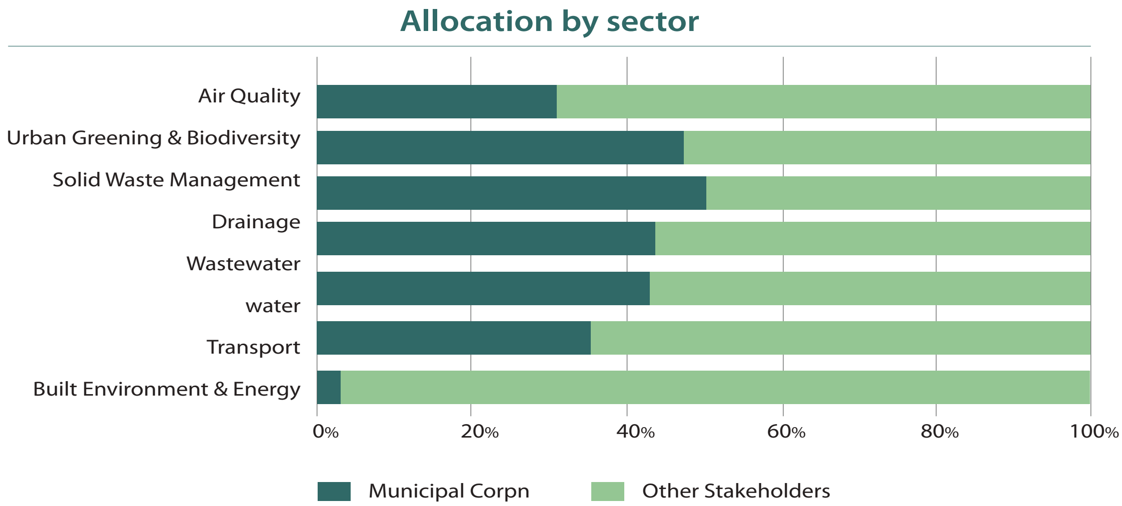


Figure 4: Allocation by sector (example)

The next important step is to determine which CRCAP actions have already been included in the municipal budget. Subtracting these costs will help determine the funding gap for the remaining climate actions identified in the CRCAP. Following this, the final allocation of climate investments for each sector across stakeholders should be summarised as shown below.

Table 7: Summary of capital investment planning by source and sector

Sector	Total Investment Required	Potential Sources of Capital for Remaining Investment							Total Funding Planned
		Extent Covered in Municipal Budgets	Remaining Investment to be Mobilised from Stakeholders	Municipal Corporation's Share	State / Central Government Schemes	Parastatal Agency	Citizens, Businesses	PPP	
Built Environment and Energy									
Transport									
Water									
Wastewater									
Drainage									
Solid Waste Management									
Urban Greening and Biodiversity									
Air Quality									
Total									
% share									

Planning for ULB's share of investment for the CRCAP

This is the final stage of the analysis that defines how the ULB could mobilise financial resources to meet its share of the Net-zero CRCAP investment. The plan should be based on the BAU financial projections and can include strategies to meet the funding gap, such as enhancing own tax and non-tax revenues, PPPs, and national or state government schemes and grants.

Table 8: Indicative financing plan for the CRCAP (INR crore)

Funding plan for ULB	Y 6 (20.. - ..)	Y 7 (20.. - ..)	Y 8 (20.. - ..)	Y 9 (20.. - ..)	Y 10 (20.. - ..)	Total
Total CRCAP Cost (5 yrs) – ULB's share						
Funding Plan						
Use of BAU budget surplus						
Loan by leveraging part of budget surplus						
Urban Challenge Fund scheme grant from Government of India						
World Bank loan						

Step 3: Policies and Strategies for Capital Mobilisation, Risk Mitigation and Stakeholder Engagement

This step establishes an enabling framework of climate policies, defining stakeholder engagement frameworks, and risk mitigation strategies to effectively overcome barriers and mobilise sustainable capital. It comprises the following sub-steps:

3.1 Identifying enabling policies to mobilise climate finance

Taking into account the climate investment requirements and the developed capital mobilisation plan, the ULB should identify relevant local, state, or national policies and schemes that can support both public and private financing. Examples include the Urban Challenge Fund, the Smart Cities Mission, the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), the Swachh Bharat Mission (Urban), the National Clean Air Programme (NCAP), and state-level urban development, renewable energy, climate resilience, and infrastructure funding schemes.

3.2 Risk mitigation strategies

It is important to identify potential political, financial, and technical risks that could affect capital mobilisation, together with mitigation measures.
Key considerations include:

- What institutional set-up or team will drive climate action and mobilise finance?
- What competencies does the team require, and how can these be supported through training or external resource support?
- Who are the key stakeholders that need to be engaged to mobilise finance, and what are the anticipated challenges?

3.3 Stakeholder engagement

Cities should adopt a structured, continuous approach to stakeholder engagement, rather than relying on one-time consultations. This is especially important during annual reviews and major revisions of the CIP, when investment priorities, financing opportunities, and implementation arrangements may evolve. As the CIP is a strategic framework for mobilising climate finance, stakeholder engagement should strengthen project design and implementation, while facilitating capital flows from public, private, and development finance sources.

Key stakeholders:

Stakeholder group	Roles
Government and Public Sector Institutions	Support policy development, planning, regulation, budgeting, and project implementation
Financial Institutions and Investors	Mobilising capital, scaling climate investments, providing information on financing requirements, investor expectations, and suitable financing instruments
Private Sector and Industry	Provide investment, innovation, technical expertise and operational capacity
Development Partners and Technical Institutions	Support project preparation, capacity building, technical assistance, and knowledge sharing to improve project bankability and investment readiness
Civil society and community stakeholders	Provide local knowledge, identify community needs, and ensure climate investments are socially inclusive and equitable

Cities must develop clear mechanisms to incorporate stakeholder feedback into CIP revisions. This should include documenting inputs, assessing their relevance and feasibility, incorporating relevant feedback into project design and financing strategies, and communicating updates to stakeholders.

Step 4: Preparation of the CIP

Once the analysis under the first three steps is complete, the final step is to compile the entire CIP. This should include a "Way Forward" section summarising the key next steps, such as securing formal council approval, submitting detailed project reports (DPRs) to State and Central ministries for integration with relevant schemes, and initiating pre-feasibility studies for projects earmarked for implementation through PPPs. A sample table of contents for the CIP is provided below.

Table of Contents

Figure 5: Sample Table of Contents for a CIP

Approval and integration of the CIP

Once the CIP has been prepared, it should be formally validated and approved by the city council and integrated into the city's governance and financial processes, particularly the annual municipal budgeting process. This ensures that the CIP moves from a planning document to an implementable framework for mobilising climate finance and delivering climate resilience projects.

Capacity building

Capacity building is essential to ensure that municipal institutions have the technical, financial, and managerial capabilities required to design, finance, implement, and monitor climate investments.

Given the evolving nature of climate finance, technologies, and regulatory frameworks, capacity building should be a continuous process to equip municipal staff and stakeholders with the skills required to effectively manage climate investments. Key capacity building areas include:

- **Climate finance:** Training should focus on the climate finance landscape, including domestic and international funding sources, concessional finance, blended finance, and private sector finance. Staff should also be trained in financial structuring, risk assessment, and the requirements of funding instruments such as green bonds and climate funds**.**
- **Climate budgeting:** Training should cover climate budget tagging, expenditure tracking, and alignment of budget allocations with climate goals and the CIP (refer to Tool 5.3B on Municipal Climate Budgeting).
- **Bankable project preparation and pipeline development:** Training should cover preparation of concept notes and DPRs, feasibility and cost-benefit analyses, and project structuring to meet investor and lender requirements. This should enable staff to create and maintain a robust pipeline of investment-ready projects.
- **Monitoring and Reporting Systems:** Training should cover monitoring and reporting systems for financial tracking and climate impacts, including identification of indicators, data collection, standardised reporting, and stakeholder engagement.

To achieve long-term impact, the city can institutionalise capacity building through dedicated training programmes, integration of climate-related competencies into staff performance assessment frameworks, dedicated budgets, and induction programmes.

Monitoring and Reporting

The Monitoring and Reporting (M&R) framework is a critical component of the CIP, ensuring that planned investments translate into measurable emissions reductions and resilience outcomes. The framework should integrate financial monitoring, climate impact assessment, and implementation tracking into a unified system that is embedded within existing municipal processes.

- Monitoring framework and investment tracking: Cities should establish a dedicated monitoring framework, typically anchored within the Net-zero or Climate Action Cell. The framework should outline data flows, reporting responsibilities, and timelines for submission and review. It should also include a digital or spreadsheet-based investment tracking system to capture project-level data on financial allocations, disbursements, and implementation status across sectors.
- Financial monitoring and evaluation: Cities should monitor the total volume of funds mobilised annually, disaggregated by source. They should also track budgeted versus actual expenditure.

- **Climate impact monitoring:** Alongside financial tracking, cities must assess the environmental and resilience impacts of their investments. This can be linked to a project-level Monitoring, Review, and Verification (MRV) system (refer to Tool 6.2: Climate Project Monitoring and Reporting).

Updating and revising the CIP

To ensure that the CIP remains relevant and responsive, the following review mechanisms should be established.

Annual review: An annual review should assess progress in implementing the CIP.

It should examine the municipal budget, identify deviations in climate-related allocations, revise the funding strategy, and add or remove projects in response to changes in funding availability, project readiness, or market conditions. The outputs should be documented in an annual progress report and shared with key stakeholders.

Major revision (3-5 years): In addition to annual reviews, cities should undertake a comprehensive revision of the CIP every three to five years. This allows for a comprehensive reassessment of assumptions and data, and can be aligned with updates to the Net-zero CRCAP baseline assessments.

Beyond tracking and reporting, the M&R framework should be seen as an iterative process that enables cities to enhance the effectiveness, efficiency, and impact of their climate investments and ensure that the CIP remains a dynamic and results-oriented tool.

Tool 5.3B

Municipal Climate Budgeting

This tool provides guidance to cities on municipal climate budgeting. Climate budgeting helps to translate the Net-zero Climate Resilient City Action Plan (CRCAP) from being a standalone plan into a statutory document that cities can use for tagging, tracking, and prioritising expenditure against defined mitigation and adaptation outcomes. This prevents climate action planning and implementation from being treated as an off-budget or independent climate initiative and instead integrates it into the municipal governance processes. This tool sets out a step-by-step process that cities can institutionalise to prepare a climate-responsive annual municipal budget.

Municipal Climate Budgeting

The CRCAP developed and adopted by a city can be effectively implemented by translating it into actionable climate projects aligned with the city's development priorities and climate ambitions (refer Tool 5.2: Near-term Project Prioritisation and Preparation). These projects can then be funded, implemented, monitored, and reviewed as part of routine municipal governance processes and decision-making, aligned with the annual municipal budget cycle to ensure continuity and long-term impact.

Municipal Climate Budgeting is a strategic financial planning and governance process that enables local governments to integrate climate goals and targets into municipal budgeting. This involves identifying, tagging, prioritising, and allocating dedicated funds for outcome-based implementation of climate resilience interventions. By institutionalising municipal climate budgeting, cities can move toward developing municipal budgets that are transparent about climate-related expenditure and are better positioned to access climate finance due to increased accountability for progress on their net-zero commitments.

The key aspects of a municipal climate budget are:

1. **Alignment of climate targets with budget heads** by mapping the Net-zero CRCAP's priority interventions and sectoral targets to existing municipal budget lines and departments.
2. **Climate expenditure tagging** categorises capital and revenue expenditure by the city government based on climate relevance (mitigation, adaptation, or dual benefit) to enable tracking and reporting of its climate actions.
3. **Resource mobilisation** by identifying convergence opportunities with state and national schemes, grants, and climate finance instruments to supplement local revenues for implementation of climate actions.
4. **Allocation of dedicated funds** for climate actions by earmarking a defined share of the annual budget through a dedicated climate budget chapter or head or tagged line items to ensure predictable resource allocation for prioritised interventions across budget cycles.

To develop a municipal climate budget, institutional coordination during the budgeting process is crucial. The ownership of the climate budgeting process needs to be clearly defined, with typically the Finance Department taking the lead. A coordination mechanism among all concerned departments should be established and supported by a Net-zero / Climate Action Cell or a similar institutional structure (refer Tool 6.1A: Institutionalising Climate Action Planning and Implementation). By establishing roles and responsibilities across the finance, engineering, and planning departments, the institutional structure can ensure that climate considerations are built into the annual budget preparation process. As the institutional structure leads the monitoring and reporting of climate resilience interventions and the progress of Net-zero CRCAP implementation, budgeted climate expenditure should be linked to the Monitoring, Reporting and Verification (MRV) framework (refer to Tools 6.2 and 6.3) so that outcomes can be tracked against allocations annually.

