ADVANCING CITY CLIMATE ACTION IN MADHYA PRADESH

Towards a low-carbon, climate-resilient **INDORE**

Indore City Climate Action Plan

DISCLAIMER

This document is prepared by WRI India in partnership with Environmental Planning & Coordination Organisation (EPCO), Department of Environment, Government of Madhya Pradesh to support Indore city in developing its Climate Action Plan. The data and information used for preparing this report have been sourced from Indore city, State Government departments, published sources of Government of India, etc. While due care has been taken to ensure authenticity of the data and other information used, any error in their accuracy or interpretation is absolutely unintentional.

About WRI India
WRI India is a research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Design credits: Manasi Nandakumar (*Senior Communications Associate, WRI India*) and Ronak Naik

Image credits: Office of Hon'ble Mayor, Indore

GULSHAN BAMRA (IAS)
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Preface

No evidence is required to prove that climate is changing and that too because of increased human activities which have serious repercussions on economic development and natural resource management. Various recent extreme weather events in Madhya Pradesh, urban flooding, and untimely rains have shown that developing localised mitigation and resilience strategies is the need of the hour.

Paris Agreement 2015 and Glasgow Pact 2021 have shown the commitments from the international communities for reducing or mitigating GHG emissions, however to resolve this global issue, there lie the local solutions at sub-national level, district level and city level. Hon'ble Prime Minister of India has also launched the LiFE Movement which emphasizes on change in the lifestyle and behavioural patterns of living. He has stressed on reduce, reuse and recycle concepts as also on the circular economy to be an integral part of our lifestyle and for sustainable development. Concept of inclusivity is also very much integrated with this movement.

We in Madhya Pradesh are also committed to addressing the challenge of climate change in order to pursue the state's development goals in a sustainable manner.

Taking the cue from Ministry of Housing & Urban Affairs (MoHUA) as part of Climate Smart Cities Assessment Framework, the preparation of Climate Action Plans (CAPs) of all the 7 smart cities of MP by State Knowledge Management Centre on Climate Change (SKMCCC), EPCO and WRI India are steps towards making the local authorities equipped with strengths for tackling the challenge of climate change. The city level GHG inventorisation also helps in quantifying the actions to reduce the CO_2 emissions and offsetting the current emissions.

The City level Climate Action Plans (CAPs) for all the 7 smart cities have been drafted after wide consultations and participation with city experts so as to bring all the stakeholders on board and make their say.

I appreciate the efforts of EPCO and WRI India for taking the lead in preparing the City level Climate Action Plans.

These CAPs have flagged important issues which require attention and are expected to be implemented by the local authorities & SPVs.

(Gulshan Bamra)

MUJEEBUR REHMAN KHAN (IAS)
EXECUTIVE DIRECTOR

Environmental Planning &
Coordination Organisation

Foreword

As extreme weather events unfold across the globe, the climate crisis has reached our doorstep. While India is on track to achieve the Nationally Determined Contributions, the State of Madhya Pradesh (MP) is determined to lead India's fight against this impending crisis by policy-governance reforms and inculcating a climate action culture in the society. With MP's complex urban challenges and increasing climate risks and disasters, sustained actions ensuring cities to prepare for and develop the ability to thrive in the varying climate is crucial. In MP, the rising urban population has created a reason to be concerned about climate change, and therefore the interventions at the city level are deemed important.

In this connection, the Climate Smart Cities Assessment Framework (CSC-AF) issued by Ministry of Housing & Urban Affairs (MoHUA) plays an important role in devising the appropriate actions to keep our cities safe from the adverse impacts of climate change. This brings an opportune time to integrate the concerns of climate change into our on-going program & policies and achieve the goal of low carbon development with inclusive growth.

It has been a very good opportunity for EPCO to join the LiFE movement launched by Hon'ble Prime Minister of India during Glasgow CoP. All the concepts of LiFE have been tried and addressed in the cities while developing the plans.

It is also important for us to develop well researched strategies specific to the cities to respond effectively to the possible impacts of climate change. To address these challenges, City level Cimate Action Plans (CAPs) have been developed by State Knowedge Management Centre on Climate Change, EPCO in association with WRI India. The CAPs have highlighted key concerns and strategies for actions as per the indicators outlined in the CSCAF.

I would like to acknowledge the efforts of EPCO professionals and WRI India team for their commendable work. I would also like to extend my gratitude towards UADD, all the SPVs and other stakeholders for extending their support to formulate these plans and providing necessary data and information to make these plans more robust.

