WRI INDIA

WORKING PAPER

Applying a data-driven approach to assess greenhouse gas mitigation potential in urban India: Learnings from Surat, Ujjain, and Indore

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HIGHLIGHTS

- With urban climate action gaining momentum, several Indian cities are preparing plans and strategies to mitigate and adapt to climate change.
- However, lack of data and limited awareness of existing tools for developing short-, medium-, and long-term mitigation scenarios and targets remain significant barriers to data-driven climate action.
- This paper uses the Climate Action for Urban Sustainability tool to understand the challenges and enabling factors affecting scenario development and target setting for climate mitigation in three Indian cities.
- Grid decarbonization, solar photovoltaic systems in residential buildings, a Mode Shift toward public transport, and wastewater treatment with gas capture demonstrated the highest potential for mitigation across the three cities.
- Strengthening institutional and financial structures, and building a robust monitoring, evaluation, and verification framework are crucial for supporting data-driven mitigation actions in cities.

EXECUTIVE SUMMARY

Context

Cities contributed to 44 percent of India's scope 1 and scope 2 carbon emissions in 2019, mainly from buildings, transport, and solid waste and wastewater (World Wide Fund for Nature, n.d.). New Delhi, Kolkata, and Mumbai were the three top cities in India with the highest carbon footprints in 2017 (Moran et al. 2018). Despite having just over one-third of the total population, cities contribute around two-thirds of India's gross domestic product (GDP) and are growing rapidly. India's urban population is expected to double to 814 million by 2050 and the country is projected to add seven megacities by 2030. India currently has five megacities (urban areas with a population of 10 million people) and two more cities (Hyderabad and Ahmedabad) that are likely to become megacities by 2030 (Torkington 2016). This rapid urbanization will, in turn, exacerbate urban emissions. Therefore, city-level mitigation action is critical to drive national greenhouse gas (GHG) emission reduction and help India meet its climate goals.

It is important that cities, particularly growing Tier 2 cities, implement a data-driven approach to better quantify their mitigation potential. Cities are uniquely positioned to drive national GHG emission reduction and help India meet its climate goals by integrating climate mitigation into urban planning. Mumbai became the first South Asian city to set a net zero target by 2050. Tier 2 cities are experiencing significant economic activity and emerging as real estate growth engines. This urbanization will most definitely be accompanied by an increase in emissions, indicating the need to couple low-carbon growth and economic development. With cities like Coimbatore, Rajkot, Udaipur, and Siliguri already implementing low-carbon action plans, Tier 2 cities offer significant mitigation potential that needs to be tapped into (Padmanaban 2022).

However, availability and awareness of data requirements and existing tools for developing GHG inventories and long-term GHG mitigation scenarios are limited. This has led to the creation of mitigation plans without robust and time-bound mitigation targets and strategies, leading to siloed actions that lack interdepartmental coordination and limited quantitative data on sectoral mitigation potential.

About this working paper

This paper examines the use of the Climate Action for Urban Sustainability (CURB) tool, an open-source tool developed by the World Bank for setting city-level mitigation targets, in the Indian context. Its findings provide insights from the three cities of Surat, Indore, and Ujjain on

- the subsectors with the highest mitigation potential;
- challenges and enabling factors for tool-based mitigation scenario modelling;
- capacity-building needs for city-level data-driven mitigation actions and strategies; and
- limitations of the CURB tool.

These insights stem from extensive primary and secondary data collection, as well as stakeholder consultations with government and with non-governmental and parastatal agencies. Further research using similar tools or the expansion of the CURB tool to other cities will be crucial for strengthening and localizing the tool landscape to drive data-driven climate mitigation in Indian cities.

Key findings

Grid decarbonization and energy-efficient urban infrastructure have the highest mitigation potential. Enabling and coordinating with distributing companies (DISCOMs) to switch to renewable energy (RE) sources for electricity; promoting energy-efficient lighting, heating, cooling, and cooking solutions within municipal buildings; and implementing decentralized solar rooftops in urban buildings were identified as the high-impact sectors for climate mitigation across the three cities.

Long-term technological lock-ins can deter ambitious mitigation targets. Existing investments and long-term contracts for establishing and managing power plants can lead to carbon-intensive lock-ins, preventing cities from setting ambitious targets for low-carbon solutions.

Cities lack the capacity to consolidate quantitative data for GHG mitigation inventories and scenario development. Data across different sectors is managed by different departments, both within the city as well as in parastatal agencies, leading to institutional fragmentation. Cities require Technical handholding support to collect and consolidate primary data from different departments to feed into data-intensive tools such as CURB. Centralized coordination within cities driven by key political leaders, smart city CEOs or municipal commissioners, was found to be an important enabling factor.

Data collection remains a challenge for improving energy efficiency in informal housing and Micro, Small, and Medium Enterprises (MSMEs). Cities lack data on current energy consumption and the proliferation of energy-efficient equipment for cooking, heating, cooling, and lighting in MSMEs and informal areas. These data are crucial for setting inclusive targets and actions to mitigate emissions from the building sector and improve energy efficiency in a systematic and data-driven manner, particularly in cities with MSME-driven economies. Although MSMEs are not directly within

their purview, cities should work toward improving awareness and baseline data collection through coordination with MSME associations, MSME departments, NGOs, etc.

Recommendations

Institutional structures to facilitate data collection in cities

Given the institutional fragmentation often seen between city-level departments, it is important for cities to involve multi-departmental stakeholders, parastatal agencies, NGOs, research organizations, etc., to bring in climate-related expertise and capacity and to facilitate data collection for planning and scenario development. One example is instituting a "climate cell" comprising key representatives across municipal departments, parastatal agencies, state government departments, research, academia, and the private sector. This cell can be tasked with facilitating data collection, planning capacity building around the usage of tools, and providing expertise and inputs for policy development. The cell can be instituted within a key city-level department or the municipal commissioner's office to enable effective integration with urban planning. The cell can also implement training for its members using CURB or other tools for mitigation planning.

Creating a dynamic, city-level central data repository

Along with the cell, a central data repository dashboard should be created and housed within the municipal corporation, for example, within the Integrated Command and Control Centre. This dashboard should collate all the data required for the tool as well as for other platforms, such as the Climate Smart Cities Assessment Framework and the Swachh Bharat Mission, and should be regularly updated. This data repository can also feed into updates of city-level plans, such as the comprehensive mobility plan and development plans, which will, in turn, increase data availability for tool-based scenario development and mitigation planning.

Consistent multilevel stakeholder engagement for effective target development

Developing a stakeholder engagement plan is crucial to ensure that scenario development includes the perspectives of all stakeholders. This will lead to more feasible targets and actions that are likely to be implemented. It also ensures that stakeholders are represented and included and have accountability and a sense of responsibility for implementing those actions.

Periodic training for city officials on tool implementation

The city needs to organize periodic training on how to use scenario-modelling tools, the data required, the processes involved, and how to analyze the outputs. This training can be facilitated using the climate cells.

INTRODUCTION: CITIES AND CLIMATE CHANGE MITIGATION

India is the world's third-largest emitter, accounting for 6.67 percent of global emissions as of 2020 (Climate Watch 2023). At the same time, India's per capita GHG emissions of 2.29 tCO_2e is less than the global average of 4.7 tCO_2e/capita in 2020. However, the trend is upward, with emissions increasing by 14 percent between 2005 and 2018 (CEEW et al. 2023).

This emissions increase is driven by the urban population, with cities contributing 44 percent of India's scope 1 and scope 2 carbon emissions in 2019, mainly from transport, buildings, and waste (World Wide Fund for Nature, n.d.) (Figure 1). Urban buildings alone consumed 33 percent of electricity in 2021 (Malviya and Shankar 2021). India's urban population is expected to increase from 34 percent of the total in 2019 to 53 percent by 2050 (Coetzee 2020) on the back of significant in-migration (Benu 2023). This can be attributed to the ongoing technological revolution and economic growth seen in Tier 2 and Tier 3 cities, which are rapidly becoming real estate development hubs (Ojha 2023). While such rapid urbanization is likely to put enormous pressure on cities and peri-urban areas in terms of resources and energy demand, it also offers a significant opportunity to create sustainable, people-friendly, and low-carbon cities.

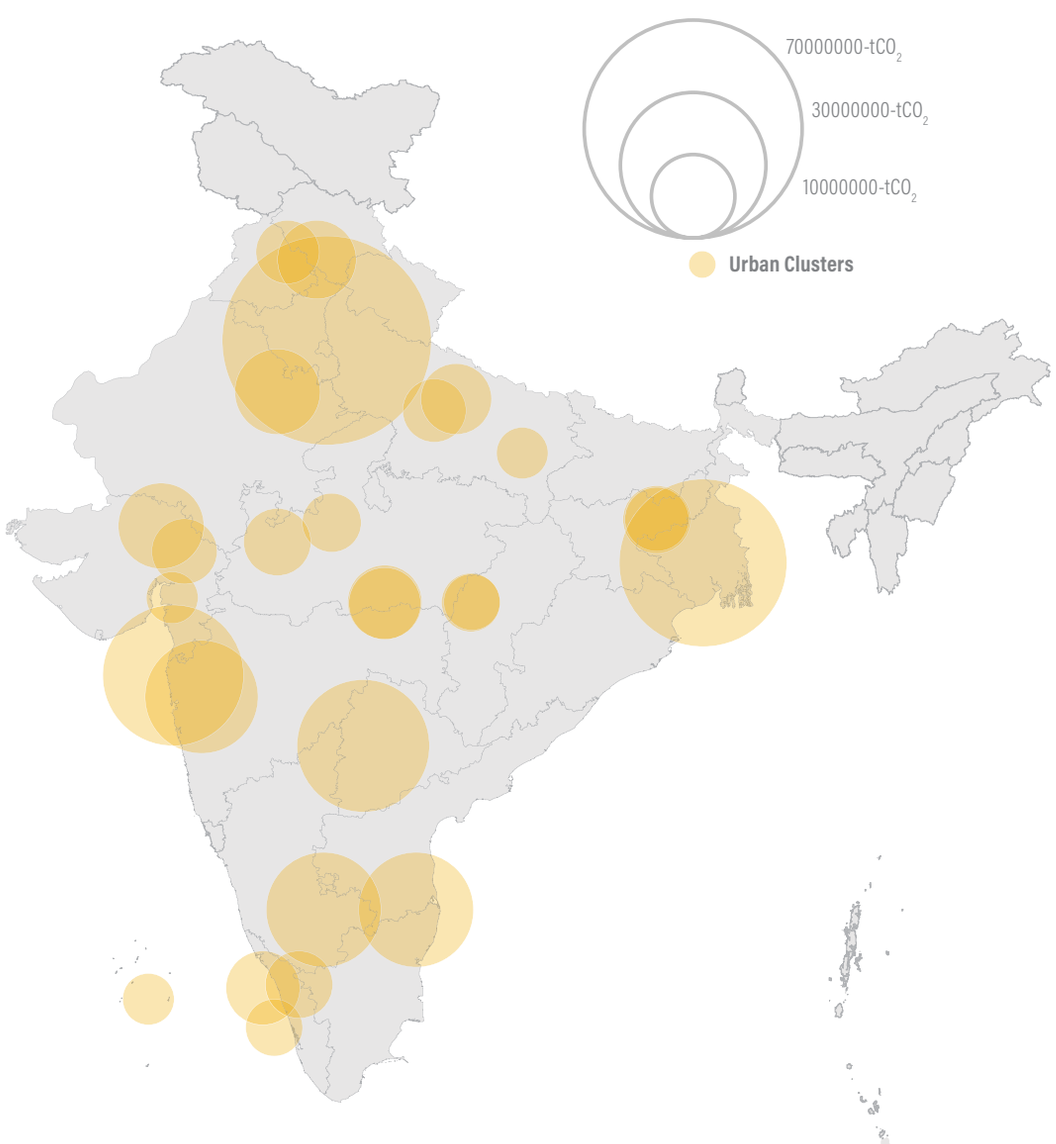
While the Union government and state governments have set ambitious greenhouse gas emission-reduction targets (MOEFCC 2022) and formulated policies, plans (DST 2023), and schemes (Ministry of Heavy Industries 2022) to reduce greenhouse gas emissions across key sectors, there remains a lack of guidance for setting similar targets and policies at the city level, hindering effective planning for urban-level climate mitigation.