How to Develop a Municipal Climate Budget?

Integrating climate priorities into the municipal budget cycle is typically a six-step process and should be supported by the city's Net-zero / Climate Action Cell established for planning and implementation of local climate actions. Municipal budgeting processes and timelines vary across cities depending on regional context, and the steps described below should be adapted accordingly to prepare an impactful and effective municipal climate budget.

Step 1: Secure Administrative or Political Commitment for Climate Budgeting

The climate budgeting process begins with a strong commitment from the city leadership, led by the Municipal Commissioner or Mayor. A high-level consultation chaired by the Municipal Commissioner and including all departmental heads can be held to establish a shared understanding of the climate budgeting process in line with the city's Net-zero CRCAP.

Step 2: Build Capacity on Climate Budgeting for Relevant Departments

Capacity-building and training sessions may be organised to help concerned departments understand the climate budgeting concept, their role in the process, and the framework of identifying, prioritising, and proposing climate-relevant projects aligned with priorities. These engagements will help departments identify how their routine activities and projects contribute to climate mitigation, climate adaptation and overall societal benefits. Budget instructions, guidelines, and planning notes should be updated to reflect climate budget requirements.

Step 3: Identify, Prepare, and Review Short-term Climate Actions

Long-term climate goals and targets should be broken down into short-term, achievable climate actions to be implemented within a three-year period. It is recommended that existing municipal budget project information formats be updated to integrate a climate-relevance lens, ensuring a sustained climate budgeting process based on standardised formats.

Each department should prepare a list of climate-relevant actions and projects aligned with national and state priorities, as well as the Climate Action Plan or the Net-Zero CRCAP. Climate projects may include:

- Ongoing projects to be completed during the current budget cycle;
- Projects proposed for the current climate budget cycle that were dropped in previous climate budget cycles; and
- New projects proposed for the current climate budget cycle.

It is important for the relevant departments to systematically identify climate actions and projects and ensure uniformity, clarity, and completeness of information submitted as part of the climate budgeting process. Standardised formats for climate budgeting should capture key administrative details, project characteristics, financial information, implementation timelines, and alignment with the Net-Zero CRCAP.

Step 4: Prioritise Projects and Prepare the Climate Budget

This step will support structured decision-making in the climate budgeting process by systematically assessing, comparing, and ranking proposed climate actions / projects. Identified climate actions should be reviewed and prioritised by city officials based on agreed-upon criteria such as technical readiness, political acceptability, financial viability, funding availability, climate impact, and linkage to national/ state priorities. Project priority should be determined based on the number of feasibility and impact parameters assessed positively. It is important to prepare a separate list of projects requiring further bankability assessment, while low-priority projects may be deferred, redesigned, or considered in future budget cycles following further technical and financial feasibility assessment.

Where appropriate, stakeholder and citizen engagement processes may be undertaken to strengthen transparency and inclusiveness. The prioritised projects are then consolidated into a climate budget, which is integrated into the regular financial budget documents and submitted through established approval processes. This approach supports the efficient allocation of financial resources and ensures alignment between departmental proposals, overall climate goals, and implementation capacity.

Step 5: Execution of Climate Budget, Monitoring and Reporting

Approved projects as mentioned in the climate budget may be implemented through existing departmental execution mechanisms. Departments remain responsible for project delivery, while the lead department, Net-zero / Climate Action Cell or similar coordination unit supports oversight and coordination. Implementation should follow standard administrative, financial, and procurement procedures to ensure continuity with existing governance systems.

This step will also support city governments in tracking the implementation status and progress of climate-related projects identified under the climate budget. It is important to capture sector-wise and location-specific details for each project, including the implementation stage (with the expected completion date for each stage), approved costs, annual budget allocation against total estimated costs, and the responsible agency, contractor, or official.

Linking the climate budget to the city's MRV framework for the Net-zero CRCAP enables effective project management, inter-departmental coordination, and transparent reporting of climate actions throughout the budget cycle. It is recommended that the status of each project be tracked and monitored monthly, and where this is not feasible, at least quarterly.

Step 6: Review, Learn and Improve for Integrating Climate Lens into Annual Budget Cycles

Climate budgeting is a continuous and iterative process. Lessons from implementation and monitoring should be used to improve data quality, strengthen methodologies, and refine project selection in subsequent budget cycles. Over time, the scope of climate budgeting can be progressively expanded to include additional sectors, climate dimensions, and more advanced impact assessments, thereby ensuring continuous improvement and institutionalisation of the climate budgeting process.

Tool 6.1A

Institutionalizing Climate Action Planning and Implementation

This tool provides guidance for cities to establish and operationalize a Net-zero / Climate Action Cell that will lead and coordinate the implementation of the Net-zero Climate Resilient City Action Plan (CRCAP) in a city. It supports cities in embedding the Net-zero CRCAP implementation into daily governance by defining how the Cell will guide annual planning, oversee pilot projects, and prepare bankable projects for scale-up.

It recommends that the local government evolve its existing Climate Core Team established during the development of the Net-zero CRCAP (refer to Tool 1.2: Formation of Climate Core Team) into a permanent institutional structure, clarifying roles, mandates, staffing, and coordination mechanisms.

Net-zero / Climate Action Cell at the city level

Implementation of the Net-zero CRCAP requires developing a near-term implementation plan that translates the city's climate vision and goals into actionable, investable climate actions, integrating the CRCAP recommendations and priorities into municipal planning, policy, budgeting, and project development processes.

Developing near-term plans, implementing them, ensuring effective coordination between departments and stakeholders, and maintaining long-term continuity within the local government require the establishment of a Net-zero / Climate Action Cell—an institutional unit responsible for the planning, implementation, and monitoring of climate actions. The Cell can facilitate inter- and intra-departmental coordination, manage data and reporting, ensure that the measures proposed in the Net-zero CRCAP are integrated into the municipal governance processes and implemented, and undertake periodic monitoring of outcomes and impacts.

It is recommended that the city build on the roles established for the Climate Core Team during the climate action planning process and develop the Net-zero / Climate Action Cell as the central coordination unit for climate governance.

Roles and Responsibilities of Net-zero / Climate Action Cell

Implementation Plan

Prepare a short-term implementation plan for climate resilience interventions based on city priorities and Net-Zero CRCAP recommendations

Policy Interventions

Identify enabling policy interventions and engage with regional governments for implementing policy and regulatory measures

Climate Financing

Implement a climate-responsive municipal budgeting process and support the mobilisation of climate finance for large-scale interventions

Monitoring, Reporting and Verification

Monitor and report on implementation of pilot and bankable projects and policy related interventions periodically

Project Development

Identify and deploy pilot projects to test novel solutions and conduct techno-economic feasibility studies to develop a pipeline of bankable projects

The key roles of the Net-zero / Climate Action Cell with respect to the implementation framework are shown above. The details of the various roles and responsibilities are given below:

1. Strategic Functions

a. Oversee, guide, and coordinate the planning, implementation, and monitoring of the Net-zero CRCAP.

b. Develop and implement strategies, actions, and projects to address climate change while promoting urban sustainability, resilience, and livability.

c. Facilitate effective integration of Net-zero CRCAP initiatives into statutory planning instruments, including Development Plans, Perspective Plans, Master Plans, and city-level schemes.

d. Establish and maintain a centralized climate data bank and city-level digital portal containing climate-related information such as greenhouse gas (GHG) inventories, vulnerability maps, adaptation indicators, and sectoral data.

2. Governance and Coordination

a. Ensure adherence to national and state-level climate change frameworks, policies, and guidelines.

b. Coordinate with the Climate Core Team and Stakeholder Committee and seek technical guidance from external agencies, research institutions, and sector experts.

c. Facilitate inter- and intra-departmental coordination to integrate climate targets into decision-making processes and infrastructure planning.

d. Identify and allocate adequate financial, technical, and human resources for the effective functioning of the Net-zero / Climate Action Cell, including necessary budgetary provisions.

e. Engage with regional and state governments to contribute to and influence relevant policies, guidelines, and regulatory frameworks supporting climate action.

3. Technical Planning and Implementation

a. Support municipal departments and stakeholders in preparing department-wise integrated five-year sectoral climate action plans, followed by annual or short-term implementation plans aligned with Net-zero CRCAP priorities.

b. Develop sector-specific strategies and actionable roadmaps integrating net-zero targets into service delivery, infrastructure development, and urban planning processes.

c. Facilitate the climate-responsive annual budgeting process, including integration of Net-zero CRCAP priorities into municipal budgets and climate tagging of projects.

d. Conceptualize climate resilience and net-zero projects, undertake technical feasibility assessments (through in-house expertise or external experts), and support pilot demonstration projects and development of bankable projects.

e. Provide technical guidance for climate risk-proofing major urban infrastructure projects, ensuring long-term resilience in projects that span multiple years.

f. Identify enabling policy and regulatory measures and support their implementation at the municipal level.

g. Align Net-zero CRCAP actions with government programs, missions, and policies.

h. Support the identification of pilot demonstration projects and sectoral investment opportunities arising from climate action plans.

4. Monitoring and Reporting

a. Conduct quarterly internal review meetings of the Net-zero/ Climate Action Cell, chaired by the Municipal Commissioner, to review progress on the Net-zero CRCAP implementation.

b. Monitor progress of climate mitigation and resilience strategies using Key Performance Indicators (KPIs) aligned with state and national climate frameworks.

c. Regularly review and update the GHG emissions inventory and Climate Risk Assessment (CRA) at least once every three years.

d. Verify and report climate actions on state, national, and international reporting platforms, including submission of proposals and reports for climate funding opportunities.

e. Submit periodic updates and progress reports to state or regional government authorities as part of the existing urban local body review and monitoring mechanisms.

5. Stakeholder Coordination, Public Awareness and Capacity Building

a. Facilitate inter-departmental coordination for the preparation, implementation, and monitoring of climate action plans.

b. Conduct stakeholder consultations, public engagement activities, and awareness campaigns to strengthen climate literacy and participation.

c. Organize capacity-building programs and training workshops for municipal officials on climate action planning, risk assessment, low-carbon infrastructure, and climate finance, among other topics.

d. Promote inclusive participation of communities, institutions, and private sector stakeholders in climate initiatives.

e. Conduct sensitization programs, public consultations, and Information, Education, and Communication (IEC) campaigns to promote climate awareness among stakeholders and citizens.

f. Promote environmental education, institutional partnerships, and knowledge exchange, including collaboration with academia, private sector organizations, and civil society.

g. Promote a gender-inclusive, equitable, and socially responsive approach in climate planning and project implementation.

6. Financing and Resource Mobilization

a. Prepare a Climate Investment Plan and Climate Budget

b. Identify and pursue funding opportunities from state and central government schemes, international climate finance mechanisms (e.g., Green Climate Fund, Adaptation Fund, financial institutions), corporate social responsibility (CSR) funds, and private partnerships.

c. Develop guidance and frameworks for accessing local climate finance mechanisms, including CSR and corporate environmental responsibility (CER) funds.

d. Maintain a CSR partnership repository and engage with private sector entities to mobilize investments for climate action projects.