(Mujeebur Rehman Khan)

Acknowledgements

Environmental Planning and Coordination Organization (EPCO) is grateful to Mr. Gulshan Bamra, Principal Secretary, Government of Madhya Pradesh, Environment Department; Mr. Mujeebur Rehman Khan, Executive Director EPCO; and other team members from EPCO for their continuous support and guidance at various stages of developing the inclusive-climate action plan for Indore city.

We extend gratitude to Commissioner, Urban Administration and Development Department (UADD) for facilitating the plan development process and providing necessary guidance. We also are grateful to Commissioner, Indore Municipal Corporation and Chief Executive Officer of Indore Smart City Development Corporation Limited for constant support in providing valuable city level inputs and facilitating data collection across all departments and parastatal agencies. We would also like to thank all officers and city experts from concerning line departments and external agencies who contributed to the development and refinement of this plan through timely provision of data and valuable insights during stakeholder consultations.

EPCO would like to thank World Resources Institute (WRI) India, especially Mr. Madhav Pai, CEO, Dr. OP Agarwal, Senior Advisor and Former CEO, Ms. Ulka Kelkar, Director Climate Program for providing technical support to EPCO and Indore city, which played a key role for developing this plan.

We would also take this opportunity to appreciate the efforts made by the study team Mr. Saransh Baipai, Mr. Prateek Barapatre, Ms. Ramya MA, Ms. Faiza Solanki and Ms. Avni Agarwal for providing their expertise to assist in the research and development of the climate action plan.

Lastly, we would like to thank the internal reviewers from WRI India including Ms. Marie Duraisami, Ms. Sumedha Malaviya, Mr. Dhilon Subramanian, Ms. Azra Khan, Ms. Chaitanya Kanuri and Ms Sahana Goswami for providing valuable feedback to strengthen the sectoral strategies in the plan.

(Lokendra Thakkar)

Coordinator,
State Knowledge Management
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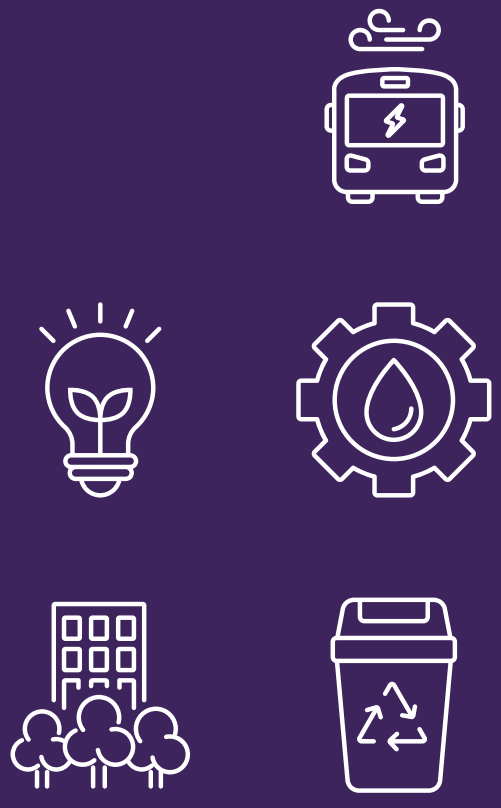

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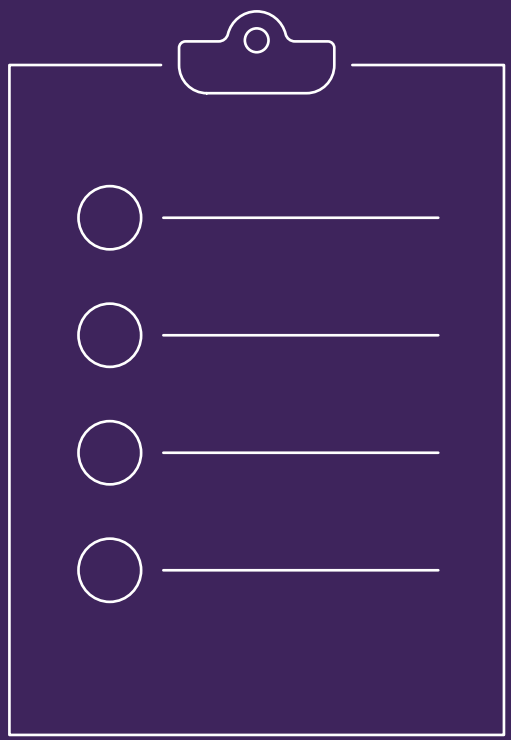
Abbreviations