Despite limited guidance for data-driven target setting and mitigation planning at the urban level, several Indian cities, with support from state governments, are taking voluntary action to mitigate carbon emissions by participating in global campaigns and city networks. For instance, 43 cities in Maharashtra have joined the UN Race to Zero Campaign, where cities must prepare a plan to halve emissions by 2030 and achieve net zero by 2050 (UNFCCC n.d.). Six metropolitan cities (Delhi NCT, Ahmedabad, Mumbai, Bangalore, Chennai, and Kolkata) are part of the C40 Cities

Group, a global network of cities working toward climate action to halve their emissions by 2030. Furthermore, 31 municipal corporations have committed to the Global Covenant of Mayors for Climate & Energy (GCoM), and 32 municipal corporations are members of the International Council for Local Environmental Initiatives (ICLEI) cities network. This network require members to take climate action, implement measures, and report on their progress. Furthermore, 12 Indian cities voluntarily disclose their emissions through the Carbon Disclosure Project platform (Carbon Disclosure Project 2023), demonstrating their commitment to transparency and accountability in climate-change mitigation.

The Climate Smart Cities Assessment Framework (CSCAF), spearheaded by the Ministry of Housing and Urban Affairs, provides a framework for cities to assess their climate performance and identify priority interventions. One of the indicators within the framework entails preparing a mitigation- and adaptation-focused climate action plan, which Tier 1 cities such as Chennai and Mumbai and Tier 2 cities such as Coimbatore, Rajkot, Udaipur, and Siliguri have already prepared. Mumbai has gone one step further to become the first South Asian city to set a net-zero plan in compliance with C40 standards (Padmanaban 2022). However, it is worth noting that, as seen in Table 1, these plans vary in terms of climate mitigation strategies, usage of tools, inclusion of scenario development, levels of ambition, and estimation of mitigation potential. Other than the Mumbai Climate Action Plan, no plan includes all these components.

Figure 1 | **Percentage fuel consumption by fuel type and vehicle type in 2050 in the BAU scenario**



Source: citycarbonfootprints.info

Table 1 | **Focus on mitigation in different types of Indian city-level climate action and other published plans**

CITIES AND ACTION PLANS	EMISSION INVENTORY AND EMISSIONS PROJECTIONS	EMISSIONS REDUCTION SCENARIO ANALYSIS USING TOOLS	ASSESSMENT OF SECTORAL MITIGATION POTENTIAL OF ACTIONS	ASSESSMENT OF SUB-SECTORAL MITIGATION POTENTIAL OF ACTIONS	SUB-SECTORAL MITIGATION TARGETS	IMPLEMENTATION FRAMEWORK WITH MONITORING AND EVALUATION INDICATORS	ASSESSMENT OF INVESTMENT AND PAYBACK PERIOD FOR MITIGATION ACTIONS
Rajkot, Udaipur, Siliguri, and Coimbatore -Climate Resilient City Action Plans (ICLEI 2019a; 2019b; 2022; 2020)	■		■				
Mumbai Climate Action Plan (Brihanmumbai Municipal Corporation 2021)	■	■	■	■	■	■	■
Chennai Climate Action Plan (Greater Chennai Corporation 2022)	■	■			■		
Madurai "Future Proofing" Action Plan (weADAPT 2016)						■	
Delhi State Action Plan for Climate Change (Department of Environment, Government of NCT, Delhi 2017)					■	■	

Source: Authors' analysis.

■ Included in the plan

Need for this study

Despite the commendable independent efforts of cities, they clearly have limited institutional coordination and implementation capacities, particularly regarding access to and availability of data and tools. A study conducted by ICLEI, WRI India, and GCoM in 2021 examined 58 different tools for climate action planning, 25 of which had a mitigation focus, and analyzed them in terms of functionality, usability, and connectivity with other tools. The analysis highlighted that while many tools support data analysis and actions such as developing GHG inventories, there is a need for more tools to support the implementation stages of climate change mitigation. The study also highlighted that while some tools can quantify the GHG emission benefits of potential actions, evaluation of co-benefits and simplified financial analysis are needed, which currently available tools are unable to do, particularly in the Indian context. Moreover, the study included a survey of representatives from 292 cities spanning 58 countries to understand the current challenges cities face in their climate journeys and whether they use any tools. It identified that 50 percent of respondents did not use any tools to support climate mitigation.

The limited usage of tools can be attributed to limited awareness and the lack of literature on available tools, their scope, and existing gaps. The study also recommends undertaking a region-specific analysis of city needs, gaps in data and tools, and areas for capacity building (Global Covenant of Mayors for Climate and Energy 2021).

The lack of a tool-based approach is also evident in existing city-level policies and plans (Table 1). A review of climate action plans across cities in the Asia-Pacific region identified wide variations in the availability and use of data for mitigation. For example, although Delhi's climate action plan includes specific mitigation measures, the targets were not formulated through a robust mitigation scenario analysis with current and future emissions scenarios. Seven of the nine city climate action plans lacked concrete mitigation targets and a robust identification of mitigation strategies driven by smart and systematic tools.

Thus, there is a need to expand the literature base and increase the awareness of Indian cities regarding tools that can help assess mitigation potential, set mitigation targets, and aid in mitigation planning, along with a simplified financial analysis of actions.

METHODOLOGY

WRI India has analyzed the city-specific needs for and barriers to tool-based mitigation planning using the Climate Action for Urban Sustainability (CURB) tool, which was designed in 2016 by the World Bank in partnership with the C40 Cities Climate Leadership Group, GCoM, and AECOM Consulting.

CURB allows cities to plan in an integrated manner across six sectors: private buildings; municipal buildings and public lighting; electricity generation; solid waste; transportation; and water and wastewater. Following the selection of the tool, further discussed below in Tool selection, CURB was piloted in the cities of Surat, Indore, and Ujjain, which were chosen for their varying population sizes, urbanization levels, and economic and demographic profiles. Another factor that played a role was the presence of strong existing project-related partnerships in all three cities. The key attributes of the three cities are listed in Table 2.

Table 2 | **Key attributes of the three Indian cities chosen for this study**

INDICATOR	SURAT	INDORE	UJJAIN
Population (2011)	44 lakh	19 lakh	5 lakh
Area	462 km^2	276 km^2	92 km^2
Key economic sectors	Textiles, diamonds	Textiles, metal industries	Heritage tourism around Mahakal, textiles
City GDP per capita in rupees (₹1= US$0.012) for 2011	₹0.8 lakh	₹0.7 lakh	₹0.5 lakh
Pioneering initiatives	Pilot emissions trading scheme (Greenstone et al. 2019), projected to reduce particulate emissions by 29% from 158 plants.	Carbon credit pilot (Kumar 2020), generating annual revenue of ₹50 lakh.	Waste from temple waste pilot (TOI 2016) generating 180kg manure daily.

Source: Authors Analysis from Census data and secondary literature.

The tool was used to develop long-term mitigation scenarios with sectoral strategies and to identify their cumulative impact on emissions reduction. These scenarios were vetted by city-level stakeholders.

Through this study, we provide insights into how the CURB tool was used to help three Indian cities assess their sectoral mitigation potential and develop possible actions. The study aimed to discuss the following:

- The limitations and benefits of the CURB tool
- The challenges and enabling factors for implementing the tool in the three cities
- The sectors with the highest mitigation potential identified across the three cities
- Other aspects that interested cities could consider to implement similar tools to support mitigation

Tool selection: CURB tool

Various international tools are available for developing mitigation scenarios and setting targets based on a city's baseline emissions. Some notable tools in this domain include Apex (APEX 2024), CURB, Pathways by C40 cities and Climate OS (Lovell and Parry 2022), and the Healthy and Efficient Retrofitting Buildings (HERB) tool (C40 cities 2023). However, it is essential to consider the specific focus of these tools and their accessibility.

The CURB tool was chosen based on the following attributes: it is an open-source tool, easily accessible on the World Bank website; it is city-focused and uses local data to evaluate low-carbon actions; it provides proxy data in case cities face issues with data availability; and it has been designed in consultation with technical experts (World Bank 2023).

The Climate Action for Urban Sustainability (CURB) tool helps cities prioritize low-carbon investments based on cost, feasibility, and impact on energy use and greenhouse gas emissions. CURB allows cities to develop integrated plans across six sectors: private buildings; municipal buildings and public lighting; electricity generation; solid waste; transportation; and water and wastewater. It can be used by cities to compare the cost, energy, and climate impacts of different technological and policy solutions; select the most effective investments possible; develop and refine climate action plans; set informed targets; and acquire project financing.

Despite the potential of the CURB tool, there is limited documentation on its usage. A Google Scholar search of the terms "Climate Action for Urban Sustainability (CURB) tool," "CURB," and "Climate Action for Urban Sustainability" yielded only four studies of the tool's use in locations such as Iraq and Europe. These studies did not provide any information on the limitations of the tool or how cities can build capacity for its use and implementation. Moreover, no publicly available studies have been conducted in an Indian context (Abokharima 2020; Balouktsi 2019; Eqra et al. 2022; Grafakos et al. 2020).

Using the CURB tool

Data collection

Primary data for the tool, such as city population, number of streetlights, waste generation and recycling, types of waste facilities, wastewater generation and management, fuel consumption from solid waste transportation, and water pump efficiency, were collected from city corporation departments, parastatal agencies, private stakeholders, and other third-party agencies handling the management of utilities. The data collection process involved several distinct stages. Initially, the data requirements were communicated to the relevant city-level stakeholders using a structured data requirement format. This step was followed by ongoing data-related interactions with those stakeholders to ensure accurate and comprehensive data acquisition. After successful data collection, a stringent data verification procedure was performed. This involved cross-checking the collected data to ensure accuracy, consistency, and completeness. Subsequently, the validated datasets underwent an additional review process within the respective departments to ensure integration of the correct and appropriate data points.

For instance, the data collection procedure for electricity consumption involved obtaining data from various sectors within the city through the state distribution company. Data such as transport mode shift, groundwater depth, and vehicle kilometers traveled were collected from parastatal agencies and secondary literature such as the city's comprehensive mobility plan and groundwater assessment studies. Data on utility costs were also included. Appendix A provides an overview of the broad data requirements for the CURB tool and where they can be obtained. The complete template can be found on the tool website (World Bank 2017).

GHG inventory

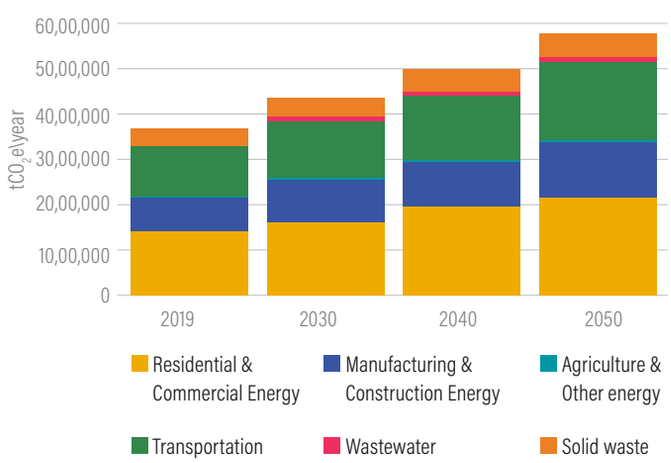
As a first step, a greenhouse inventory was prepared for each city. This involved entering activity data inputs in alignment with the "Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)" framework to estimate emissions from transportation, stationary energy, solid waste, and wastewater. The GPC is an accounting and reporting standard that provides a robust framework for cities to calculate greenhouse gas emissions (Fong et al. 2024). The inventory includes scope 1 emissions (GHG emissions from sources located within the chosen boundary) and scope 2 emissions from grid-supplied electricity. Only the waste

sector includes scope 3 emissions (GHG emissions that occur outside the city boundary due to activities taking place within the city boundary).