Institutional Structure of Net-zero/ Climate Action Cell

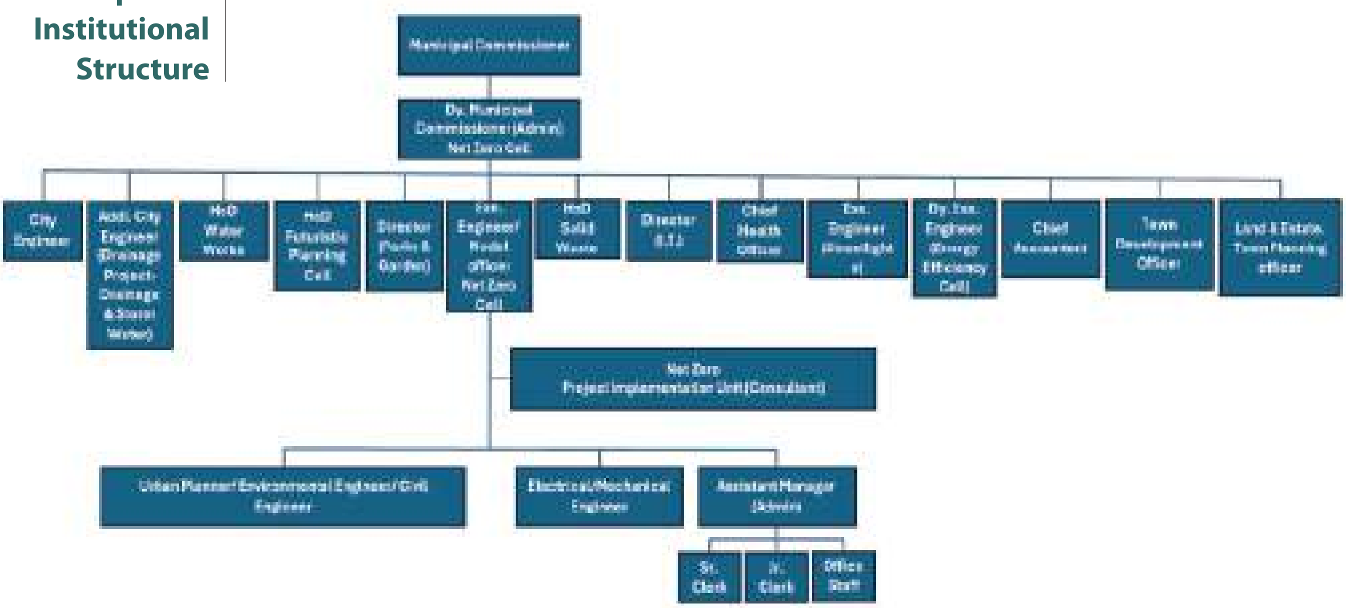
The operational functioning of the Net-zero / Climate Action Cell shall be led by a Deputy Municipal Commissioner–level officer, who will serve as the Head of the Cell, with support from a Nodal Officer (Technical Officer). The Cell shall function under the overall supervision and guidance of the Municipal Commissioner. The Net-zero / Climate Action Cell will coordinate closely with the Climate Core Team, key municipal departments, and external stakeholders to plan, identify, and implement climate-resilient and low-carbon interventions across the city, in alignment with the Net-zero CRCAP.

To ensure effective implementation and coordination, nodal officers from each key municipal department shall be designated under the leadership of the Deputy Municipal Commissioner. These departmental nodal officers will periodically coordinate with the Nodal Officer of the Net-zero / Climate Action Cell to facilitate climate action planning, project implementation, monitoring, and reporting.

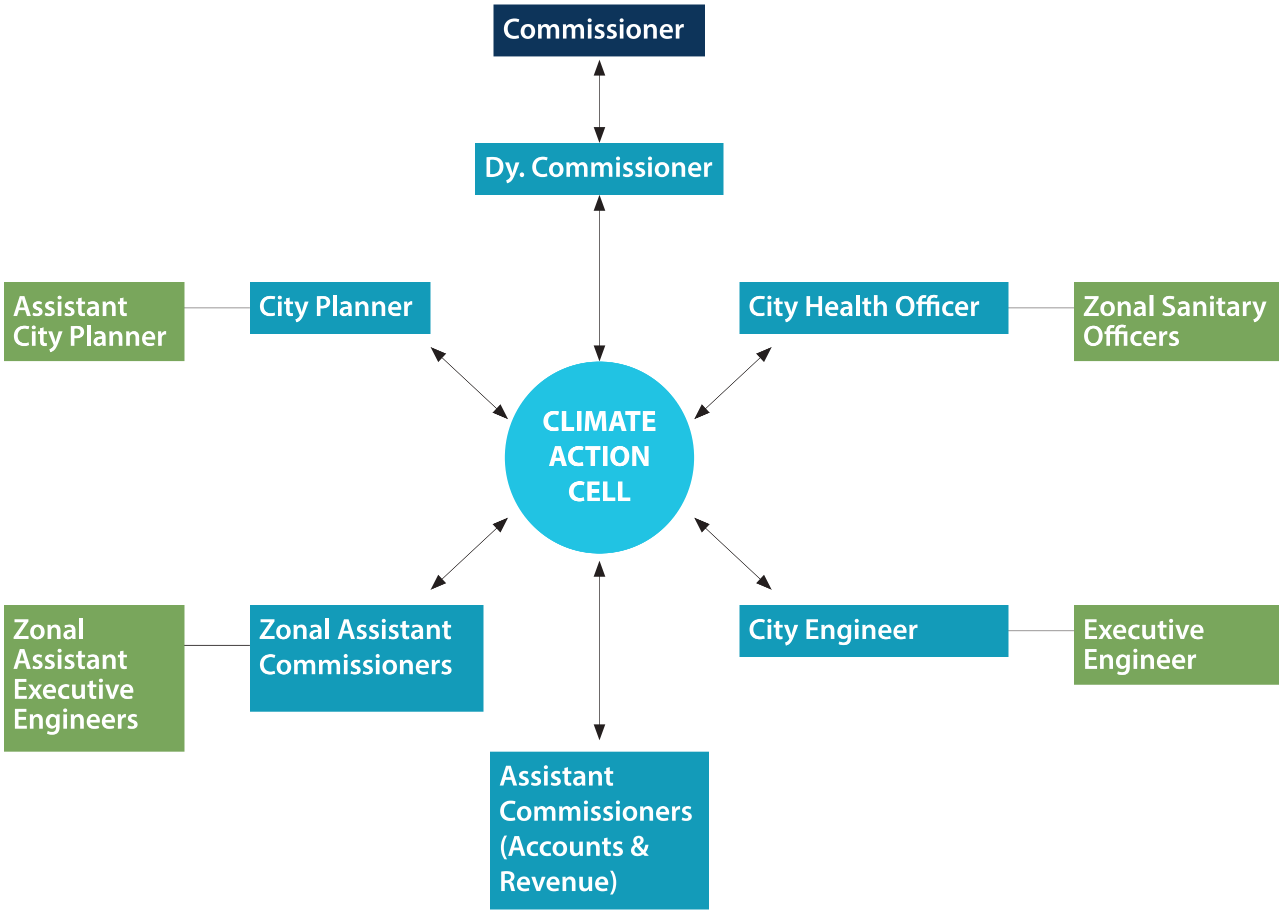
The implementation of the Net-zero CRCAP requires a multidisciplinary and integrated approach, including data collection and analysis, inter-departmental coordination, identification and development of climate-resilient projects, mobilization of resources, and the conceptualization and implementation of climate initiatives across sectors.

Examples of Institutional Structure

1. Net-zero, Environment and Climate Resilient Cell, Ahmedabad Municipal Corporation



2. Climate Action Cell, Tirunelveli City Municipal Corporation



Tool 6.1B

Capacity Building Needs Assessment

This Capacity Building Needs Assessment (CBNA) tool provides a structured framework for cities to self-assess the institutional, technical, and human resource capacities required for the planning, implementation, and monitoring of climate actions in line with the Net-zero CRCAP.

The tool enables cities to systematically identify existing strengths, institutional gaps, and priority capacity-building requirements within the local government. This helps cities strengthen their readiness to plan, finance, implement, and monitor climate change mitigation and adaptation actions.

The CBNA tool is intended to be used by municipal departments, Net-zero / Climate Action Cells, implementation partners, and other relevant stakeholders. It is recommended that cities undertake this assessment after preparing and adopting the Net-zero CRCAP to operationalize the plan and strengthen their institutional readiness for implementing local climate actions.

The tool assesses the city's preparedness across several functional areas, including: 1) technical assessments and climate planning; 2) project conceptualization and development; 3) climate-responsive budgeting and financing; 4) data management and digital systems; 5) stakeholder engagement and institutional coordination; and 6) monitoring, reporting, and evaluation.

Why Capacity Building is Important

Effective implementation of a Net-zero CRCAP requires strong institutional capacity, technical expertise, financial planning mechanisms, and robust governance structures within the municipal administration. The CBNA supports cities in systematically identifying the following: 1) existing technical and institutional strengths; 2) capacity gaps across departments and sectors; 3) priority areas requiring training, staffing, or technical support; and 4) opportunities for partnerships, collaboration, and knowledge exchange.

Through this assessment, cities can develop a clear understanding of the institutional changes and capacity enhancements required to implement climate actions effectively as they move towards a Net-zero future.

Potential Capacity-Building Interventions

Cities should undertake the CBNA through internal consultations across departments, a review of existing governance systems and processes, and engagement with key stakeholders, including state agencies, technical institutions, development partners, and the private sector.

The results of the CBNA should inform targeted capacity-building interventions, including:

Potential Capacity-Building Interventions cont.

1. development of structured training programs for municipal officials;
2. strengthening of institutional mechanisms such as the Net-zero / Climate Action Cell;
3. preparation of staffing and technical support plans;
4. development of partnerships with academic institutions and knowledge organizations; and
5. engagement with external experts for project preparation and access to climate finance.

- These measures will help ensure long-term institutional capacity and the effective implementation of climate resilience actions across sectors.

Template for Cities to Undertake CBNA

The following tables present the template for CBNA in cities across 6 functional areas:

Table 1: Technical Assessment and Climate Action Planning

Assessment Area	Current Status	Gaps/Challenges	Capacity Building Needs
Urban system gap analysis			
Identification of priority wards for improved urban services based on analysis of comprehensive grievance redressal systems			
Preparation and periodic updating of the city's GHG emissions inventory			
Climate Risk and Vulnerability Assessment (CRVA)			
Scenario modeling and target setting for Net-zero transition			
Sectoral technical expertise (water, wastewater, solid waste management, energy, transport, urban greening, etc.)			
Integration of climate considerations into Development Plans and Master Plans			
GIS, remote sensing, and spatial analysis for climate planning			

Table 2: Project Development and Implementation

Assessment Area	Current Status	Gaps / Challenges	Capacity Building Needs
Identification of priority climate action projects			
Design and implementation of pilot demonstration projects			
Techno-economic feasibility assessments			
Development of bankable projects			
Procurement and contracting processes			
Project management and implementation capacity			
Integration of climate resilience into large infrastructure projects			
Preparation of DPRs for climate-resilient infrastructure			

Table 3: Climate Budgeting and Climate Financing

Assessment Area	Current Status	Gaps / Challenges	Capacity Building Needs
Preparation of Climate Investment Plans and Climate Budgeting processes			
Cost estimation of climate action projects			
Climate-responsive budgeting and climate tagging of projects			
Assessment of funding opportunities through state and national schemes and missions			
Mobilization of climate finance from the private sector, financial institutions, and community sources			
Project structuring (bankability, PPP models, blended finance, etc.)			
Accessing international climate finance (GCF, Adaptation Fund, MDBs, etc.)			
Engagement with CSR partners and private sector investors			

Table 4: Monitoring and Reporting of Climate Actions

Assessment Area	Current Status	Gaps / Challenges	Capacity Building Needs
Selection of KPIs and long-term performance tracking			
Data collection and management systems			
Monitoring of actual GHG emissions reductions			
Monitoring the impacts of climate adaptation actions			
Reporting to national and international platforms			
Development of digital dashboards for climate action monitoring			

Table 5: Institutional Governance and Coordination

Assessment Area	Current Status	Gaps / Challenges	Capacity Building Needs
Institutional structure for climate governance within the ULB			
Inter-departmental coordination mechanisms			
Integration of climate action into municipal decision-making			
Stakeholder engagement and partnerships			
Capacity of the Net-zero / Climate Action Cell			

Table 6: Digital Systems and Data Management

Assessment Area	Current Status	Gaps / Challenges	Capacity Building Needs
Climate data portal / centralized data bank			
Integration of GIS and spatial data systems			
Use of remote sensing and satellite data for monitoring			
AI and analytics tools for climate modelling			
Digital dashboards for climate budgeting and reporting			

Tool 6.2

Climate Project Monitoring and Reporting

This tool is designed to help cities develop project-level Monitoring, Reporting, and Verification (MRV) system to track the performance of both climate adaptation and mitigation projects. This tool outlines good practice approaches for developing an MRV framework, along with practical indicators and clearly defined responsibilities for both internal and external reporting

SECTION A

What is Monitoring, Reporting, and Verification (MRV)?

A clear and structured MRV system ensures that project implementation is consistently monitored, results are measured using well-defined indicators, and progress is reported transparently in a traceable format for decision-making. The MRV system also improves the credibility of climate interventions and supports compliance with national frameworks and international reporting platforms.

A robust MRV system is also key to helping cities access climate finance. Many climate finance instruments, including grants, concessional loans, results-based finance, and carbon market mechanisms, require credible, transparent, and quantifiable evidence of the impacts and outcomes of climate interventions. MRV offers a structured framework for accountability and transparency, allowing cities to demonstrate their progress towards their climate goals and targets and validate the effectiveness of their emission-reduction and climate adaptation efforts.

Definitions of MRV

Monitoring (M) involves regularly tracking data and information on the impacts of climate resilience interventions. This includes measuring or estimating greenhouse gas (GHG) emissions and assessing the impacts of climate resilience interventions or projects using climate resilience indicators. Monitoring also involves gathering details on the financial and technical support required for implementing climate resilience initiatives.

Reporting (R) involves compiling measured information in a systematic and consistent way, for example, through inventories or progress reports, using standardised reporting formats, to make it available to decision-makers, stakeholders, and the public. This improves the accessibility of the information, promoting transparent and informed decision-making.

Verification (V) involves reviewing or assessing the reported information to establish completeness and ensure transparency and reliability. Verification helps ensure data accuracy and compliance with established reporting procedures and can provide meaningful feedback for future improvement.

MRV is a systematic approach that helps cities track the progress of their climate interventions. The MRV system enables cities to verify that projects are implemented as planned, assess their climate impacts, and report these results in a clear and consistent manner. It also helps ensure that each project has clear indicators, assigned responsibilities, defined data sources, and a robust review process, providing cities with a transparent system to demonstrate the results and impacts of their interventions and to identify areas requiring further efforts.

Cities should structure the MRV framework using a logical hierarchy that covers inputs, outputs, outcomes, and long-term impacts, to support systematic tracking of implementation progress and results (see Figure 1). Cities can use a simple impact logic (Input ⟶ Output ⟶ Outcome ⟶ Impact)[1] to link project activities to short-term results and longer-term impacts and to define project-specific indicators, targets and means of verification using the template provided in figure 2.

Figure 1: Impact Logic Model

Figure 2: Sample Solar PV Impact Logic Model

6. Causal impact logic helps explain how a project leads to results. Inputs are the resources used (finance, technology, people). Outputs are what the project delivers (e.g., infrastructure or services). Outcomes are the changes that follow (e.g., energy savings or cleaner technologies). Impacts are the long-term effects (e.g., reduced emissions or improved resilience).

The MRV system should be implemented as a continuous cycle, following a Plan–Do–Check–Act approach,[2] in which monitoring results inform periodic reviews, corrective actions, and necessary updates to project implementation.

In addition, the MRV system should align with the broader planning cycle outlined in the Net-zero Climate Resilient City Action Plans (CRCAP), as well as with state and national plans or frameworks such as the Climate Smart Cities Assessment Framework (CSCAF), State Planning Commission plans, the Urban Outcomes Framework (UOF) and others. Cities should ideally have multi-year implementation timelines (e.g., 5-6 years) supported by annual action plans, with monitoring results informing annual reviews and subsequent planning updates. Indicators, baselines, and reporting cycles should be defined at the planning stage to ensure consistency during implementation.

Cities should establish periodic review mechanisms, led by the City Climate Core Team, to assess implementation progress, identify corrective measures, refine targets and interventions where required, and facilitate evidence-based decision-making. Monitoring outcomes should also inform annual departmental planning and budgeting processes, as well as future revisions of the Net-zero CRCAP.

SECTION B

Monitoring, Reporting, and Verification (MRV) of Climate Projects

Project-level MRV enables cities to systematically monitor and report on the implementation, outcomes, and impacts of climate resilience interventions, such as reduced GHG emissions, improved air quality, and reduced flood risk.

A strong project-level monitoring system is a prerequisite for accessing climate finance and carbon credits. Carbon markets and funding agencies require clear, measurable, and well-documented evidence of a project's climate resilience benefits. By tracking projects using defined indicators, maintaining accurate records, and demonstrating real GHG reductions or improvements in resilience, cities can meet the eligibility criteria for climate finance instruments such as carbon credit standards and strengthen their case for accessing climate finance.

1. Purpose of Project-Level MRV

Project-level MRV enables cities to:

- Track whether climate interventions (mitigation or adaptation) are being implemented as planned
- Quantify the impacts of interventions using defined Key Performance Indicators (KPIs) (e.g., GHG emission reductions, flood-risk reduction, improved air quality, energy savings)
- Identify implementation gaps and areas where corrective measures are required
- Aggregate project-level impacts into citywide monitoring frameworks, climate action plans, and reporting commitments
- Provide evidence for funding agencies where verification is required for accessing climate finance.

7. The Plan Do Check Act (PDCA) is an iterative improvement approach for carrying out change by planning actions, implementing them, monitoring results, and taking corrective measures based on performance.

2. Components of the Project-Level MRV System

A. Monitoring

For each project, cities should define clear indicators that track both how the project is being implemented and its outputs and outcomes. Examples include:

- **Implementation indicators:** These are used to measure project outputs and implementation progress. Examples include the number of buildings retrofitted with energy efficient measures, EV charging stations installed, and lakes rejuvenated.
- **Impact indicators:** These are used to measure project impacts or outcomes. Examples include electricity or fuel savings, biogas generated, emissions reduction, and improved air quality.

For each indicator, the MRV template should specify:

- Required data with units of measurement
- Calculation methodology
- Baseline and target values
- Data collection methodology and tools
- Frequency of measurement/monitoring
- Responsible department
- Data sources and documentation templates
- Clear milestones for data collection, mid-term reviews, and end-of-project assessments

Monitoring systems should combine quantitative and qualitative indicators with simple qualitative status ratings (e.g., "on track", "delayed") to better capture implementation progress. Further, indicators should, where possible, be standardized to align with state and national frameworks (e.g., State Action Plan for Climate Change or SAPCC), Nationally Determined Contributions (NDCs), and Service Level Benchmarks)., to enable easy aggregation and comparison across projects and cities.

Where direct measurement is difficult (e.g., GHG emissions reductions or fuel savings), cities may use proxy indicators that are closely linked to expected outcomes. For example, changes in public transport or non-motorized transport modal share can serve as proxy indicators for reduced fuel consumption and transport-related emissions. The identified indicators should be translated into measurable KPIs with baselines, targets, timeframes, and responsible departments/agencies for monitoring (refer to Tool 6.3 for more information on establishing KPIs). The KPIs should facilitate periodic tracking of implementation progress, project performance, and climate resilience impacts across sectors. Cities should also standardise KPIs, where possible, to facilitate aggregation of project-level monitoring outputs into broader city-level climate monitoring and reporting systems.

Cities should also establish dashboard-based monitoring systems for consolidating and visualizing sector-wise KPIs, implementation progress, climate resilience impacts, and reporting status. Where feasible, these systems may be integrated with existing municipal e-governance systems or Integrated Command and Control Centers (ICCCs) to support periodic review, transparency, and decision-making.

B. Reporting

Reporting requirements for projects depends on the city's established internal procedures or on donor requirements for external funding. Cities should define reporting milestones for each project and develop a system that captures key updates at regular intervals. This includes:

- Periodic progress reports (monthly, quarterly, or annual)

- Summary of implementation status
- Measurement results against defined KPIs
- Challenges, delays, or deviations from expected outcomes
- Updates to climate action contributions uploaded to national or international reporting systems (e.g., Global Covenant of Mayors for Climate & Energy (GCoM), CDP-ICLEI Track, national MRV platforms like CSCAF or UOF)

Reporting should take a multi-layered approach that includes qualitative implementation status, milestone tracking, and quantitative indicators. It should be embedded in the annual administrative and planning cycle as part of the routine governance processes rather than a stand-alone exercise. It should also support impact-oriented assessment and continuous learning, helping cities understand what their projects are achieving over time. Results from each reporting cycle should be used to review progress and adjust future plans and targets.

C. Verification

Verification ensures that reported information and data is accurate, complete, and consistent with the defined MRV methodology. Verification helps confirm that:

- Indicators are correctly measured
- Data sources are reliable
- Assumptions are documented
- Calculations follow defined protocols and standards
- Results are reliable for higher-level reporting
- Planned measures are being implemented on the ground as per design and specifications (for example, materials installed in buildings, equipment type and capacity, locations)
- Implementation is progressing as per schedule and in line with the MRV plan

Cities should distinguish between can opt for internal or third-party verification. Internal verification is carried out periodically by the City Climate Core Team to assess data quality and consistency and progress in implementation of climate actions. Third-party verification is required when accessing carbon markets or results-based finance and must be conducted by accredited auditors at milestones defined by the relevant methodology or financing platform. The frequency and scope of both should be decided at the planning stage and recorded in the MRV plan.

3. Integrating Project MRV into Citywide Monitoring Systems

Project-level MRV feeds into broader city climate monitoring and reporting processes, including:

- Annual Net-Zero CRCAP reviews
- GHG inventory updates
- Vulnerability and adaptation progress assessments
- National and international reporting requirements where applicable (e.g., Urban Outcomes Framework, Swachh Bharat Mission, GCoM). Cities may already be reporting to a national MRV framework; where such systems exist, the project-level MRV framework should be adapted to align with national guidelines.

For effective MRV of projects, cities must establish clear institutional arrangements that define who is responsible for monitoring, recording, analyzing, and reporting project-level data. A well-designed institutional set-up ensures accountability, consistency, and continuity, even when staff or contractors change. Cities should ideally designate two types of actors in the MRV system:

1. **A City Nodal Department and Nodal Officer** responsible for oversight, coordination, and reporting
2. **Implementing department or a Technical Partner** responsible for operating monitoring equipment, collecting data, and reporting to the nodal officer as per defined indicators.

SECTION C

Unlocking Climate Finance through the MRV System

At the project level, MRV enables cities to transform climate interventions into funding-ready projects by precisely recording baselines, targets, progress, and outcomes. Effective monitoring and transparent reporting show that projects produce real mitigation or adaptation benefits. This boosts the city's ability to access funding through multilateral development banks, climate funds, and private investors, who rely on accurate data to assess project performance, mitigate investment risks, and allocate financing.

A robust MRV system enables cities to access a range of climate finance instruments. Public and multilateral climate funds often adopt a results or outcome-based financing approach that requires regular reporting against specific indicators. Results-based financing links payments to verified outcomes, sometimes called "Disbursement-Linked Indicators", such as emissions reductions or improved service delivery. The MRV system strengthens a project's bankability, as private investors are increasingly relying on transparent performance data to prioritise low-carbon and climate-resilient projects.

For cities seeking to access carbon markets, MRV is critical. Carbon markets require robust monitoring, transparent reporting, and independent verification to demonstrate that emission reductions are credible and measurable. A well-designed MRV system provides the necessary framework to support project validation, verification, and the issuance of carbon credits under voluntary or compliance market mechanisms.

Beyond individual initiatives, the MRV system supports cities in developing long-term capacity to access climate finance. Over time, consistent monitoring and reporting can:

- Enhance the quality and dependability of data across various sectors
- Help cities aggregate smaller projects into larger, fundable portfolios
- Minimise the effort and time required for future funding applications.

SECTION D

Example of Data Recording for MRV of a Project

An example of the MRV framework is provided below for reference. The example pertains to a grid-connected solar PV system installed at a city water filter station. It is important to note that this format supports only data monitoring and reporting and does not include third-party verification. Any independent verification must be conducted by cities through accredited GHG auditors. The table tracks outcome-level indicators for the project. Impact-level assessment, such as contribution to citywide GHG targets, is captured through the broader city climate monitoring framework described in Section B.

Monitoring, Reporting, and Verification (MRV)
Example: 70 KWP grid-connected solar PV system at water filter plant

Introductory Note:
This project aims to reduce conventional electricity consumption from the water sector and related GHG emissions. This MRV system will support the city in capacity building and establishing an institutional structure for periodic monitoring of the plant's performance to maximize benefits.

Institutional Set Up:
Cities should designate people for the roles they play in monitoring and reporting the project:
1. A City Nodal Department and Nodal Officer responsible for oversight, coordination, and reporting
2. A Technical Partner or Implementing Agency responsible for operating monitoring equipment, collecting data, and maintaining the system

Guidance note for using monitoring and reporting sheet:
1. The responsible Nodal Officer will collect and fill in the relevant information in Columns 1 and 2.
2. The responsible officer will collect the electricity bills and enter the required information in Columns 3 and 4.
3. The responsible officer shall coordinate with the contractor for comprehensive operation and maintenance; O&M-related information may be provided in Column 10.
4. Based on the information provided above, Columns 6,7, and 8 will be auto-calculated using the formulas provided in the column headings.