TARGET-SETTING PROCESS

Along with the inventory, overarching city-level and sectoral GHG reduction targets were set for each city, relative to the business-as-usual increase in emissions. These targets were set through city-level consultations involving relevant stakeholders. This was done to ensure better acceptance and accountability of targets but runs the risk of introducing an element of personal bias.

Figure 2 | **Projected emissions under the BAU scenario for Indore**



Source: Authors' analysis using CURB tool

Scenario modelling

Three main scenarios were developed in this study, comprising subsectoral strategies with targets for Interim 2030, 2040 and target year 2050. These scenarios are explained in detail using Indore as an example. The scenario-modelling outcomes from the other two cities are provided in Appendix C.

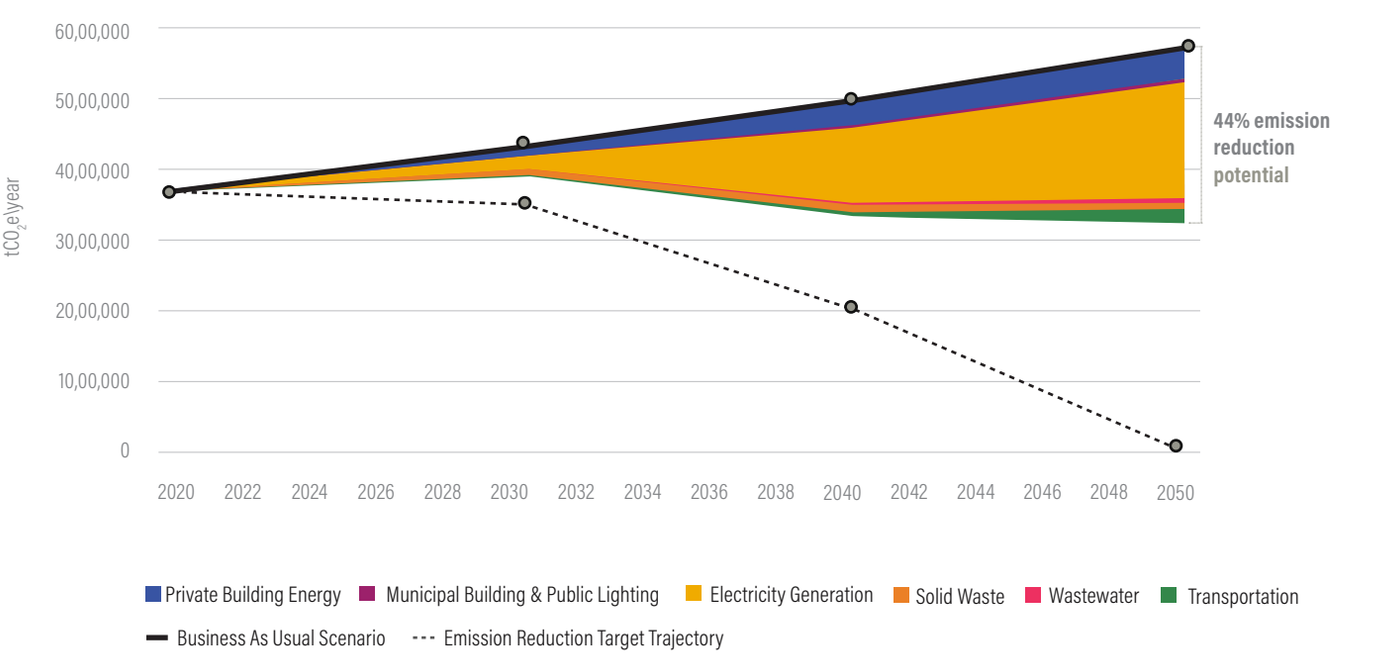
BUSINESS-AS-USUAL (BAU) SCENARIO

This scenario provides the projected GHG emissions and energy consumption across sectors, assuming the city implements no new actions beyond the base year, the 2019 status quo. Emissions are projected based on estimated population growth. The BAU scenario for Indore sees emissions rising by 55 percent between 2019 and 2050 (Bajpai et al. 2023).

PLANNED SCENARIO

This scenario shows potential emission reductions based on ongoing projects that the city is already undertaking or proposed policies or plans in the pipeline. The scenario and associated targets were developed based on primary data from stakeholder consultations and city-level policy documents, such as Indore's comprehensive mobility plan and development plan. In sectors with no planned projects, business-as-usual growth is assumed. In the case of Indore, this scenario has the potential to reduce emissions by 44 percent to overall emission by 2050.

Figure 3 | **Emissions reduction potential for Indore under the planned scenario**



Source: Authors' analysis using CURB tool.

ACHIEVABLE SCENARIO

If emission reductions in the planned scenario are not sufficient to meet the planned targets, then an additional scenario, the achievable scenario, can be created. This scenario represents the potential for additional emissions reductions beyond the planned scenario and aligns with national or state emissions and policy targets, including India's Nationally Determined Contribution (NDC). This includes targets deemed achievable in terms of implementation through a series of city-level stakeholder consultations.

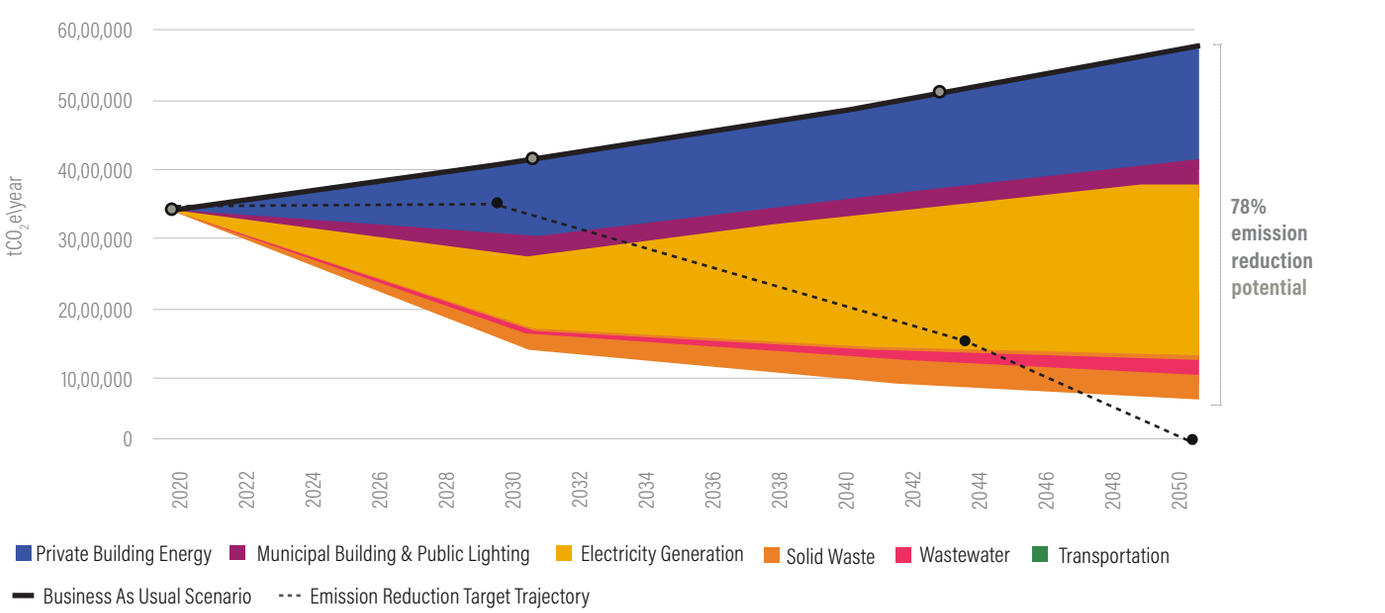
For the planned and achievable scenarios, the CURB tool provides the final cumulative impact of all subsectoral strategies on emissions and energy consumption, the investment required, and the payback period for each strategy, along with its contribution to the sectoral GHG reduction targets.

Analysis of all scenario outputs provides a comprehensive understanding of the potential emission reduction trajectory of the city, the efficacy of existing plans, and the strategic adjustments required to achieve emission targets within specified timeframes. This informed analysis can underpin evidence-based decision-making and support cities' efforts to design emission-reduction-focused climate strategies. However, although this tool makes many important contributions, it is not designed to provide insights into the equity or distributional implications of mitigation measures.

STAKEHOLDER CONSULTATIONS

The entire analysis, including the GHG emissions inventory, city-level emissions reduction targets, and subsectoral strategies and targets, was vetted through stakeholder consultations in each of the three cities. These consultations included participants from city-level departments, such as the town planning department, solid waste department, utilities department, and parks and gardens department, and from parastatal agencies, such as DISCOMs and the regional transport offices (RTOs), research institutions, and city police. The targets in the achievable scenario were vetted and revised based on discussions with stakeholders regarding their feasibility and challenges for implementation. Subsequently, the final strategies and findings from all three cities were reviewed by internal sectoral experts from WRI India and external sectoral experts. The complete list of stakeholders consulted in each city and the key takeaways can be found in Appendix B.

Figure 4 | **Emission reduction potential for Indore under the achievable scenario**



Source: Authors' analysis using CURB tool.

FINDINGS AND INFERENCES ON EXISTING POLICY

The remainder of this paper is organized as follows. First, we discuss our findings regarding the sectors and subsectors that have the highest mitigation potential across the three cities to highlight priority intervention areas. We then discuss a few key targets proposed for each of these sectors and provide examples of actions to achieve these targets in an inclusive manner, using Indore as an example. This is followed by a discussion of the factors that determine a city's capacity to use the CURB tool to set proposed sectoral mitigation targets and actions. This is followed by a brief discussion of some limitations of the CURB tool. Finally, we present capacity-building recommendations for cities to better equip them to conduct tool-driven scenario-modelling exercises to assess their sectoral mitigation potential, set GHG mitigation targets, and develop climate action plans.