Name of Responsible Department for Monitoring	**Electrical Department**		
Head of Department	Name:	Designation:	Contact:
Responsible officer for monitoring and reporting (Nodal Officer)	Name:	Designation:	Contact:
Name of the agency responsible for O&M			
Responsible person for O&M	Name:	Designation:	Contact:
Submission to Nodal Officer	**Date of Submission:** **Remarks (If any):**		

Billing month (1)	(2) Total units generated from SPV till date (kWh)	(3) Units generated from SPV per month (kWh/ month)	(4) Units exported to the grid (kWh/ month) (Will be available in DISCOM Bill)	(5) Amount credited in user's account from DISCOM (INR/ month) (Will be available in DISCOM Bill)	(6) Actual electricity produced from SPV used on-site (kWh/ month)	(7) Total GHG emission reduction till date (tCO2e) (Column 2) * Grid Emission Factor	(8) Total GHG emission reduction per month (tCO2e/ month) (Column 3) * Grid Emission Factor	(9) Evidence Electricity bill (Yes/ No)	(10) Cleaning of panels or service-related activity done Can also mention major break-downs, if any
Month 1	69448.8	10617.5	0	0	10617.5	57.14	8.74		
Month 2									
Month 3									
Month 4									
Month 5									
Month 6									
Month 7									
Month 8									
Month 9									
Month 10									
Month 11									
Month 12									

Tool 6.3

Tracking CRCAP Implementation

This guidance tool supports cities in establishing Key Performance Indicators (KPIs) for climate resilience interventions to monitor and track the implementation of the Net-zero Climate Resilient City Action Plan (CRCAP). It suggests developing a simple Monitoring, Reporting, and Verification (MRV) framework that defines measurable indicators, assigns responsibilities, and periodically reviews progress across sectors, covering both adaptation and mitigation interventions.

This tool includes sample KPIs for climate resilience interventions and a summary reporting template to support the consistent tracking of interventions across sectors. For individual climate resilience interventions, it is recommended to develop a project-level MRV system to monitor and evaluate these actions (refer to Tool 6.2: Climate Project Monitoring and Reporting).

SECTION A

KPIs for Monitoring and Tracking of CRCAP Interventions

The Net-zero / Climate Action Cell established within the Urban Local Body (ULB) of a city (refer to Tool 6.1A: Institutionalising Climate Action Planning and Implementation) can take the lead on MRV of the Net-zero CRCAP implementation. The Nodal Officer of the Cell can coordinate with representatives from different departments within the Net-zero / Climate Action Cell to identify, monitor, and report measurable KPIs for each climate intervention.

The KPIs capture relevant data from various sources for climate resilience interventions identified and detailed sector-wise in the Net-zero CRCAP, and will help cities track their progress towards achieving the sectoral goals and targets set in the Climate Action Plan. Sample sector-wise KPIs are provided in Table 1 for reference.

The KPIs should be categorised based on whether they are measured using internal or external data sources. The internal sources include the various departments of the ULB, and external data sources may include national and sub-national government agencies and parastatal organisations.

Table 1: Sample Key Performance Indicators (KPIs)

Climate Resilience Intervention	KPI
Sector: Water Supply	
Reduction of non-revenue water (NRW)	Percentage of water distribution network with sensors installed Percentage reduction of identified unbilled, authorised consumption Number of houses with smart water meters Percentage reduction of leaks in the piped supply in a year Water audits completed in a year Percentage reduction in NRW
Climate resilience intervention 2	[Add KPI]
Sector: Wastewater	
Improve the collection, scientific disposal, and treatment of sewage	Percentage of sewage collected and treated properly Percentage increase in anaerobic treatment capacity Percentage increase in sewerage network connected to the centralised system
Access to toilets for all	Percentage of population practising open defecation Percentage of population with unsafe toilets Percentage of toilets with safe disposal of sewage in septic tanks.
Climate resilience intervention 3	[Add KPI]
Climate resilience intervention 4	[Add KPI]
Sector: Solid Waste Management	
Increase waste collection coverage	Percentage of households with door-to-door collection Percentage of wards with 100% collection coverage
Improve the scientific treatment of solid waste	Percentage of waste processed at treatment facility Tonnes of waste diverted from open dumping per year
Expand source segregation	Percentage of households practising source segregation Number of wards with a dry waste collection centre
Climate resilience intervention 4	[Add KPI]
Sector: Energy and Buildings	
Increase renewable energy use in municipal operations	Installed renewable energy capacity (kWp) Percentage of municipal energy from renewable sources GHG emissions avoided (tCO_2e/year)
Improve energy efficiency in municipal buildings	Percentage reduction in municipal energy consumption Number of buildings with energy audits completed
Climate resilience intervention 3	[Add KPI]
Sector: Transport	
Promote the use of non-motorised transport	Length of dedicated cycling and pedestrian infrastructure added (km) Modal share of NMT trips (%)
Increase the share of clean public transport	Number of electric vehicles introduced in the city fleet Percentage reduction in transport-related GHG emissions
Climate resilience intervention 3	[Add KPI]

Note: *The KPIs listed above are indicative. Cities should select indicators relevant to their local context and the interventions identified in their CRCAPs. Additional sector-specific indicators may be added as appropriate.*

SECTION B

Tracking Net-zero CRCAP implementation using KPIs

Once sectoral KPIs have been identified, cities should develop a structured MRV framework to track the implementation of the Net-zero CRCAP. The identified indicators should be monitored, verified, consolidated, and periodically reported by the Net-zero / Climate Action Cell to the city leadership and external stakeholders. The Nodal Officer from the Net-zero / Climate Action Cell can lead this effort by coordinating the collection of the information and data required to track the implementation of various climate interventions from internal and external sources and compiling it into a monitoring report.

A sample summary table for reporting sector-specific KPIs is provided in **Table 2**. This table can be updated periodically by representatives from ULB departments who are part of the Net-zero / Climate Action Cell, as well as external stakeholders from the city's Stakeholder Committee (refer to Tool 1.3A: Stakeholder Engagement). The Net-zero / Climate Action Cell can then consolidate and report the indicators. This will enable transparent evaluation and tracking of progress in implementing the Net-zero CRCAP and help the ULB assess whether the city is on track to meet its mitigation and resilience targets and undertake corrective measures where necessary.

The monitoring process should also support the assessment of progress towards sectoral and city-level climate targets and ambitions. The compiled monitoring outputs can also be used for:

- monitoring progress in the implementation of climate actions
- assessing implementation delays, gaps and resource needs
- monitoring sectoral performance against set targets and milestones
- assisting inter-departmental coordination and decision-making
- refining interventions and targets based on implementation learnings
- strengthening city-level climate governance and accountability mechanisms.

Cities may also periodically compile sectoral monitoring outputs into an integrated city-level monitoring report or publicly accessible dashboard to showcase progress in implementing climate actions. An effective MRV framework will help track the progress of implementation of the Net-zero CRCAP while also supporting:

- assessment of long-term climate performance considering national and sub-national priorities
- evidence-based planning
- reporting to national and global climate reporting platforms
- accessing performance-linked climate finance
- prioritising investment for high-impact interventions
- future revisions and improvements of the CRCAP.

Table 2: Summary Table for Compiling KPIs (Maintained and Updated Periodically by the Nodal Officer)

Sector	Climate	KPIs	Expected Timeline (Month and Year)	Monitoring Status (Year 1) (Status with Supporting Document from Base Year to Year 1)	Monitoring Status (Year 2) (Status with Supporting Document from Year 1 to Year 2)	Monitoring Status (Year 3) (Status with Supporting document from Year 1 to Year 3)
Example: **Target Sector – Water Supply** **Department** – Water Supply Department, ULB Name / PHED, Govt of (State Name) **Person Responsible for Monitoring and Updating** – Name and Designation **Contact Information** -						
1.1: Water Supply	1.1.1 Detection of leakages in distribution lines	Water audit and NRW assessment to identify ageing pipeline networks Detailed Project Report for assessing technical and financial feasibility Budget provision and tendering Implementation and monitoring (NRW reduction analysis)	Start: December 2026 End: January 2027	- Water audit is completed - Detailed Project Report is prepared - Budget is allocated - Tendering is done	- Work order provided - Work in progress (40% completed)	
	1.1.2 Integrate additional water sources					
	1.1.3 [Add intervention]					

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Tool
7.1

Horizontal Collaboration with Other Similar Cities in the Country

This tool provides guidance to cities on key actions to help them collaborate effectively with various city government departments and with other local governments in the country through structured coordination strategies and peer exchanges that support planning, implementation and regional scale-up of local climate actions. Consistent and effective communication about climate change and its impacts will enhance support for the implementation of the Net-zero Climate Resilient City Action Plan (CRCAP) with other departments and the citizens. A structured horizontal collaboration can help cities collectively build and strengthen institutional capacity and drive impactful climate resilience actions in alignment with regional and national goals and targets.

Horizontal Collaboration for Climate Actions

Horizontal integration refers to cooperation and coordination within the city and between local governments in a region, with the potential to significantly improve system efficiency, particularly by enhancing coherence and sustainability of vital urban infrastructure that does not end at administrative borders. For example, in the mobility sector, the coordination of interfaces, timetables, ticketing and operators is necessary to increase the use of public transport, non-motorized modes, car sharing, etc., thus reinforcing the need for enhanced collaboration between multiple departments.

Horizontal collaboration with neighboring local governments may also help to achieve the necessary scale for a strategy that might not be viable for a city. For example, setting up a regional waste management facility will help local governments that do not generate enough waste to implement an economically sustainable facility. Similarly, neighboring cities can establish a bulk purchasing consortium for renewable energy or sustainable public transport networks.

The intent of horizontal collaboration and communication with other departments and local governments should be to avoid duplication of efforts by sharing knowledge and best practices, supporting training and handholding of aspirational cities by lighthouse cities and supporting aligned regional climate strategies. It should also help enhance buy-in with new audiences and make the plan more accessible to communities that have historically not been involved in the process.

Horizontal collaboration for enhanced inter-departmental coordination and communication on climate actions: Enhancing horizontal cooperation between government departments and parastatal agencies within the city will help prevent a siloed approach to climate action planning and implementation. The key actions that a city can take to enhance inter-departmental collaboration are as follows:

- The Net-zero / Climate Action Cell (see Tool 6.1A: Institutionalizing Climate Action Planning and Implementation) or Climate Core Team (see Tool 1.2: Formation of Climate Core Team) established by the cities should include representatives from key local government departments such as water supply, waste management, electricity, and transportation.
- Create a sub-group within the Net-zero Climate Cell or Climate Core Team for a communication SPOC from each department. Each department should assign a person who can efficiently convey information to the entire team and to their own department, ensuring collaborative action between different departments. The group should meet regularly, with each department contributing sectoral input (such as transport, waste, and green cover).
- Establishing a Communication Dashboard or other feasible communication platform to monitor the effectiveness of climate communication, align communication timelines and responsibilities, and review steps.
- The stakeholder committee established (see Tool 1.3A: Stakeholder Engagement) to support climate action planning and implementation should include key representatives from government departments and parastatal agencies in the city. The stakeholder committee should be convened periodically, with stakeholders engaged regularly for input and coordination on key infrastructure projects in the city.
- Standardize key messages across departments to ensure transparent and clear communication. A One City One Message approach creates clarity of intent through a single visual identity. For example, if the core messaging is centered around 'Clean Cities' or 'Green Cities,' then all departments should strategize to resonate the same point.
- Organize Joint Public Consultation events to enable a comprehensive approach to addressing climate-centric issues. For example, an Electric Mobility consultation should be undertaken jointly by all relevant departments, such as Transport, Waste, and Electric Utility. This avoids conflicting messaging from departments working in silos.

Horizontal collaboration between cities for shared learning on local climate actions:

Collaboration between cities within a country or region helps accelerate climate action through peer-to-peer learning and exchanges on challenges, lessons learned, and best practices from the implementation of local climate actions.

- Create a city exchange group/forum with representatives from all participating cities, enabling sustained engagement and structured communication and coordination.
- Establish an institutional coordination mechanism where engagements with other cities are scheduled with periodic virtual or in-person meetings.
- Use shared digital platforms such as knowledge portals, communication groups for sharing resources, data, and tools and for sharing knowledge on different issues.
- Produce knowledge products such as case studies, toolkits and periodic collaboration reports that highlight regional climate action progress.
- Identify and implement collaborative projects such as clustered waste management facilities for neighboring cities and towns that benefit from implementation at scale and alignment with regional needs and targets.
- Undertake collaborative capacity building and awareness initiatives. Joint technical training on project development and climate financing can help explore approaches such as pooled budgets and shared resources to cost-effectively implement and scale climate resilience infrastructure. Collaborative efforts to build awareness through climate storytelling, narratives, crisis communication and response programs, and behavioral change campaigns help build awareness on climate change and its impacts for citizens.

Tool 7.2

Vertical Collaboration with Provincial and National Governments

This tool provides guidance to cities on implementing actions to support vertical integration and collaboration and enhance access to resources for implementing and scaling up pilot projects identified in the Climate Resilient City Action Plan (CRCAP). Vertical collaboration, also referred to as sub-national integration or multi-level governance, refers to structured engagement and collaboration between different levels of government (national, state, and local) to enable regular information exchange, planning and coordination for local climate action planning, implementation and reporting and to enhance the effectiveness of policies and programs.

Vertical Collaboration with Provincial & National Governments

Vertical collaboration supports the integration of local priorities into state and national planning, and enables the effective design, implementation, monitoring and reporting of policies, programs, schemes and funding mechanisms across all levels. It helps to identify and bridge local resource and capacity gaps, build local strengths, and enable local governments to access state or national financial and technical resources. Conversely, local governments play a crucial role in achieving national-level climate targets and commitments, and vertical integration ensures that climate actions are not limited to city boundaries but are supported, aligned with, and reinforced across tiers of governance.

Since local governments operate within the national and regional policy and infrastructure frameworks, it is in their interest to take advantage of available opportunities and channels for vertical communication and coordination. By doing so, local governments can address enabling framework conditions and improve access to external financing. It may also provide additional technical, financial and political support for cities testing innovative strategies, technologies, systems and practices with potential for national-scale replication.

Vertical collaboration can also support the identification of model cities and provide them with enabling frameworks for the national scale-up and replication of innovative climate solutions. The following steps can be undertaken by cities to enhance vertical collaboration and integration:

1. **Align CRCAP and its communication with national and state plans and priorities:** Throughout the CRCAP preparation, the city must ensure that the plan aligns with national and state mitigation and adaptation targets and priorities. For example, the mitigation scenarios for the CRCAPs of Vijayawada and Kakinada are aligned with Andhra Pradesh's target of achieving net-zero greenhouse gas emissions by 2047.

   The Communications single point of contact must ensure that city-level messaging around the CRCAP reflects national climate commitments, state climate action plans and sectoral schemes. This creates coherence and prevents conflicting public messaging across governance levels. It also enables the integration of local priorities into national policy discourses, supporting national and regional advocacy (see Tool 9.3: Engagement in Local, Regional and Global Climate Advocacy).

2. **Develop standardized reporting templates aligned with state and national policies and targets:** To improve multilevel governance and alignment with state and national climate priorities, cities can ensure consistent reporting through standardization of policy briefs, implementation toolkits, climate action guidelines, reporting templates, media kits and press releases, etc. While cities can localize messages, overall alignment with national and state priorities should be maintained.

3. **Designate communication focal points at each governance level:** Cities and states should designate technical and communication focal points at each governance level. These focal points should facilitate continuous intergovernmental coordination, lead multi-level capacity-building efforts and create a shared understanding of climate action across different governance levels.

4. **Integrate local data with national/state platforms:** Vertical communication can help cities to integrate local data from greenhouse gas emissions inventories, climate risk assessments, monitoring, reporting and verification, CRCAP progress tracking, budget and financing needs and pilot demonstrations with national or state-level data management systems and platforms (see Tools 6.2 and 6.3 for detailed guidance). This will enable vertical collaboration, knowledge sharing and visibility.

5. **Create structured institutional mechanisms to enable vertical collaborations:** The climate action or net-zero cell established by the city (see Tool 6.1A: Institutionalizing Climate Action Planning and Implementation) should be formally linked to similar state-level cells, committees or other coordination structures. The city must establish clear communication and reporting protocols, such as quarterly meetings, to enable regular engagement and coordination.

   Creating such structured, institutional mechanisms will enable integrated planning, facilitate joint development of climate strategies, co-create implementation roadmaps, and align state budgets with city-level project pipelines and development needs. Such alignment will improve project implementation efficiency and resource allocation, reducing the risk of misaligned investments and fragmented governance.

6. **Training and capacity building across different government tiers:** The city can collaborate with technical experts or city networks to conduct cross-level training sessions on climate literacy for government representatives, public outreach and behavioral change campaigns, disaster and climate risk communication, and CRCAP development and implementation. To create institutional memory, the training modules can be integrated into the curricula of state-level training institutes to enable sustained policy harmonization, capacity building and vertical integration.

7. **Align financing and enable convergence with state and national schemes:** Cities should regularly engage with state finance departments and map projects identified within the CRCAP to existing funding schemes. These can be integrated into municipal budgets as separate climate budget chapters or notes highlighting key climate-related projects and their funding sources. This enables vertical collaboration for resource mobilization and project implementation.

8. **Institutionalize policy advocacy across governance levels:** Cities should regularly engage in policy advocacy to communicate local actions and implementation challenges to state and national stakeholders. This can be done through policy briefs, consultations, intergovernmental forums, and conferences (see Tool 9.3: Engagement in Local, Regional and Global Climate Advocacy).

Tool 7.3

Developing Global City Partnerships

This tool guides cities in engaging with global networks and developing partnerships that help them move beyond city boundaries to learn from international best practices, access technical and financial resources and translate global learning into local contexts. It provides guidance on engaging with international city networks, multilateral platforms, financial institutions, development agencies, and peer cities to support the implementation of local climate actions.

Participation in global networks and platforms can help connect cities with counterparts worldwide who share similar needs or challenges, enabling them to exchange knowledge and best practices. This can help identify and implement pioneering climate solutions that have a broader impact across the country.

Engaging with international networks and developing global partnerships

Cities that engage with their international counterparts through global networks gain access to global knowledge and technical and financial resources. This can help raise awareness, expose them to new ideas, directions and innovative approaches, which can be translated into support for policy making and implementation of climate actions.

By engaging with cities with similar climate challenges, such as heatwaves and flooding, local governments can identify relevant and contextualized climate solutions, avoiding trial-and-error approaches. Exchange of common implementation challenges, best practices, and success factors can build confidence among local governments contemplating implementation of new technologies or innovative climate solutions.

Networking with global cities also offers an opportunity not only to share experience and expertise that can help other cities, but also to position the local government as a leader in implementing innovative climate solutions. The following are key steps a city can take to engage and learn from international cities and develop partnerships for local climate actions:

1. **Join international city networks:** Cities can join international city networks such as ICLEI - Local Governments for Sustainability, C40 Cities, and the Global Covenant of Mayors for Climate and Energy (GCoM). They offer structured platforms for peer exchange, capacity building and collaborative problem-solving. These networks usually require an annual membership fee, but provide valuable access to thematic working groups, shared knowledge, and peer-to-peer exchange programs, webinars, and workshops that promote cross-sectoral and cross-city exchanges.

   For example, ICLEI South Asia organized a webinar in December 2025 on disaster risk reduction, bringing together 12 municipalities from Bangladesh, India, Nepal, and Sri Lanka, to learn and share common experiences. ICLEI South Asia also provides its members with access to various knowledge-sharing networks, such as GCoM and the Asia Low Emission Development Strategies (LEDS) Partnership Forum (ALP Forum), to support global networking.

2. **Establish international partnerships and engage in mentorship programs:** Cities can form global partnerships, such as sister-city twinning arrangements or lighthouse city models with international peers to accelerate climate action. Lighthouse cities can adopt an aspirational city and help them achieve their climate targets, which can then be a lighthouse city, handholding a third city.

   These partnerships should focus on transferring knowledge and best practices, and on connecting cities with similar local contexts, climate risks, challenges, economic backgrounds and targets for climate action. Such collaborations can include study visits, technical exchanges, joint pilot projects, and co-development of solutions tailored to similar climate risks. Knowledge sharing can be conducted through joint masterclasses and webinars or exchange programs.

   For example, the City-to-City Partnerships program, implemented under the India-European Union (EU) Urban Partnership program, connected Indian cities with EU counterparts to share best practices and co-develop sustainable urban development solutions. The cities were paired based on thematic issues, such as Pune paired with Leeds for sustainable urban mobility, Kochi with Messina, Panaji with Almada, and Surat with Rotterdam, to learn about water management, flooding and coastal resilience.

3. **Nominate dedicated representatives for global engagement:** Aligned with recommendations provided in **Tool 9.2: Communication for Visibility and Recognition**, the city should champion local leaders and delegate representatives to participate in international forums, communities of practice, summits and other knowledge-sharing platforms. These focal points should be responsible for facilitating engagement with global networks and sharing insights and learnings with city officials.

4. **Mobilize expertise, funding and solutions:** Cities should engage with networks to facilitate exchange programs to help local government officials build capacity, receive technical assistance in contextualizing solutions and understanding climate budgeting, and ensure continued fiscal support to identified climate solutions.

   For example, the Climate Project Preparation Facility (CPPF) project helps cities assess local requirements and prepare bankable projects through technical and financial resources for project design and development, with implementation through public or private sector finance.

5. **Engage in global thematic groups and forums for sectoral solutions:** Cities can partner with their international peers to create thematic working groups where cities with similar challenges can lead, learn, guide or leverage solutions. A membership approach can be adopted, in which cities must meet their climate goals periodically to maintain their membership.

   Cities should also regularly engage in technical working groups, communities of practice, webinars, and workshops organized by global networks to build relationships with international cities, share knowledge and gain access to technical and financial resources.

   For example, the Kaohsiung-ICLEI Climate Neutral and Smart Cities Community of Practice serves as a platform for capacity building and peer learning for 15 cities and regions across East Asia and the Asia-Pacific. As part of this, cities participate in workshops and peer learning activities hosted in Kaohsiung City, supported by ICLEI - Local Governments for Sustainability's World Secretariat.

Tool 9.1

Global Reporting of Climate Actions

This tool provides guidance on how cities can report their climate actions through global platforms, including Net-zero Climate Resilient City Action Plans (CRCAPs), greenhouse gas (GHG) emissions inventories, climate risk assessments, targets, and mitigation and adaptation actions. One such platform is the CDP-ICLEI Unified Reporting System, developed jointly by Climate Disclosure Project (CDP) and ICLEI – Local Governments for Sustainability. It allows cities to report to multiple initiatives simultaneously, such as the Global Covenant of Mayors for Climate and Energy (GCoM), ICLEI's GreenClimateCities Program, and the Transformative Actions Program (TAP).

Through this platform, cities can disclose information on GHG inventories, climate risk assessments, climate action plans (CAP), targets, and actions. This tool guides cities on the reporting requirements, timelines, and reporting process for using the CDP-ICLEI Unified Reporting System.

Why Reporting Matters?

Global reporting of a city's climate action helps it demonstrate its year-on-year efforts to mitigate and adapt to climate change. This, in turn, supports cities in improving targets, understanding data gaps, benchmarking progress over time, and attracting funding.

Reporting also strengthens city-level monitoring, reporting, and verification, while enhancing transparency and cross-departmental coordination. Key benefits of regular reporting include:

1. **Competitive Positioning**: Several global frameworks and funding institutions require cities to demonstrate alignment with international standards and best practices. Regular reporting strengthens credibility on global platforms and helps cities position themselves competitively for:
   - Climate finance opportunities
   - International partnerships and networks
   - Knowledge exchange and technical assistance
   - Recognition and visibility

2. **Demonstration of Leadership**: Reporting enables cities to showcase the robustness of their climate strategies and tangible impacts to state and national governments, international organizations, the private sector, and citizens. It also helps cities access technical support, training, and collaboration opportunities.

3. **Access to climate finance**: Many philanthropies, multilateral development banks, private funders, and other funding agencies require structured reporting on climate actions, emissions, and project outcomes, either before funding or during implementation. For example, the Green Climate Fund requires annual performance- and results-based reporting to track emissions reductions and resilience outcomes. Regular reporting provides the evidence-backed documentation required to qualify for grants, climate finance, and international support programs.

4. Strengthening of MRV (Measurement, Reporting, and Verification)

Periodic reporting strengthens city-level MRV systems by requiring consistent methodologies, structured data collection, and management, thereby enhancing transparency, accuracy, and institutional capacity.

Specifically, reporting helps cities to:

- Improve measurement systems by applying globally accepted methodologies (e.g., the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC), and the ICLEI CRC Methodology) to quantify emissions and risks, and to prepare CAPs.
- Institutionalize continuous reporting cycles that establish routine data collection and cross-departmental coordination.
- Strengthen verification and quality control by requiring cities to validate data sources, document assumptions, and maintain methodological transparency.
- Track progress more effectively through year-on-year comparisons, enabling mid-term adjustments and updates to CAPs.

How Reporting Works?

Since 2019, CDP and ICLEI have partnered to provide one unified portal, the CDP-ICLEI Track, for cities. Cities are required to report once per year through this platform.