Sectors with the highest potential for urban climate mitigation

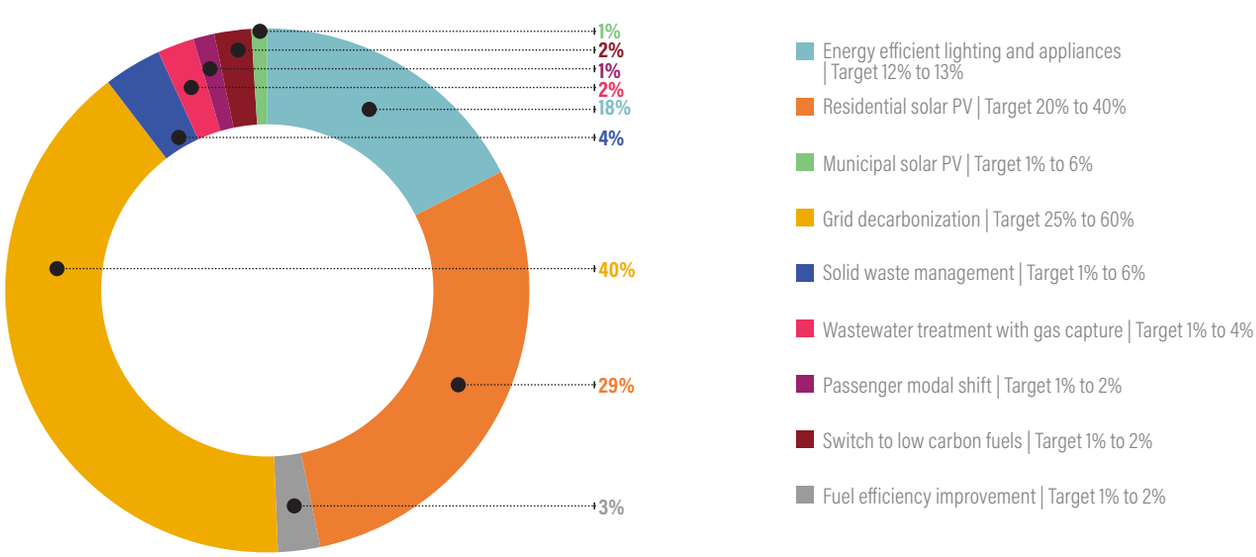
This study analyzed the contribution of different sectoral policies to overall city-level GHG emission mitigation by 2030, averaged across the three cities (Figure 5). Our research shows that grid decarbonization has the highest mitigation potential (39 percent of total GHG emissions reduced by 2030), followed by solar photovoltaic (PV) systems for residential buildings (28 percent), and energy-efficient lighting and appliances for commercial and residential buildings (15 percent). Solar PV for municipal buildings contributes 3 percent of total GHG mitigation by 2030. In the solid waste management sector, organic waste composting and recycling of dry waste had the highest mitigation potential (18 percent), followed by shifting to wastewater treatment with gas capture (2 percent). None of the three cities currently only Surat captures bio-gas from wastewater. Within the transport sector, switching to cleaner fuels like bio-compressed natural gas or electric vehicles provided the highest mitigation potential (2 percent), followed by strategies to enable a shift in passenger demand from private to public transport (1 percent).

Proposed targets and actions derived from scenario modelling

Based on the analysis, strategies with targets for 2030, 2040, and 2050 were proposed for each city that aligned with existing city-level targets within state and national policies as well as existing and proposed city-level projects. The strategies and targets were vetted by city-level experts. Some of the proposed targets are listed in Table 3. The full list of targets can be found in Appendix C.

After setting targets using the CURB tool, cities can develop short-, medium-, and long-term actions for target implementation. While not included in the tool, it is important to consider the equity impacts of each action on vulnerable groups such as informal workers, women, children, the elderly, migrants, people with disabilities, and religious minorities. The proposed actions should also include clear indicators and monitoring frameworks to measure the inclusivity of impacts across each impact group (Ghojeh et al. 2021). The results from the CURB tool were used to develop mitigation targets and subsectoral actions for Indore, which were published in Indore's climate action plan (Bajpai et al. 2023). An example of two actions in Indore's climate action plan to meet the targets set under the goals of promoting public transport and moving toward renewable energy is provided in Tables 4 and 5 to elucidate the actions and their implementation framework.

Figure 5 | **Sectoral mitigation potential averaged across the three Indian cities**



Source: WRI India analysis using primary and secondary data

Table 4 | **Proposed actions in the Indore climate action plan to meet the target for public transport set using CURB**

TARGET	50% MODE SHARE FOR PUBLIC TRANSPORT BY 2050
Action 1	**Improving last-mile connectivity of Indore's proposed metro**
Action description	The Ministry of Housing and Urban Affairs (MoHUA) has shifted its focus to improving last-mile connectivity, one of the goals stated in the 2017 New Metro Policy (Ministry of Housing and Urban Affairs 2017). Indore should ensure good last-mile connectivity for its metro through initiatives like: ▪ Linking metro routes with ibus (BRTS) stations ▪ Public bike-sharing rentals outside metro stations ▪ Autorickshaw depots close to metro stations
Inclusivity analysis	Mobility options must integrate facilities for people with disabilities and the elderly such as pedestrian walkways with ramps and street furniture. Women's safety should also be addressed through women-only compartments, helpline numbers, seats reserved for women, and the provision of panic buttons, made compulsory by the national government in 2019.
Indicators	Increase in metro ridership and use of feeder services (disaggregated by gender), modal shift for public transport (disaggregated by income and gender)

Source: Indore Climate Action Plan 2023 (Bajpai et al. 2023)

Table 5 | **Proposed actions in the Indore climate action plan to meet the target for renewable energy set using CURB**

TARGET	60% SHARE OF RENEWABLE ENERGY IN THE GRID BY 2050
Action 1	**Retrofitting buildings under the Pradhan Mantri Awas Yojana (PMAY) scheme with climate-sensitive infrastructure**
Action description	Indore plans to increase affordable housing under the PMAY scheme for its slum population, which comprised 28% of the total population in 2019. This is a chance for the city to retrofit low-cost housing with components that will lead to increased energy efficiency, optimized water consumption, reduced heating effects, and efficient waste management.
Inclusivity analysis	This action will ensure more equitable access to cleaner fuel, reduce emissions, and improve air quality in low-income areas, without raising rental costs. Indore must ensure these retrofits do not raise the cost of living.
Indicators	Reduced energy costs and improved access for slum dwellers, improved air quality and reduced negative health effects

Source: Indore Climate Action Plan 2023 (Bajpai et al. 2023)

Factors affecting data-driven scenario modelling and target-setting in cities

This section identifies key factors affecting the capacity of cities to use the CURB tool to propose sectoral GHG reduction targets and assess their mitigation potential. This can guide city planners, international development organizations, and other intermediaries working with cities in building their capacity for climate mitigation and resilience.

DATA AVAILABILITY AND ACCESS AT THE URBAN LEVEL

A major challenge is the limited availability of and access to quantitative climate-relevant data for cities. This can be attributed to the limited knowledge of the data needed to develop GHG inventories and mitigation scenarios, as well as the lack of familiarity with global and local tools for developing GHG mitigation scenarios, targets, and actions. Moreover, there remains a need to localize tools such as CURB to make them more relevant and compatible with locally available data. The data for all three cities were collected by multiple departments and parastatal agencies with no internal coordination for data collection and compilation. Quantitative data such as fuel sales in the city, electricity consumption across subsectors, and waste generation and recycling data are crucial for developing a robust greenhouse gas inventory, which is the first step toward setting long-term goals and targets. Although the Climate Smart Cities Assessment Framework (CSCAF) provides a good starting point and directs cities to collect data from multiple agencies, we observed limited coordination between the Smart City Special Purpose Vehicle (SPV), the nodal agency for India's smart city mission at the city level, and the municipal corporations.

It appears that cities will need at least three to six months for data collection and follow-up when planning scenario modelling and GHG target setting, especially for data-intensive tools such as CURB. In cases of limited data availability, secondary sources at the city or state levels can be used (Table 6). However, it is preferable to use primary data where possible for higher levels of contextual data accuracy and better acceptance by cities. Our study also highlighted the need for support in conducting data-collection surveys. For example, Indore city officials highlighted the need for technical and workforce support to conduct ward-level surveys on the number of houses with solar PV to understand the current uptake and challenges to expanding rooftop solar across residential consumers of different income levels.

CLIMATE-CONSCIOUS LEADERSHIP FOR URBAN CLIMATE ACTION

During consultations, we observed that climate-conscious leaders, including political leaders and/or city administrators with a proactive outlook on initiating climate actions, played an important role in stimulating collective action and were most effective in driving local climate strategies. Active leadership has also been found to enhance the impact and governing capacity of intermediary organizations working on climate action planning in these cities (Kern and Bulkeley 2009). For example, consultations in Indore—driven by the Smart City CEO, who demonstrated a strong understanding of climate-related issues and initiatives—saw excellent levels of participation and deliberation. Indore also has a visionary political leadership that aims to integrate climate change into different facets of urban planning and has created a conducive ecosystem within the city administration to incorporate climate concerns into development planning.

DATA, TECHNICAL, AND FINANCIAL CAPACITIES FOR RENEWABLE ENERGY (RE) TARGET SETTING

In line with India's Nationally Determined Contribution (NDC) target to generate 40 percent of electricity from RE sources by 2030, the State Electricity Regulatory Commissions (SERCs) are required to meet RE purchase obligations for solar and nonsolar sources (TERI and MNRE 2023). This is supported by various incentives such as production-linked incentives for solar, central financial assistance for grid-connected rooftop solar PV projects, and procurement-based incentives for DISCOMs (MNRE 2023). India will be the lowest-cost producer of solar power in 2022, with solar power tariffs declining by 80 percent between 2010 and 2018 (Civil Society News, Gurugram 2022; Singh 2019).

Despite the clear top-down focus and support, guidance, and direction from central and state governments for renewable energy as well as technology improvements, some cities like Indore and Ujjain were not keen to propose ambitious targets for solar PV in buildings and energy generation from renewables using the CURB tool (60 percent by 2050 in Indore and 45 percent by 2050 in Ujjain). Based on our analysis, this reluctance can be attributed to several factors:

- Limited technical knowledge, data availability, and financing for implementing energy efficiency and scaling up renewable energy in commercial buildings and residential housing, including informal communities, especially in cities like Indore, which has a large informal housing sector
- Limited interest and awareness within DISCOMs in setting a long-term renewable energy vision and targets
- Desire to prioritize urban development over climate action, due to limited financial resources.

Table 6 | **Secondary data sources for city-level data**

SECONDARY DATA SOURCES CAN INCLUDE:
▪ **Data portals and tools:** The Smart City Open Data Portal (MOHUA n.d.) provides some quantitative data across various sectors and cities, and the State Energy Calculators for Maharashtra (Vyas 2018) and Gujarat (DNA 2018), development tools provide scenarios up to 2050 for the state. State-level targets can be scaled down to city level and used to inform the level of ambition.
▪ **City-level plans and policies:** Comprehensive Mobility Plans, Development Master Plans, Smart City proposals, green and blue master plans, state and city electric vehicle policies, etc.
▪ **Third-party studies prepared by universities, think tanks, international development organizations, NGOs, etc.:** Examples include the Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh (Pandey 2019) report which was a useful source for the cities of Indore and Ujjain; the Water Demand Management and Strategy plan for Indore prepared by UN Habitat (Ray et al. 2003); the City Resilience Strategies (Shah et al. 2017) prepared by the Rockefeller Foundation for Surat and Indore; and "Mumbai Metro: Transforming Transport Contributing Toward an Equitable, Safer, and Cleaner City," prepared by the Asian Development Bank (Saxena et al. 2021).

Source: Indore Climate Action Plan 2023 (Bajpai et al. 2023)

EXISTING UTILITY INFRASTRUCTURE, DEMAND, AND POLICY FRAMEWORKS

The sectoral targets for transport and waste are contingent on the current state of infrastructure and demand in cities. Ujjain has a very small public transport system comprising 36 buses (Ujjain Smart City Limited 2021) and low demand owing to the small size of the city and short trip distances. Thus, the city aimed only for a 40 percent modal share for public transport by 2050. Moreover, the city does not have a comprehensive mobility plan, making it difficult to assess baseline conditions for the transport sector and set long-term targets. Another example is the potential for establishing a waste-to-energy plant in Ujjain. This was deemed to have low feasibility because the city does not generate the minimum amount of waste required to operate such a plant under optimal conditions. Moreover, without proper waste segregation, waste-to-energy plants face operational challenges that pose significant hurdles for cities.

LONG-TERM TECHNOLOGICAL LOCK-INS

Long-term technological lock-ins were also identified as another factor affecting target setting. For example, after the scenario-modelling exercise and subsequent stakeholder consultations, Indore's proposed fleet electrification target for public transport was only 80 percent by 2050, as opposed to the state EV policy target of 100 percent. This was because Indore's fleet would continue to rely on bio-CNG (Compressed Natural Gas), a purified form of biogas with over 95 percent pure methane gas, due to the recently inaugurated 550-tonnes-per-day bio-CNG plant, which is set to power buses and solid waste transport fleets for the next 20 years. CO_2 emissions from bio-CNG are 70 percent lower than from diesel and it is rapidly being adopted across cities (Nazri Wani 2022). The number of bio-CNG vehicles has increased from 1.47 million to 3.4 million between 2014 and 2020 (Global Green Growth Institute 2021). However, electric vehicles offer greater emission reductions and reduced energy consumption compared to bio-CNG, provided the grid demand comes from renewables. The plant in Indore was set up on a Public-Private Partnership basis with Indo Enviro Integrated Solutions Limited (IEISL), the private partner, which has made a 100 percent capital investment in the project and will bear operational and maintenance costs for the entire concession period of 20 years.

Limitations of the CURB tool

The CURB tool, despite its various advantages such as being open access and easy to use, has certain limitations. The tool requires detailed data across all sectors, some of which may not be collected by cities and will require significant capacity building in data collection in the future. Another limitation is that the tool requires a host server with a high computing capacity, which the cities lack. Technical issues, errors in variables, and long delays in data processing are other limitations that affect the tool's performance. Information on investments and utility costs is in U.S. dollars with no option of converting to the currency of a different country. Having an idea of investments in the local currency would provide readers with a more localized financial analysis.

The rationale for the scenario development is verified through stakeholder consultations. This can introduce an element of bias or subjectivity, which can affect the veracity of the results, another potential limitation of the tool. One way to reduce this bias is to ensure representation across all social groups, private and public bodies, citizen groups, research organizations, and other stakeholders during consultations for scenario development. Finally, the tool provides only mitigation components and does not include carbon sequestration.

Capacity-building recommendations for cities

Our insights into the factors affecting the capacity of cities to use CURB for developing mitigation scenarios, targets, and actions led to broad recommendations around institutional, financial, and technical capacity building for the use of tools to set mitigation targets and actions (Figure 6).

Creating institutional structures for data coordination urban governance in India focuses on urban service delivery and function as per the provisions enshrined in the 74th Constitutional Amendment Act 1992, where different departments within an urban body carry out their respective functions. Given that climate change is a cross-sectoral issue, incorporating climate change into development planning requires close coordination between these departments. However, they often work in silos, leading to institutional fragmentation. To overcome this challenge, cities must establish institutional structures for data collection. An example is a climate coordination cell housed within a municipal corporation to mandate and coordinate data collection across various departments. The cell can include representation from multiple departments related to issues of urban planning, energy, DISCOMs, parks and gardens, water, etc., as well as from parastatal agencies to ensure that climate parameters are integrated into urban development projects. Apart from data collection, climate cells could have the following mandates:

- Oversee mainstream climate mitigation and resilience in existing and proposed projects
- Develop stringent mandates for new infrastructure that align with climate goals
- Monitor the progress of climate action plan initiatives
- Evaluate outcomes and report progress to multiple stakeholders
- Conduct training for members on the data collection requirements for tools and how to collate those data

Constituting a climate cell within an Urban Local Body would send a broader message to citizens emphasizing proactive and responsible political leadership, which is committed to addressing the climate challenge. The political leadership could convene climate cells during review meetings, which are a regular phenomenon in any Urban Local Body. The cell can be headed by a municipal commissioner or any other key stakeholder in the municipal government. The proposed climate action cell for Mumbai is to be housed within the Department of Environment and headed by the Deputy Municipal Commissioner, Department of Environment.

Building city-level data dashboards

Cities can try to collate climate-relevant data from different departments needed for frameworks such as the CSCAF, Swachh Bharat Mission, and scenario development tools in the form of a data dashboard. This dashboard can be housed within the Integrated Command and Control Centre, which is used by several cities in India for centralized data management and real-time tracking of aspects such as solid waste management, and public bus fleet route tracking and utilization. The first step is to build capacities within departments for the types of data to be collected, frequencies of and formats for data collection, and collaboration with relevant agencies. This dashboard can also feed into open data platforms, such as the Ministry of Housing and Urban Affairs' smart city open data portal, and should be regularly updated. Data on energy efficiency and usage in private and commercial buildings should also be collected. These players should also be involved in the data-collection and action-implementation stages.

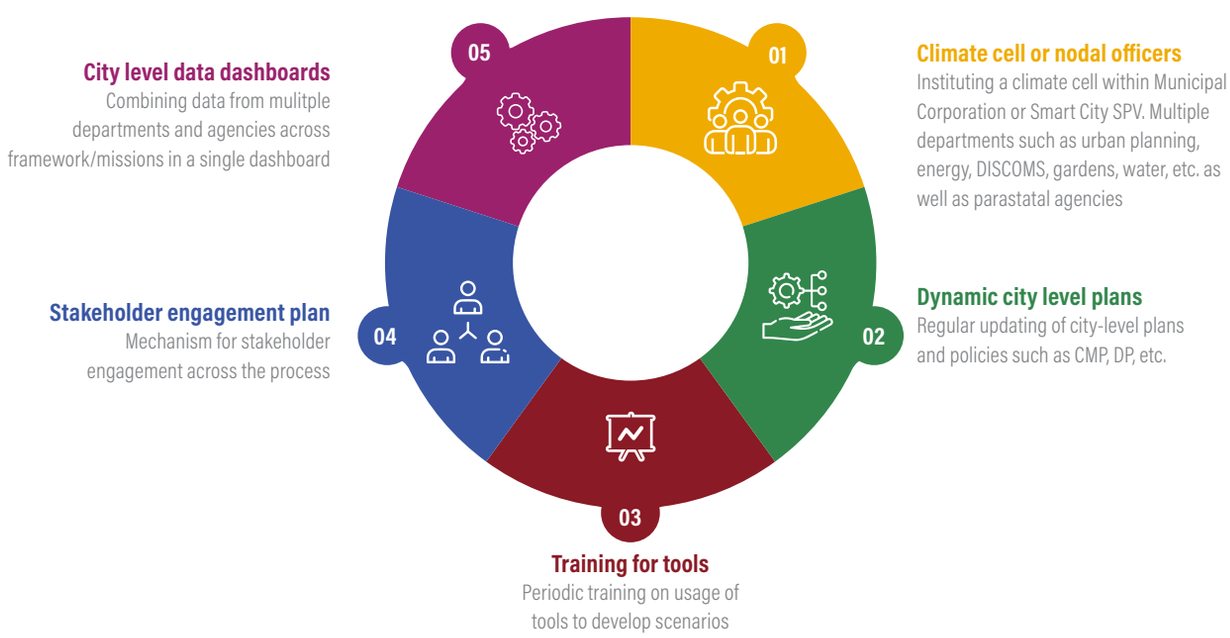
Periodic training on scenario development tools

Cities need to organize periodic training on how to use scenario modelling tools, the data required, the processes involved, and how to analyze the outputs. This training could be conducted for one representative from each department and facilitated through a climate cell.

Developing a stakeholder engagement plan

Cities should develop comprehensive plans that involve stakeholders in every step of the process, including tool development, strategy, target development, vetting, and

Figure 6 | **Capacity-building recommendations for data-driven scenario modelling for climate mitigation in cities**



Source: Authors' analysis

finalization. Stakeholder mapping for each sector must be carried out based on the data requirements to understand which city departments, parastatal agencies, and other organizations/CSOs/citizen forums and private entities must be involved in the process. This engagement will instill a sense of responsibility and ensure greater uptake of targets and actions. This plan can be spearheaded by a central institutional structure created for data coordination, such as a climate cell, or by the municipal commissioner or departmental heads.

Regular update and renewal of city-level plans

A major barrier to modelling in cities is the lack of updated sectoral parameter data. To address this issue, plans such as comprehensive mobility plans, development and master plans, air quality action plans, and green cover action plans should be regularly updated to provide the latest baseline information for climate action plans and tools. Cities could use external organizations to help conduct baseline surveys and other data collection activities.

CONCLUSION AND WAY FORWARD

This study provides a unique analysis of how the Climate Action for Urban Sustainability (CURB) tool can be used to assess mitigation potential in urban areas in India. It focuses on three cities with varying population sizes, economic conditions, and governance structures (Surat, Indore, and Ujjain). It yielded valuable insights into which sectors have the highest mitigation potential in each of the three cities, along with the challenges and factors affecting such tool-driven approaches to climate mitigation.

Our findings demonstrate the high potential for emissions mitigation through urban actions. Under the business-as-usual (BAU) scenario, the increase in emissions across the three cities is between 1.5 and 2.7 times by 2050 compared to the 2019 values. However, in a relatively high-ambition scenario, cities could reduce the greenhouse gas (GHG) emissions projected for 2050 by an average of 70 percent (Surat) to 77 percent (Indore) compared with the BAU. The energy and buildings sectors showed the greatest potential for emissions reduction. Whereas energy efficiency in private buildings yielded the greatest emission reductions in Indore, shifting to renewables achieved the highest CO_2 reduction in Ujjain and Surat. Scenarios that provide quantitative estimates of potential emissions reductions through various strategies for each city provide policymakers with a stronger basis for setting clear mitigation targets, exploring actions, and prioritizing investments.

Although municipal governments have the jurisdiction to act on renewable energy and energy efficiency within urban areas, this potential remains largely untapped in most cities owing to limited financial, technical, and data consolidation capacities, particularly in informal areas, and the limited involvement of state energy-distribution companies. Similarly, cities have yet to set targets for the transportation sector, which not only contributes to GHG emissions, but also affects air quality. Furthermore, while there have been some efforts in solid-waste management, such as segregation and composting, successful scaling of these practices is necessary. Wastewater is also a significant source of methane emissions. To address this issue, plans should include methane avoidance in new wastewater treatment plants and the adoption of methane capture in existing plants.

This study sheds light on the potential for emissions mitigation in three urban areas and highlights the importance of concerted efforts to address climate change at the city level. The findings identify sectors and actions with significant potential such as energy, buildings, transportation, waste management, and wastewater treatment.

However, several issues arose during our work. These include the limited institutional capacity for data-driven exercises, lack of multilevel governance for urban stakeholders, limited availability of quantitative data, lack of climate-conscious decision-making, and the need to develop and implement customized tools and models for urban climate mitigation. By addressing these challenges and leveraging the mitigation opportunities identified in this study, Indian cities can play a central role in reducing GHG emissions and creating sustainable and resilient urban environments. Civil society organizations, think tanks, academia, and research institutions can gain insights from this study to understand the key areas of intervention in data collection and evidence-based climate action planning. More in-depth studies on similar tools that focus on the adaptation and mitigation of target setting and implementation are necessary to tap into the existing tool landscape and identify areas for improvement. Financial institutions, development banks, funders, and donors can also contribute significantly through funding, technical assistance, piloting, testing, and scaling interventions for mainstream impactful actions in cities.