The CDP-ICLEI Track serves as the single reporting portal through which cities can report to multiple global frameworks and initiatives simultaneously, including:

- GCoM
- GPC
- ICLEI's GreenClimateCities Program
- ICLEI's TAP
- WWF One Planet City Challenge
- Race to Zero Campaign
- Race to Resilience
- 100% Renewable Energy
- C40 Cities

Figure 1: Global frameworks that the CDP-ICLEI Reporting Track is aligned with (Source: ICLEI Europe).

Example of Reporting for Global Frameworks

Reporting as a GCoM member city: The GCoM is the largest alliance for city climate leadership, with more than 12,600 cities and local governments. It supports voluntary climate action towards climate-resilient and low-emission development.

Cities can report their climate performance on the CDP-ICLEI Unified Reporting System and receive GCoM badges based on progress across phases such as Commitment, Mitigation, Adaptation, Energy Access and Poverty, and Compliance. These badges recognize and reward a city's progress in meeting GCoM's climate planning and reporting requirements, help cities connect with opportunities, resources, and other cities engaged in the same processes, and can be used as tools for communication, promotion, and knowledge sharing.

Box 1: Rajkot became the first city in South Asia to be declared compliant with the Global Covenant of Mayors for Climate and Energy (GCoM) requirements. Its reporting was based on its Climate Resilient City Action Plan, developed using ICLEI's ClimateResilientCities, and ratified in 2019. The city received all four GCoM badges—Commitment, Mitigation, Adaptation, and Compliance—based on its CDP-ICLEI submission in 2020.

Source: GCoM badges awarded to Rajkot city - https://www.globalcovenantofmayors.org/cities/south-asia/india/rajkot/

Reporting Process

The platform includes:

- A **dashboard** (cities' questionnaire, account page, guidance tool and other resources)
- The **Online Response System (ORS)** (for submitting responses to the questionnaire)

The annual reporting cycle has the following steps:

1. **Register or log in:** Cities register or log in to the CDP portal.
2. **Select initiatives**: Cities can choose to participate in additional global or regional initiatives via the CDP-ICLEI Track, such as Race to Zero and Race to Resilience. A list of initiatives is available when the questionnaire is activated for the first time and can be selected using the **"Report"** button located next to each initiative.
3. **Access questionnaire**: Cities receive an annual questionnaire based on their chosen pathway, covering governance, emissions, climate risks, mitigation, and adaptation actions.
4. **Submit data**: The **main user or designated lead** submits the completed questionnaire through the CDP–ICLEI Unified Reporting System. **Contributors** can edit data but cannot submit a response via the ORS.
5. **Review and Revise**: Cities can update submissions before the deadline.

Reporting Process cont.

6. **Data processing**: CDP reviews, organizes, and analyzes the submitted data to ensure completeness and structure.
7. **Publication**: All public data is published on the Open Data Portal (ODP), increasing transparency and enabling global access.
8. **Partner access**: Key partners, including ICLEI, GCoM, and other global networks, access the data for alignment and verification.
9. **Support**: Cities receive support through capacity-building events, consultations, access to climate finance, and advocacy activities.
10. **Performance improvement**: Cities receive scores and feedback to improve future reporting, enhance data quality, refine targets, and advance CRCAP implementation.

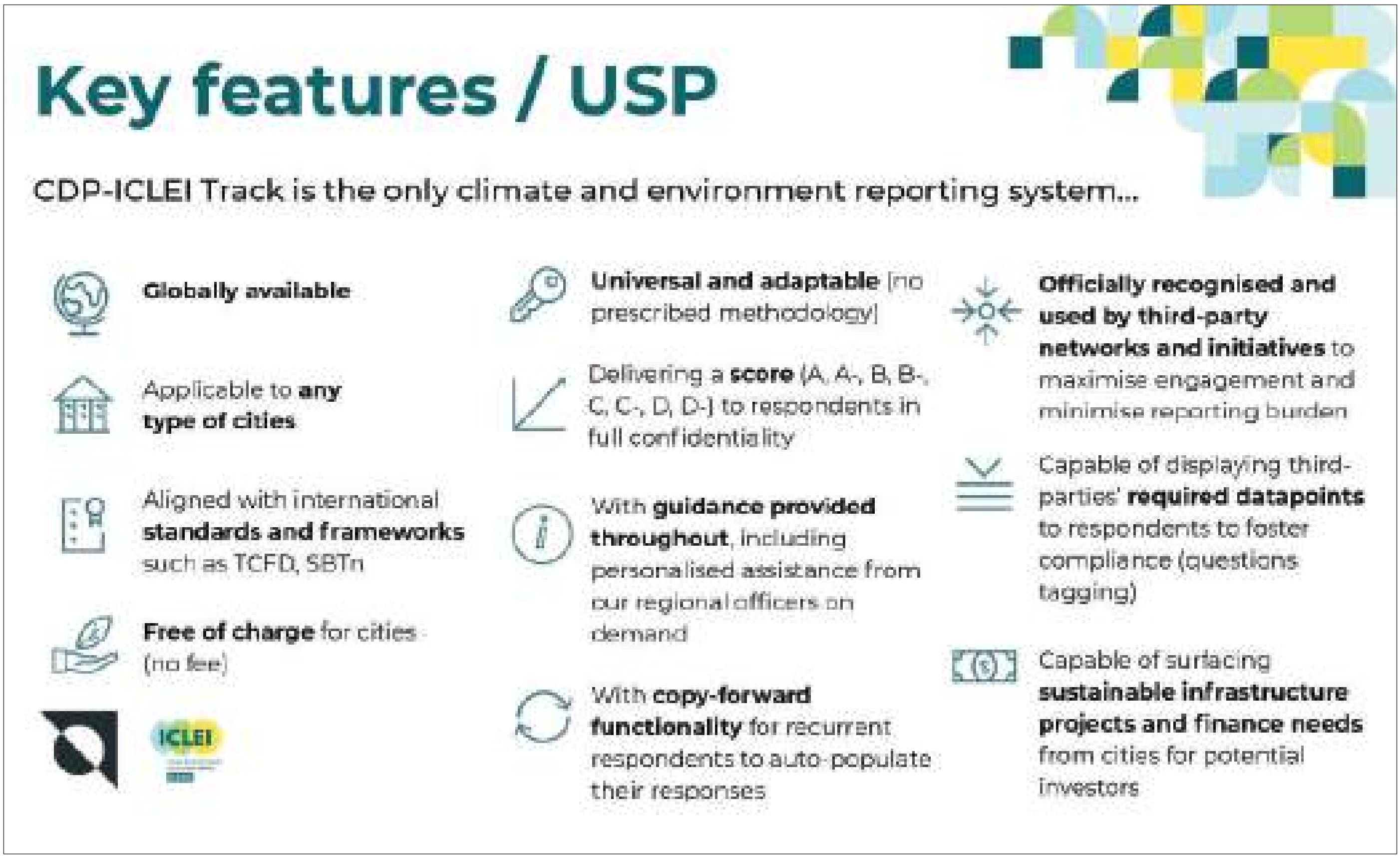

Figure 2: Key features of CDP-ICLEI Reporting Track (Source: ICLEI Europe).

Questionnaire Structure

The reporting questionnaire is organized into three pathways, allowing cities to find the most appropriate questionnaire based on three indicators: (a) per capita emissions, (b) population, and (c) Human Development Index (HDI). Cities are recommended a pathway based on their response to the three indicators but can change it before submission. The pathways have different numbers of questions: Pathway 1 has 28, Pathway 2 has 35, and Pathway 3 has 45.

The reporting questionnaire is aligned with the reporting requirements of key global frameworks and initiatives (Figure 1) and has five sections: Governance; Assessment; Planning; Targets; and Actions, as indicated below:

Sections	Structure of Questionnaire
Governance	Oversight of climate issues, opportunities, equity, multi-level governance, and collaboration
Assessment	• Risk and Vulnerability Assessment (Tools 3.1A to 3.1C provide detailed guidance) • GHG Emissions Inventory (Tools 3.2A up to 3.2F provide detailed guidance) • Sector-specific Data
Targets	• Adaptation Goals • Emissions Reduction Targets (Tool 4.2C provides detailed guidance) • Sector-specific Data
Planning	Climate Action Plan(s)
Actions	• Adaptation Actions • Mitigation Actions

Scoring Methodology

The CDP-ICLEI reporting system uses a four-tier scoring methodology to assess progress in city reporting:

Disclosure (D): In the initial stage, the city recognizes the value of collecting data to drive climate action but lacks the required technical or financial resources. It reports on the degree to which climate impacts and risk data have been measured.

Awareness (C): The city has identified and assessed the main risks and impacts of climate change but has not implemented actions to reduce them.

Management (B): The city is actively implementing mitigation and adaptation measures in collaboration with stakeholders.

Leadership (A): The city demonstrates best practices, has set ambitious but realistic goals, and is making progress towards achieving them.

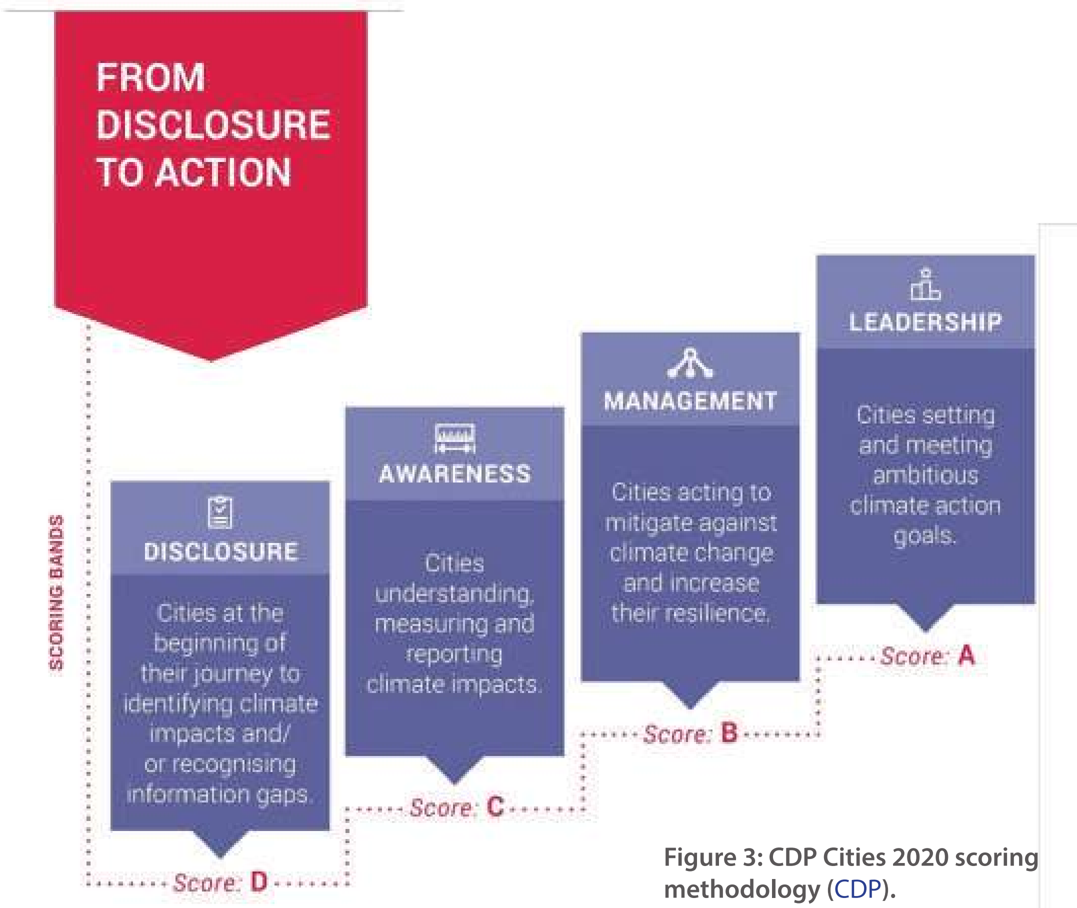

Figure 3: CDP Cities 2020 scoring methodology (CDP).

Guidance Tool: To access the Guidance Tool, sign in to the CDP website, open the account menu, and select '**Guidance Tool**'. The tool includes CDP's reporting guidance documents, recorded webinars, and translations. You can also access selected resources through the public guidance page. Click on 'Guidance & Questionnaires' at the top right of the dashboard or CDP website, and then select '**Guidance for Cities**'.

Here, cities can view:

- The **Cities Questionnaire,** which details every question, including those where CDP collects data on behalf of partners such as ICLEI, C40, GCoM, WWF, etc.
- The **Cities Reporting Guidance,** which explains each question and the required information in detail.