APPENDIX A. DATA REQUIREMENTS FOR THE CURB TOOL

Table A-1 | **Business-as-usual (BAU) scenario assumptions**

SECTOR	DATA SETS
Basic data	City name, area, climate, population, GDP, growth rate
Buildings	Energy use in private and municipal buildings, proportion of buildings by economic type, proportions of residents with electricity
Streetlights	Streetlight electricity consumption, usage (hours per day)
Electricity	Electricity generation by type
Solid waste	Solid waste composition, percentage of commercial and residential waste, solid waste management methods, methane gas capture, waste facilities, waste collection vehicle energy consumption
Water management	Sources of water, wastewater management, water loss, proportion of residents with access to treated water
Transportation	Mode share

SECTOR	SUBSECTOR	PROVIDING ORGANIZATION
Energy and buildings	Residential-commercial-institutional electricity consumption	DISCOMs
	Residential-commercial-institutional LPG/PNG for cooking practice and water heating	Fuel and other gas agencies
	Electricity generation with detailed fuel use including distributed RE contribution	Various generation companies; state power department; NTPC website
Transport	Type of vehicle registered with RTO under Transport and Non-Transport	RTO; municipal corporation
	Various forms of fuel consumption such as petrol, diesel, CNG, LNG, EV, and hydrogen	Fuel agencies; gas agencies; charging infrastructure agencies
	Mode shift data; trips data, etc.	Municipal corporation; operating agencies
Solid waste	Organic and dry waste generation; composition and characteristics of waste; waste-to-energy process; composting process; waste collection and transport; landfill details, etc.	Municipal corporation; maintenance and outsourcing agencies
Wastewater	Water supply; wastewater generation; wastewater collection; wastewater processing; methane capture and energy generation; water reuse, etc.	Municipal corporations; maintenance and outsourcing agencies

APPENDIX B. STAKEHOLDER CONSULTATION LIST

Stakeholder consultations in Surat

NAME	DESIGNATION	ORGANIZATION
Mr. Niraj Umrigar	Executive Engineer	DGVCL
Mr. Debasis Basak	Executive Engineer	SMC
Mr. Nitin Malkan	Vice President	Torrent Power
Mr. Kamlesh Yagnik	Chief Resilience Officer	SCCT
Mr. Dhiraj Gaur	Technical Officer	Gujarat Gas
Mr. Vishal Shah	Architect & Faculty	Aangan Architects & Sarvajanik University
Mr. Jignesh Patel	Member	Credai Surat
Dr. Chetan Patel	Professor	SVNIT
Mr. Nitin Malkan	Vice President	Torrent Power
Mr. Vipul Kadakia	GM district	Torrent Power
Mr. Mustafa Sonasath	AM (Operations)	Surat Sitilink Limited
Mr. Cheetan Prajyupati	AM (Operations)	Surat Sitilink Limited
Mr. Jwalant Naik	Environment Officer	SMC
Mr. Jugmohan Singh	Manager MMI	GMRCL
Mr. Jagdish Thandani	Deputy Engineer	SMC
Mr. K.J.V R. Rao	Multimodal Expert	GEC Surat

Stakeholder consultations in Indore

NAME	DESIGNATION	ORGANIZATION
Smt. Vinti Yadav	Joint director	Town and Country Planning, Indore
Mr. Sumit Gupta	EE	IMC
Mr. Akash Jain	SF	IMC
Mr. R.S. David	AA engineer	IMC
Mr. D.N. Sharma	SE	MPEB
Mr. Mayank Jagwani	Urban planner	IDA
Mr. S.K. Jain	Scientist	MP Pollution Control Board, Indore
Mr. Dharmendra Kumar	Food safety officer	Food and Drugs Department, Indore
Dr. D.K. Waghela	AQTC	WRI CAC
Dr. Jayeshree Sikkha	Professor	Gujarat Science College, Indore
Ms. Uzma Khan	Sub-engineer	JMC Indore

Mr. Shrigoar Jagtap	SWMS	UMS
Mr. S.K. Upadhyay	Asst. Professor	ACPC
Mr. Ashitosh Rathod	SG	IMC
Mr. Garima Goswami	TSU	IMC
Mr. Lokendra Garbyal	Chief Depot Manager	HPCL LPG bottling plant
Mr. Vardeep Kumar	Add. Com	IMC
Mr. Vijay Jatthap	Sub-engineer	TCCP, Indore
Capt Surpreet Singh	COO and Director	HMS
Mr. Sunil Dubey	Executive Engineer	Smart City Indore
Mr. Mahesh Sharma	SE	IMC

KEY TAKEAWAYS FROM STAKEHOLDER CONSULTATION

Surat

Energy and buildings

- The adoption of ECBC norms in residential and commercial buildings needs to be promoted.
- There is a need to strengthen the implementation of the Surat Solar Master Plan for private-sector buildings.
- The renewable installed capacity in the city is only 12 percent; the share of RE in the energy mix needs to be boosted by providing incentives to MSMEs to switch to renewable power generation. DISCOMs need to develop their respective plans based on the national target for the RE mix in power generation.
- Surat has been selected as one of the cities to achieve its target of 25 percent RE by 2030. To fulfil this target, the city is adopting technologies such as rooftop solar power, windmills, biomass, and biogas. A wind-power generator of 170 MW has already been installed.
- The cooling load of buildings needs to be assessed, and the transition to energy-efficient measures may be promoted or incentivized by the corporation.

Transport

- The city aims to have 100 percent electric buses by 2030 and is also deploying public EV charging stations to promote EVs in the city.
- Surat aims to complete both phases of the metro by 2026, which will contribute to 20 percent of total public transport, apart from the city bus/BRT and bus corridor fleet.
- The NMT network needs to be improved and integrated with the existing infrastructure to reduce traffic congestion.

Waste and wastewater management

- The city aims to treat 50 percent of total wastewater at the tertiary level and sell the treated water to nearby industrial areas by 2026, thus reducing the load on groundwater resources.
- The city aims to complete the ongoing bioremediation of the Khajod landfill by 2024 and plans to capture methane gas during the process.
- For transportation of waste, the city aims to transition to electric vehicles: 25 percent by 2030 and 40 percent by 2040.
- The city aims to recycle 100 percent of all textile waste by 2025.

Indore

Energy and buildings

- The city aims to ensure solar rooftop-based generation in 100 percent of residential buildings by 2050 and 60 percent of installed capacity from renewable energy by 2050. Three thousand residential buildings in the city have solar rooftops with an average capacity of 4 kW, and an additional 400–500 installations are added every year. DISCOM's city circle states that by 2050, the city may achieve 70–80 percent of solar rooftop penetration.
- The city plans to install solar panels on public toilets. A tender for 100 toilets, each using 2 kW, has already been floated and the units will be installed by the end of 2022.
- The city can expect an installed solar-powered capacity of 50 MW by 2030 and 1000 MW by 2050 in municipal buildings, public hospitals, and schools.
- The streetlights in gram panchayats within city limits are already powered with solar panels.

- The city has nine solar-powered traffic signals; all traffic signals are expected to become solar-powered over the next two to three years.
- As part of the lighthouse project, under the Global Housing Technology Challenge, the city is planning eight blocks with 1024 flats to follow green building standards.

Transport

- The city aims to deploy 400 bio-CNG buses to maintain the feasibility of the newly commissioned bio-CNG plant over the next decade, possibly longer.
- The city aims to deploy 160 EV charging stations by the end of 2022 to increase the uptake of EVs and aims to have 30 percent EVs by 2030 and 80 percent EVs by 2050.
- The Indore Metro's estimated mode share is 18 percent by 2030, and the city aims to increase public transport share to 50 percent by 2050.

Waste and wastewater management

- Of city waste, 66 percent was food and yard waste. The city utilizes 80–85 percent of this waste to generate bio-CNG and the remaining is composted. The city recycles 100 percent of paper and plastic waste.
- The waste composition comprises 40–60 percent wet and 45–55 percent dry waste, of which 20 percent is commercial waste and 80 percent residential.
- The city treats 100 percent of its wastewater and has water plus status. However, methane capture is not practiced in sewage treatment plants (STPs).

Ujjain

Energy and buildings

- DISCOM city circle highlighted that the city has only 0.2 percent solar rooftop installed capacity at present. However, achieving 30 percent energy generation from renewables by 2030 is possible.
- The city may achieve up to 25 percent energy-efficient lighting in buildings by 2030 and further upscale this by 2040 to further reduce GHG emissions.
- This means the adoption of solar water heating in existing and future multistory buildings needs to be upscaled.
- The city has electric, CNG, and PNG geysers, with the electric geysers accounting for the largest share. By 2040, the city can expect installation of solar water heaters to meet approximately 60 percent of water heating demand from renewables; however, this needs to be coupled with awareness programs.
- The government has a target of generating 30 percent of energy from renewables by 2030. Green building adoption is low because of a lack of awareness among citizens.

Waste and wastewater management

- The city is implementing a plan to achieve 100 percent household-level metering and ensure a 24/7 water supply.
- The process of developing a detailed project report to reduce non-revenue water, which at present is estimated to be around 50 percent, has been initiated.
- Wastewater generation in the city is approximately 83 million liters per day, and the city is currently establishing STPs for treatment and reuse.

Transport

- The city is following MP EV Policy 2019 with a target to convert 100 percent of the public transport bus fleet into electric buses (Battery Electric Vehicles) by 2026. Ten charging stations have been installed in the city.
- The city is in the process of developing its Comprehensive Mobility Plan, which aims to meet 38 percent of the transport sector's energy demand from renewables by 2050.

APPENDIX C. GHG MITIGATION POTENTIAL ACROSS URBAN SUB-SECTORS

GHG mitigation potential in Indore

SECTORS	2030			2050		
	EMISSION REDUCTIONS (TONNES CO_2E/ YEAR	TARGET	PERCENTAGE OF TOTAL REDUCTIONS	EMISSION REDUCTIONS (TONNES CO_2E/ YEAR	TARGET	PERCENTAGE OF TOTAL REDUCTIONS
1. PRIVATE BUILDING ENERGY	**12,84,510**		**54%**	**14,88,270**		**34%**
1.1 Energy efficiency and fuel switching	**3,80,670**		**16%**	**3,63,867**		**8%**
1.1.1 Existing residential buildings	**2,58,239**		**11%**	**1,83,388**		**4%**
Lighting - residential	1,65,848	50% of existing residential buildings with LED	7%	1,01,636	100% of existing residential buildings with LED	2%
Appliances and electronics	18,402		<1%	14,585		<1%
Space heating	1,189		<1%	5,029		<1%
Cooling	53,940		2%	33,965		<1%
Water heating	-5,484		0%	1,667		<1%
Water fixtures	3,634	40% of residential buildings with low-flow fixtures	<1%	12,645	90% of residential buildings with low-flow fixtures	<1%
Building envelopes	20,709		<1%	13,862		<1%
1.1.2 Existing informal residential	**-2,437**		**0%**	**4,474**		**<1%**
Lighting	1,169		<1%	1,112		<1%
Space heating	-757		0%	-820		0%
Cooling	3,575		<1%	4,094		<1%
Water heating	0		0%	0		0%
Cooking	-6,423		0%	88		<1%
1.1.3 Existing commercial buildings	**53,644**		**2%**	**49,134**		**1%**
Lighting	30,135	50% of buildings with LED	1%	16,901	100% of buildings with LED	<1%
Appliances and electronics	9,290		<1%	11,620		<1%
Space heating	0		0%	0		0%
Cooling	11,568		<1%	17,586		<1%

Water heating	-77		0%	272	<1%
Water fixtures	64		<1%	173	<1%
Building envelopes	2,665		<1%	2,583	<1%
1.1.4 New residential buildings	**57,929**		**2%**	**97,026**	**2%**
Lighting	41,130		2%	52,713	1%
Appliances and electronics	849		<1%	4,476	<1%
Space heating	923		<1%	2,723	<1%
Cooling	14,982		<1%	20,202	<1%
Water heating	-1,330		0%	3,471	<1%
Water fixtures	839		<1%	6,625	<1%
Building envelopes	536		<1%	6,816	<1%
1.1.5 New informal residential	**1,269**		**<1%**	**2,560**	**<1%**
Lighting	356		<1%	579	<1%
Space heating	0		0%	0	0%
Cooling	913		<1%	1,981	<1%
Water heating	0		0%	0	0%
Cooking	0		0%	0	0%
1.1.6 New commercial buildings	**12,027**		**<1%**	**27,285**	**<1%**
Lighting	6,539		<1%	9,652	<1%
Appliances and electronics	1,779		<1%	5,926	<1%
Space heating	0		0%	0	0%
Cooling	2,953		<1%	9,940	<1%
Water heating	46		<1%	186	<1%
Water fixtures	30		<1%	145	<1%
Building envelopes	681		<1%	1,436	<1%
1.2 Photovoltaic systems	**8,75,213**		**37%**	**11,24,403**	**26%**
PV - residential	8,57,156	30% of residential high-income buildings with solar PV installed	36%	10,84,700	90% of residential high-income buildings with solar PV installed	25%
PV - commercial	18,057		<1%	39,703	<1%
1.3 District energy	**28,628**		**1%**	**0**	**0%**
District energy	28,628		1%	0	0%

2. MUNICIPAL BUILDINGS AND PUBLIC LIGHTING	**1,40,006**		**6%**	**3,74,313**		**8%**
2.1 Existing municipal buildings	**769**		**<1%**	**693**		**<1%**
Lighting	361	30% of existing buildings with LED	<1%	217	90% of existing buildings with LED	<1%
Space heating	0		0%	0		0%
Cooling	358		<1%	445		<1%
Building envelope	50		<1%	30		<1%
2.2 New municipal buildings	**49**		**<1%**	**253**		**<1%**
Lighting	41		<1%	124		<1%
Space heating	0		0%	0		0%
Cooling	2		<1%	120		<1%
Building envelope	6		<1%	9		<1%
2.3 Street and other public lighting	**2,089**		**<1%**	**30,619**		**<1%**
Streetlights	2,057		<1%	30,600		<1%
Traffic signals	32		<1%	19		<1%
2.4 Municipal PV	**1,37,099**		**6%**	**3,42,748**		**8%**
Municipal PV	1,37,099	120 MW solar PV installed	6%	3,42,748	300 MW solar PV installed	8%
3. ELECTRICITY GENERATION	**6,92,438**		**29%**	**20,04,130**		**45%**
3.1 Grid decarbonization	**6,92,438**	**Share of total grid electricity from renewables is 25%**	**29%**	**20,04,130**	**Share of total grid electricity from renewables is 60%**	**45%**
4. SOLID WASTE	**6,142**		**<1%**	**19,546**		**<1%**
4.1 Waste management	**2,461**		**<1%**	**5,013**		**<1%**
Paper waste	-10		0%	0		0%
Food scrap	2,320	80% of organic waste composted	<1%	5,220	100% of organic waste composted	<1%
Other organic waste management	151		<1%	-207		0%
Plastic waste management	0		0%	0		0%
4.2 Waste to energy	**3,517**		**<1%**	**14,532**		**<1%**
Anaerobic digestion optimization	1,575		<1%	5,445		<1%
Incineration optimization	1,942		<1%	9,087		<1%

4.3 Landfill fugitive emission capture	**164**		**<1%**	**0**		**0**
Landfill methane recovery	164		<1%	0		0%
4.4 Waste collection and transfer	**0**		**<1%**	**1**		**<1%**
Waste collection and transportation energy	0	40% of transport vehicles converted to CNG	<1%	1	100% of transport vehicles converted to CNG	<1%
Waste transfer station energy	0		0%	0		0%
5. WASTEWATER AND WATER	**1,54,269**		**6%**	**3,18,554**		**7%**
5.1 Wastewater treatment type switching	**80,659**		**3%**	**1,83,422**		**4%**
Wastewater treatment type switching	80,659	46% of wastewater treated with gas capture	3%	1,83,422	100% of wastewater treated with gas capture	4%
5.2 Latrine improvement	**1,393**		**<1%**	**3,961**		**<1%**
Sediment removal and treatment	1393		<1%	3,961		<1%
5.3 Anaerobic treatment lagoon improvement	**13,930**		**<1%**	**0**		**0%**
Anaerobic surface aeration	13,930		<1%	0%		0
5.4 Activated sludge treatment improvement	**1,336**		**<1%**	**3,288**		**<1%**
Improved nitrification	1,336		<1%	3,288		<1%
5.5 Direct discharge improvement	**0**		**0%**	**0**		**0%**
Primary treatment improvement	0		0%	0		0%
5.6 Wastewater biogas-energy optimization	**47,938**		**2%**	**1,03,152**		**2%**
Biogas-energy optimization	47,938		2%	1,03,152		2%
5.7 Water conveyance pump improvement	**4,704**		**<1%**	**15,615**		**<1%**
Water conveyance pump efficiency	4,704	60% of pumps with 80% improved efficiency	<1%	15,615	100% of pumps with 100% improved efficiency	<1%

5.8 Water delivery loss reduction	**4,310**		**<1%**	**9,117**		**<1%**
Water delivery loss reduction	4,310	40% non-revenue water	<1%	9,117	2% non-revenue water	<1%
6.TRANSPORTATION	**1,06,620**		**4%**	**1,99,906**		**5%**
6.1 Low-carbon urban design	**3,835**		**<1%**	**16,904**		**<1%**
Passenger trip reduction	3,835		<1%	16,904		<1%
6.2 Passenger mode shift	**39,014**		**2%**	**1,27,990**		**3%**
Passenger mode shift	39014	Mode share for public transport - 23%	2%	1,27,990	Mode share for public transport - 50%	3%
6.3 Vehicle fuel switch	**37,801**		**2%**	**36,229**		**<1%**
Vehicle fuel switch	37,801	35% of private automobile fleet electrified;	6%	3,42,748	300 MW solar PV installed	8%
6.4 Vehicle fuel efficiency	**25,970**		**1%**	**18,783**		**<1%**
Vehicle fuel efficiency	25,970		1%	18,783		<1%
Total	**23,83,985**		**100% (100% of total GHG reduction in 2030 which is 55%)**	**44,04,719**		**100% (100% of total GHG reduction in 2050 which is 77%)**

Emissions reduction by scenario

INDORE	2030	2040	2050
BAU emissions (tonnes CO_2e/year)	42,86,696	49,38,152	56,88,612
E&P scenario emissions reduction compared to BAU (tonnes CO_2e/year)	4,03,015	16,29,061	24,76,133
% emissions reduced	9.4%	33%	43.4%
Ambitious scenario emissions reduction compared to BAU (tonnes CO_2e/year)	23,83,985	34,19,803	44,04,719
% emissions reduced	55%	69%	77%

GHG mitigation potential in Ujjain

SECTORS	EMISSION REDUCTIONS (TONNES CO_2E/YEAR	TARGET	PERCENTAGE OF TOTAL REDUCTIONS	SECTORS	EMISSION REDUCTIONS (TONNES CO_2E/ YEAR	TARGET	PERCENTAGE OF TOTAL REDUCTIONS
1.Private building energy	**88,482**		**38%**	**Private building energy**	**1,84,657**		**19%**
1.1 Energy efficiency & fuel switching	**46,908**		**20%**	**Energy efficiency & fuel switching**	**59,889**		**6%**
1.1.1 Existing residential buildings	**32,707**		**14%**	**Existing residential buildings**	**30,644**		**3%**
Lighting – residential (existing)	31,944	Switch to LED- 50% Target	14%	Lighting - residential (existing)	29,636	Switch to LED- 100% Target	3%
Appliance and Electronics - Residential (Existing)	795	High Range Energy Efficient- Target 25%	<1%	Appliance and Electronics - Residential (Existing)	954	High Range Energy Efficient- Target 50%	<1%
Water heating - residential (existing)	-32	Electric heater- target 1%	0%	Water heating - residential (existing)	54	Solar Heater- Target 5%	<1%
1.1.2 Existing informal residential	**77**		**<1%**	**Existing informal residential**	**94**		**<1%**
Lighting - informal (existing)	77		<1%	Lighting - informal (existing)	94		<1%
1.1.3 Existing commercial buildings	**3,531**		**2%**	**Existing commercial buildings**	**7,342**		**<1%**
Lighting - commercial (existing)	2,455		1%	Lighting - commercial (existing)	4,738		<1%
Appliances and electronics - commercial (existing)	1,073		<1%	Appliances and electronics - commercial (existing)	2,597		<1%
Water heating - commercial (existing)	2		<1%	Water heating - commercial (existing)	7		<1%
1.1.4 New residential buildings	**8,864**		**4%**	**New residential buildings**	**17,316**		**2%**
Lighting - residential (new)	8,734		4%	Lighting - residential (new)	16,672		2%
Appliances and electronics - residential (new)	108		<1%	Appliances and electronics - residential (new)	413		<1%
Water heating - residential (new)	21		<1%	Water heating - residential (new)	231		<1%

1.1.5 New informal residential	**39**	**<1%**	**New informal residential**	**132**	**<1%**
Lighting - informal (new)	39	<1%	Lighting - informal (new)	132	<1%
1.1.6 New commercial buildings	**1,690**	**<1%**	**New commercial buildings**	**4,362**	**<1%**
Lighting - commercial (new)	1,009	<1%	Lighting - commercial (new)	2,700	<1%
Appliances and electronics - commercial (new)	680	<1%	Appliances and electronics - commercial (new)	1,662	<1%
1.2 Photovoltaic systems	**41,574**	**18%**	**Photovoltaic systems**	**1,24,767**	**13%**
Photovoltaic - residential	41,130	18%	Photovoltaic - residential	1,23,445	13%
Photovoltaic - commercial	444	<1%	Photovoltaic - commercial	1,322	<1%
2. Municipal buildings & public lighting	**9,409**	**4%**	**Municipal buildings & public lighting**	**50,943**	**5%**
2.1 Existing municipal buildings	**87**	**<1%**	**Existing municipal buildings**	**99**	**<1%**
2.1.1. Lighting - municipal (existing}	87	<1%	Lighting - municipal (existing}	99	<1%
2.2 New municipal buildings	**13**	**<1%**	**New municipal buildings**	**39**	**<1%**
2.2.1 Lighting - municipal (new)	13	<1%	Lighting - municipal (new)	39	<1%
2.3 Street & other public lighting	**8,169**	**4%**	**Street & other public lighting**	**39,404**	**4%**
2.3.1 Streetlights	8,219	4%	Streetlights	39,428	4%
2.3.2 Traffic signals	-50	0%	Traffic signals	-24	0%
2.4 Municipal photovoltaic systems	**1,140**	**<1%**	**Municipal photovoltaic systems**	**11,401**	**<1%**
2.4.1 Photovoltaic - municipal	1,140	<1%	Photovoltaic - municipal	11,401	<1%
3. Electricity generation	**1,25,267**	**54%**	**Electricity generation**	**6,86,571**	**72%**
3.1.1 Grid decarbonization	1,25,267	54%	Grid decarbonization	6,86,571	
4. Solid waste	**143**	**<1%**	**Solid waste**	**4,992**	**<1%**
4.1 Waste management	**70**	**<1%**	**Waste management**	**4800**	**<1%**
4.1.1 Food waste & yard waste management	5,910	3%	Food waste & yard waste management	4,800	3%

4.2 Waste collection and transfer	**73**	**<1%**	**Waste collection and transfer**	**192**	**<1%**
4.2.1 Waste collection and transportation energy	69	<1%	Waste collection and transportation energy	187	<1%
4.2.2 Waste transfer station energy	4	<1%	Waste transfer station energy	4	<1%
5. Wastewater & water	**948**	**<1%**	**Wastewater & water**	**12,337**	**<1%**
5.1 Facultative treatment lagoon improvements	**922**	**<1%**	**Facultative treatment lagoon improvements**	**12,241**	**<1%**
5.1.1 Facultative surface aeration	922	<1%	Facultative surface aeration	12,241	<1%
5.2 Water delivery loss reduction	**26**	**<1%**	**Water delivery loss reduction**	**96**	**<1%**
5.2.1 Water delivery loss reduction	26	<1%	Water delivery loss reduction	96	<1%
6. Transportation	**7,096**	**3%**	**Transportation**	**15,606**	**2%**
6.1 Low-carbon urban design	**4**	**<1%**	**Low-carbon urban design**	**87**	**<1%**
6.1.1 Passenger trip reduction	4	<1%	Passenger trip reduction	87	<1%
6.2 Passenger mode shift	**1,797**	**<1%**	**Passenger mode shift**	**5,519**	**<1%**
6.2.1 Passenger mode shift	1,797	<1%	Passenger mode shift	5,519	<1%
6.3 Vehicle fuel switch	**5,295**	**2%**	**Vehicle fuel switch**	**10,000**	**1%**
6.3.1 Vehicle fuel switch	5,295	2%	Vehicle fuel switch	10,000	1%
Total	**2,31,345**		**Total**	**9,55,106**	