Reporting Levels

There are two reporting levels—Simplified and Complete—to accommodate cities' varying needs and capacities. The Simplified level contains fewer mandatory requirements than the complete level, although most requirements are the same across both levels.

Cities are free to choose which Common Reporting Framework (CRF) level to report under by selecting the desired level in Question 1.2 of the reporting questionnaire (select which Common Reporting Framework level you are reporting to).

It is important to note that badges are awarded independently of the reporting level that cities choose. All cities are eligible to achieve the Mitigation, Adaptation, and Energy Access and Poverty badges of the CRF.

Annexure I provides the GCoM common reporting framework (CRF), including timelines for different reporting elements after joining GCoM.

Summary and Key Takeaways

Global advocacy and reporting systems represent a transformational shift in city climate reporting. By participating in annual reporting cycles, cities can achieve multiple strategic objectives, including accountability and progress tracking, competitive global positioning for access to finance and technical resources, institutional strengthening, and benchmarking.

- Cities beginning their climate reporting journey should prioritize:
- understanding reporting pathways and questionnaire structure
- consulting detailed guidance documents for each questionnaire module
- designating an experienced disclosure lead for data management
- coordinating across departments for data collection and accuracy
- engaging with technical partners for capacity building and support
- continuously improving by reviewing feedback and refining climate action annually

Resources and Guidance Documents for Cities

- Detailed guidance on using the **CDP-ICLEI platform** can be found here.
- Detailed guidance on filling the **CDP-ICLEI track questionnaire** can be found here.
- Detailed guidance for reporting to the **GCoM through the CDP-ICLEI** Track can be found here.

Annexure I:

GCoM - Reporting Timelines (Source: GCoM Common Reporting Framework)

Table: GCoM – Reporting Timelines

Reporting Elements	Commit to join GCoM	Years 1+2	Year 3	Year 4	Year 5	Year 6	Year 7
Baseline GHG emissions inventory	Submit by Year 2 at the latest						
Monitoring GHG emissions inventory						Submit four years after GHG emission inventory and every four years thereafter	Exception: submit five years after baseline inventory only if accompanied by the second progress report
Risk and vulnerability assessment	Submit by Year 2 at the latest						
Energy access and poverty assessment	Submit by Year 2 at the latest						
Targets and goals (mitigation, adaptation, and energy access and poverty)	Submit by Year 2 at the latest						
Climate action plan(s) (mitigation, adaptation, energy access and poverty, or integrated plan)	Submit by year 3 at the latest						
Progress report					Submit every two years after submission of the corresponding climate action plan		Submit every two years after submission of the corresponding climate action plan

Tool 9.2

Communication for Visibility and Recognition

This tool provides guidance on how cities can communicate their climate achievements effectively to increase visibility and recognition through award platforms, city networks, and knowledge-sharing forums.

Proactive engagement on these platforms can unlock opportunities for partnerships, technical assistance, and financial resources, while positioning the city as a leader in resilient, low-carbon urban development.

Visibility and recognition play a critical role in strengthening a city's climate action journey, as they elevate the credibility of its climate efforts, validate the work of key actors and "champions," and help sustain climate action as an institutional priority.

Why Visibility Matters

National and international platforms regularly acknowledge pioneering initiatives in areas such as low-emission development, climate resilience, energy transition, sustainable mobility, water security, solid waste management, innovative finance, and inclusive governance. Cities that proactively pursue visibility and recognition through these platforms are better positioned to attract partners, access technical support, and engage in high-value learning networks, where further opportunities for visibility and recognition are often shared.

Cities should intentionally communicate the outcomes of their climate actions to highlight their pioneering efforts, achievements, and learnings, inspire peers in the region, amplify good practices, and secure national and international recognition that can help unlock new partnerships. This strengthens political buy-in, builds credibility, and enhances public acceptance, contributing to sustained momentum for local climate resilience actions.

Structured Approach

Considering the global momentum for local climate action and the increasing competition for climate finance, partnerships, and recognition at both national and global levels, cities need to move beyond ad hoc communication efforts and adopt a structured approach to enhance visibility and recognition. This will help cities regularly document their learnings and achievements and communicate them through various media, ensuring sustained engagement with national and international audiences.

The Communications Single Point of Contact (SPOC) or technical staff from the Climate Core Team or the Net-zero / Climate Action Cell can play a vital role in enhancing the city's visibility and recognition by leading and coordinating communication activities. Stakeholders identified under the communications plan (outlined in Tool 1.3B: Communication Plan), including the Communications SPOC, public relations officers within key city departments, communications SPOCs in each department (if identified), media and communications interns and fellows (if appointed), can support the city in communicating best practices and learnings across different forums and platforms.

Cities can adopt the following practical steps to systematically communicate achievements and enhance visibility across national and international platforms:

Steps	Action Required	Purpose / Outcome	Medium	Examples
Map recognition platforms	The Communications Single Point of Contact (SPOC) identifies award programs and recognition platforms from national and international governments and philanthropies.	Ensures the city targets the right platforms for recognition. This mapping can include key award criteria, opportunities for dissemination, deadlines, and thematic areas to highlight.	Awards, newsletters, government circulars, city updates through news articles, state or national missions, etc.	WRI Ross Prize for Cities, Smart Cities India Awards, Bloomberg Philanthropies Local Leaders Climate Award, Ministry of Housing and Urban Affairs Swachh Survekshan Awards, Federation of Indian Chambers of Commerce and Industry Urban Innovation Awards.
Document achievements regularly	Prepare key monitoring and evaluation indicators to assess project impacts. Collect evidence: quantitative data, key impact indicators, case studies, photos, impact summaries, and beneficiary stories.	Builds a strong evidence base for submissions and communication.	Internal reports, video documentaries, testimonials, progress dashboards, photo libraries, and infographics.	Documentation of SWaCH Pune Seva Sahakari Sanstha model of waste management through photos, videos, and testimonials.
Report on global reporting platforms and share scoring/ badges received	Submit data to reporting frameworks (see Tool 9.1A) and share badges or rankings received. This data can also be linked to city-level public dashboards.	Cities can use the badges or scores received to showcase leadership and enhance visibility.	Showing ranking/scoring on city websites/brochures / official city circulars, etc.	Cities reporting to the Global Covenant of Mayors for Climate and Energy (GCoM) and sharing badges received; for example, Rajkot has received 7 out of 9 GCoM badges.
Develop a clear leadership narrative and engage champions	Craft a concise narrative of the city's climate journey and results, highlighting key success factors, challenges, and impacts. Identify internal experts/champions who can effectively communicate the narrative.	Communicates the city's leadership and innovations and strengthens advocacy through consistent messaging.	Communication briefs, speeches, website content, social media, case studies, and presentations.	Ms. Supriya Sahu, IAS, is championing Tamil Nadu's climate journey, positioning the state as a sustainability leader. She was also awarded the UNEP Champions of the Earth Award in 2025.

Steps	Action Required	Purpose / Outcome	Medium	Examples
Leverage city networks	Use city networks for nominations, visibility, technical support, and learning.	Improves recognition and knowledge-sharing opportunities and expands access to regional learning networks.	Network platforms, webinars, newsletters, member portals.	ICLEI-Local Governments for Sustainability, C40 Cities, GCoM.
Strengthen media outreach	The SPOC can collate a list of media contacts and set up a communication channel (e.g., WhatsApp) to regularly share information on key achievements and projects. Media outreach can be a key way to enhance visibility.	Builds public narrative and external visibility.	Print releases, features, social media posts, interviews.	Indore city's consistent communication on waste management achievements through social media, citizen engagement, and newspapers.
Present on peer-learning platforms	Showcase innovations through conferences and city-to-city exchanges.	Inspires peers and amplifies thought leadership.	Conferences, workshops, webinars, forums.	National Institute of Urban Affairs' (NIUA) National Urban Learning Platform (NULP), Asia LEDS Partnership, PEARL (Peer Experience and Reflective Learning Network), GCOM.
Share knowledge products showcasing best practices through learning and training platforms	Develop case studies and integrate them into national, state, or international learning platforms, online courses, university, or training institute curricula.	Enables peer-to-peer learning, knowledge exchange, and global visibility.	Case studies, training modules, or videos.	NIUA's NULP, Leaders in Climate Change Management program, Climate Center for Cities platform, and ICLEI's CapaCITIES project.
Monitor and update communication strategies	Track outcomes and refine communication to improve visibility.	Ensures continuous improvement and strategic visibility.	Monitoring sheets, communication calendars, and annual reports.	

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Tool 9.3

Engagement in Local, Regional and Global Climate Advocacy

This tool provides structured guidance on how cities can identify and engage with local, regional, and global advocacy platforms to share learnings, strengthen multilevel collaboration, and help shape enabling policy, regulatory, and governance frameworks.

As cities implement Net-zero Climate Resilient City Action Plans (CRCAPs), they generate valuable insights into climate risks, challenges, and innovative solutions. These insights can meaningfully contribute to local and regional policy dialogues and strengthen multilevel climate governance.

Engaging in Advocacy

To translate these insights into impact, cities need to engage in advocacy to create an enabling environment for climate resilience actions. By sharing strategic insights into ground realities, barriers, and implementation learnings, cities can inform national, regional, and global climate agendas.

By showcasing progress and communicating challenges, cities can strengthen recognition of subnational leadership, influence the development of enabling conditions, promote multilevel climate governance, and secure technical and financial support and partnerships for the implementation of local climate actions.

Platforms such as national climate consultations, international climate forums (such as the Conference of the Parties or COPs), regional forums, and city networks provide opportunities for cities to present credible evidence, share lessons, and advocate for enabling policies, regulations, financing mechanisms, and institutional frameworks. Effective advocacy helps create an enabling environment where CRCAP actions can be scaled up, sustained, and replicated at regional, national, and global levels.

The Communications Single Point of Contact (SPOC) (as identified under the communications plan outlined in Tool 1.3B: Communication Plan) and key stakeholders from the Net-zero / Climate Action Cell can support city leadership in identifying and participating in policy dialogues and advocacy platforms. The following guiding steps help cities systematically engage with regional, national, and global climate frameworks and policy advocacy forums:

Clustered Steps	Action Required	Purpose / Outcome	Medium	Examples
Identify relevant advocacy platforms (regional, national, and global)	The Communications Single Point of Contact (SPOC) identifies advocacy platforms like conferences, policy dialogues, and stakeholder consultations to promote insights from the Climate Resilient City Action Plan (CRCAP) and other climate initiatives, and to present recommendations for policy and governance.	Ensures the city participates in the right forums where local insights can influence regional, national, or global discourses.	Policy consultations, feedback sessions, workshops, conferences, policy dialogue forums, and advisory committees.	ICLEI's ARISE Cities Forum, World Resources Institute's Connect Karo, Ministry of Housing and Urban Affairs (MoHUA) High-Level Committee on Urban Planning, Observer Research Foundation's Raisina Dialogue, MoHUA's National Urban Conclave, UNFCCC Conference of the Parties.
Influence National and Global Policies and Frameworks	Develop and share inputs to shape national and international policy agendas based on grassroots experience, by compiling lessons from implementing local climate resilience actions and projects.	Provides a strong evidence base to shape national and international policy agendas.	Policy briefs, reports, and presentations.	Cities engage with research think tanks and academia, such as the Indian Council for Research on International Economic Relations, Impact and Policy Research Institute, and NITI Aayog, to develop policy briefs.
Leverage City Networks for Collective Advocacy (All Levels)	Use city networks to showcase best practices and influence subnational and international policy. City networks connect cities with local, state, and national government representatives to support policy advocacy.	Expands knowledge-sharing opportunities and access to platforms that directly influence policy and governance.	Network platforms, collaborative initiatives, and presentations.	ICLEI and C40 Cities bridge the gap between cities and governments.
Build leadership and local champions	Engage mayors, commissioners, and other local representatives to advocate for CRCAP priorities and to share implementation insights for policy discussions. The SPOC provides them with relevant briefing materials.	Strengthens credibility and visibility in advocacy platforms.	Mayoral summits, panel discussions, climate summits.	U20 Mayoral Summit, C40 World Mayors Summit, Tamil Nadu Climate Summit.
Regular engagement with state and national governments	City commissioners or mayors engage regularly with state and national government representatives and missions to discuss key findings and recommendations.	Helps align city climate priorities with broader state and national frameworks and enables policy uptake.	Government consultations, inter-departmental meetings, technical submissions.	Consultations for updating Nationally Determined Contributions or State Action Plans on Climate Change, Smart Cities Mission.

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