GHG mitigation potential in Surat

SECTORS	2030				2050		
	SECTORS	EMISSION REDUCTIONS (TONNES CO_2E/ YEAR	TARGET	PERCENTAGE OF TOTAL REDUCTIONS	EMISSION REDUCTIONS (TONNES CO_2E/ YEAR	TARGET	PERCENTAGE OF TOTAL REDUCTIONS
1. Private building energy	**10,81,508**		**48%**	**Private building energy**	**4,22,983**		**5%**
1.1 Energy efficiency & fuel switching	**2,61,009**		**12%**	**Energy efficiency & fuel switching**	**90,506**		**1%**
1.1.1 Existing residential buildings	**1,67,929**		**8%**	**Existing residential buildings**	**35,698**		**<1%**
Lighting - residential (existing)	1,48,906		7%	Lighting - residential (existing)	28,774		<1%
Appliances and electronics - residential (existing)	8,801		<1%	Appliances and electronics - residential (existing)	2,754		<1%
Cooling - residential (existing)	5,641		<1%	Cooling - residential (existing)	2,119		<1%
Water heating - residential (existing)	517		<1%	Water heating - residential (existing)	1,013		<1%
Building envelopes - residential (existing)	4,064		<1%	Building envelopes - residential (existing)	1,037		<1%
1.1.2 Existing informal residential	**3,179**		**<1%**	**Existing informal residential**	**4,214**		**<1%**
Lighting - informal (existing)	1,149		<1%	Lighting - informal (existing)	250		<1%
Cooling - informal (existing)	1,723		<1%	Cooling - informal (existing)	357		<1%
Water heating - informal (existing)	407		<1%	Water heating - informal (existing)	-91		0%
Cooking - informal (existing)	-100		0%	Cooking - informal (existing)	3,698		<1%
1.1.3 Existing commercial buildings	**26,742**		**1%**	**Existing commercial buildings**	**9,410**		**<1%**
Lighting - commercial (existing)	20,694		<1%	Lighting - commercial (existing)	5,298		<1%
Appliances and electronics - commercial (existing)	2,715		<1%	Appliances and electronics - commercial (existing)	1,410		<1%
Cooling - commercial (existing)	2,252		<1%	Cooling - commercial (existing)	1,177		<1%
Water heating - commercial (existing)	835		<1%	Water heating - commercial (existing)	1,190		<1%
Building envelope - commercial (existing)	246		<1%	Building envelope - commercial (existing)	334		<1%

1.1.4 New residential buildings	**51,668**		**2%**	**New residential buildings**	**27,169**		**<1%**
Lighting - residential (new)	41,512	Switch to LED light- Target 50%	2%	Lighting - informal (new)	16,187	Switch to LED light- Target 100%	<1%
Appliance and Electronics - Residential (New)	5,376	Switch to High Range energy efficiency- Target 50%	<1%	Appliance and Electronics - Residential (New)	3,048	Switch to High Range energy efficiency- Target 90%	<1%
Cooling - Residential (New)	2,805	Switch to high-efficiency chillers- Target 10%	<1%	Cooling - Residential (New)	1,994	Switch to high-efficiency chillers- Target 30%	<1%
Water Heating - Residential (New)	973	Switch to electric heater – Target 40%	<1%	Water Heating - Residential (New)	5,235	Switch to electric heater – Target 90%	<1%
Building Envelopes - Residential (New)	1,002	Improved Target 10%	<1%	Building Envelopes - Residential (New)	705	Improved Target 25%	<1%
1.1.5 New informal residential	**996**		**<1%**	**New informal residential**	**7,107**		**<1%**
Lighting - Informal (New)	342	Switch to LED light- Target 70%	<1%	Lighting - Informal (New}	127	Switch to LED light- Target 90%	<1%
Cooling - Informal (New)	513	Efficient ceiling fan- Target 70%	<1%	Cooling - Informal (New}	201	Efficient ceiling fan- Target 95%	<1%
Water Heating - Informal (New)	166	Switch to electric kettle – Target 30%	<1%	Water Heating - Informal (New}	-154	Switch to electric kettle – Target 70%	0%
Cooking - Informal (New)	-25	Gas Stove 90% and Electric Stove -Target 1%	0%	Cooking - Informal (New}	6,934	Gas Stove 90% Electric Stove -Target 10%	<1%
1.1.6 New commercial buildings	**10,495**		**<1%**	**New commercial buildings**	**6,909**		**<1%**
Lighting - Commercial (New)	5,241	Switch to LED light- Target 50%	<1%	Lighting - Commercial (New}	3,021	Switch to LED light- Target 100%	<1%
Appliances and Electronics - Commercial (New)	2,772	Switch to High Range energy efficiency- Target 40%	<1%	Appliances and Electronics - Commercial (New}	1,885	Switch to High Range energy efficiency- Target 90%	<1%
Cooling - Commercial (New)	2,385	Switch to high-efficiency chillers- Target 20%	<1%	Cooling - Commercial (New)	1,669	Switch to high-efficiency chillers- Target 50%	<1%

Water Heating - Commercial (New)	36	Solar Hot Water- Target 50%	<1%	Water Heating - Commercial (New}	149	Solar Hot Water- Target 95%	<1%
Building Envelope - Commercial (New)	61	Improved Target 10%	<1%	Building Envelope - Commercial (New)	185	Improved Target 50%	<1%
1.2 Photovoltaic systems	**8,20,499**		**37%**	**Photovoltaic systems**	**3,32,477**		**4%**
1.2.1 Photovoltaic - residential	**8,11,443**		**36%**	**Photovoltaic - residential**	**3,28,878**	**Solar PV target 50%**	**4%**
1.2.2 Photovoltaic - commercial	**9,056**		**<1%**	**Photovoltaic - commercial**	**3,599**	**Solar PV target 50%**	**<1%**
2. Municipal buildings & public lighting	**17,896**		**<1%**	**Municipal buildings & public lighting**	**54,203**		**<1%**
2.1 Existing municipal buildings	**51**		**<1%**	**Existing municipal buildings**	**21**		**<1%**
2.1.1 Lighting - municipal (existing)	**45**	**Switch to LED light- Target 20%**	**<1%**	**Lighting - municipal (existing)**	**4**	**Switch to LED light- Target 100%**	**<1%**
2.1.2 Cooling - municipal (existing)	**5**	**Switch to high-efficiency chillers- Target 20%**	**<1%**	**Cooling - municipal (existing)**	**17**	**Switch to high-efficiency chillers- Target 40%**	**<1%**
2.2 New municipal buildings	**11**		**<1%**	**New municipal buildings**	**7**		**<1%**
2.2.1 Lighting - municipal (new)	**10**		**<1%**	**Lighting - municipal (new)**	**2**		**<1%**
2.2.2 Cooling - municipal (new)			**<1%**	**Cooling - municipal (new)**	**5**		**<1%**
2.3 Street & other public lighting	**733**		**<1%**	**Street & other public lighting**	**2,870**		**<1%**
2.3.1 Streetlights	**742**	**Switch to LED light- Target 100%**	**<1%**	**Streetlights**	**2,867**	**Switch to LED light- Target 100%**	**<1%**
2.3.2 Traffic Signals	**-10**	**Switch to LED light- Target 100%**	**0%**	**Traffic Signals**	**3**	**Switch to LED light- Target 100%**	**<1%**
2.4 Municipal photovoltaic systems	**17,102**		**<1%**	**Municipal photovoltaic systems**	**51,306**		**<1%**
2.4.1 Photovoltaic - Municipal	**17,102**	**PV Target 15%**	**<1%**	**Photovoltaic - Municipal**	**51,306**	**PV Target 45%**	**<1%**

3. Electricity generation	**9,10,388**		**41%**	**Electricity generation**	**63,79,441**		**79%**
3.1 Grid decarbonization	9,10,388		41%	Grid decarbonization	63,79,441		79%
3.1.1 Grid Decarbonization	9,10,388	RE Mix Gen Target 27%	41%	Grid Decarbonization	63,79,441	RE Mix Gen Target 78%	79%
4. Solid waste	**80,789**		**4%**	**Solid waste**	**3,67,466**		**5%**
4.1 Waste management	57,660		3%	Waste management	3,05,980		4%
4.1.1 Food Scrap & Yard Waste Management	20	Composting Target 60%	<1%	Food Scrap & Yard Waste Management	20	Composting Target 70%	<1%
4.1.2 Other Organic Waste Management	57,640	Recycle Target 20%	3%	Other Organic Waste Management	3,05,960	Recycle Target 80%	4%
4.2 Landfill Methane Recovery	23,056	LFG target 10%	1%	Landfill Methane Recovery	61,191	LFG target 80%	<1%
4.2.1 Landfill Methane Recovery	23,056	LFG target 10%	1%	Landfill Methane Recovery	61,191	LFG target 80%	
4.3.Waste Collection and Transportation Energy	74	EV Target 20%	<1%	Waste Collection and Transportation Energy	295	EV Target 100%	<1%
4.3.1 Waste Collection and Transportation Energy	74	EV Target 20%	<1%	Waste Collection and Transportation Energy	295	EV Target 100%	<1%
5. Wastewater & water	**57,376**		**3%**	**Wastewater & water**	**87,681**		**1%**
5.1 Wastewater biogas-to-energy optimization	55,397		2%	Wastewater biogas-to-energy optimization	73,514		<1%
5.1.1 Biogas-to-Energy Optimization	55,397	W2E target 20%	2%	Biogas-to-Energy Optimization	73,514	W2E target 60%	<1%
5.2 Water conveyance pump improvements	5		<1%	Cooling - municipal (existing)	17		<1%
5.2.1 Water conveyance pump efficiency	0	Efficacy Target 60%	0%	Water delivery loss reduction	7,145	Efficacy Target 80%	<1%
5.3 Water delivery loss reduction	1,979		<1%	Water delivery loss reduction	7,022		<1%
5.3.1 Water delivery loss reduction	1,979	NRW Target 16%	<1%	Water delivery loss reduction	7,022	NRW Target 10%	<1%

6. Transportation	**83,209**		**4%**	**Transportation**	**7,74,554**		**10%**
6.1 Low-carbon urban design	790		<1%	Low-carbon urban design	15,676		<1%
6.1.1. Passenger trip reduction	790	Trip Reduction Target 10%	<1%	Passenger trip reduction	15,676	Trip Reduction Target 10%	<1%
6.2 Passenger mode shift	26,261		1%	Passenger mode shift	3,17,957		<1%
6.2.1 Passenger mode shift	26,261	Public Transport 10%	1%	Passenger mode shift	3,17,957	Public Transport 40%	4%
6.3 Vehicle fuel switch	56,158		3%	Vehicle fuel switch	4,40,920		5%
6.3.1 Vehicle fuel switch	56,158	10% private automobiles fleet electrified 5% light duty freight CNG and 100% buses electrified	3%	Vehicle fuel switch	4,40,920	50% private automobiles fleet electrified 20% light duty freight CNG and 100% buses electrified	5%
Total	**22,31,166**			**Total**	**80,86,328**		

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ABOUT WRI INDIA

WRI India, an independent charity legally registered as the India Resources Trust, provides objective information and practical proposals to foster environmentally sound and socially equitable development. Our work focuses on building sustainable and liveable cities and working towards a low carbon economy. Through research, analysis, and recommendations, WRI India puts ideas into action to build transformative solutions to protect the earth, promote livelihoods, and enhance human well-being. We are inspired by and associated with World Resources Institute (WRI), a global research organization. Know more: www.wri-india.org

Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to inform government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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