ABD	Area-Based Development
ADB	Asian Development Bank
AI	Artificial Intelligence
AICTSL	Atal Indore City Transport Service Limited
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BESCOM	Bangalore Electricity Supply Company Limited
BPCL	Bharat Petroleum Corporation Limited
BRTS	Bus Rapid Transit System
CBWTF	Common Biomedical Waste Treatment Facility
CEO	Chief Executive Officer
CETP	Common Effluent Treatment Plant
CIRIS	City Inventory Reporting and Information System
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
COP	Conference of Parties
COVID	Coronavirus Infectious Disease
CREDAI	Confederation of Real Estate Developers' Associations of India
CSCAF	Climate Smart Cities Assessment Framework
DCR	Development Control Regulations
DEWATS	Decentralized Wastewater Treatment Systems
DISCOM	Distribution Company
DPR	Detailed Project Report
ECBC	Energy Conservation Building Code
EESL	Energy Efficiency Services Limited
EIA	Environment Impact Assessment
EPCO	Environmental Planning and Coordination Organization
EV	Electric Vehicle
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
FAR	Floor Area Ratio
FSI	Forest Survey of India
FY	Financial Year
G20	Group of Twenty
GDCR	General Development Control Regulations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GI	Green Infrastructure
GPC	Global Protocol for Community-scale Greenhouse Gas Emissions
GoMP	Government of Madhya Pradesh
GRIHA	Green Rating for Integrated Habitat Assessment
HPCL	Hindustan Petroleum Corporation Limited
ICT	Information and Communication Technology
IDA	Indore Development Authority
IGBC	Indian Green Building Council
IMC	Indore Municipal Corporation
INR	Indian Rupee
IOCL	Indian Oil Corporation Limited
IPT	Intermediate Public Transport
ISCDCL	Indore Smart City Development Corporation Limited
IT	Information Technology
ITS	Intelligent Transportation System
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
kW	Kilowatt
Kl	Kilo liters
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LPG	Liquefied Petroleum Gas
MLD	Millions of Liters per Day
MoHUA	Ministry of Housing and Urban Affairs
MP	Madhya Pradesh
MPKVVCL	Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited
MPPCB	Madhya Pradesh Pollution Control Board
MP PHED	Madhya Pradesh Public Health Engineering Department
MRV	Monitoring, Reporting and Verification
MSME	Micro, Small and Medium Enterprises
Mt	Metric Tons
MUDRA	Micro Units Development and Refinance Agency Limited
MW	Megawatt
$mtCO_2e$	Million Tons of Carbon Dioxide Equivalent

NDC	Nationally Determined Contribution
NE	Northeast
NMC	Nagpur Municipal Corporation
NMT	Non-Motorized Transport
NMV	Non-Motorized Vehicle
NRW	Non-Revenue Water
OCEMS	Online Continuous Emission Monitoring System
OMC	Oil Marketing Companies
PHED	Public Health Engineering Department
PM	Particulate Matter
PMAY	Pradhan Mantri Awas Yojana
PNG	Piped Natural Gas
PPP	Public Private Partnership
PT	Public Transport
PV	Photo Voltaic
RCP	Representative Concentration Pathways
RE	Renewable Energy
RWH	Rainwater Harvesting
SAPCC	State Action Plan on Climate Change
SCM	Standard Cubic Meter
SDG	Sustainable Development Goal
SKMCCC	State Knowledge Management Centre on Climate Change
SPV	Special Purpose Vehicle
STP	Sewage Treatment Plant
SW	Southwest
TOD	Transit-Oriented Development
TCO_2e	Tons of Carbon Dioxide Equivalent
T & D	Transmission and Distribution
TPD	Tons per Day
UJALA	Unnat Jyoti by Affordable LEDs for All
UK	United Kingdom
ULB	Urban Local Body
UNFCCC	United Nations Framework Convention on Climate Change
URDPFI	Urban and Regional Development Plans Formulation and Implementation Guidelines
US	United States
VCS	Verified Carbon Standard
WRI	World Resources Institute
WTP	Wastewater Treatment Plan
ZCB	Zero Carbon Building

EXECUTIVE SUMMARY



Indore and its Vulnerability to Climate Change

Indore is the largest city and commercial hub of Madhya Pradesh, prominent for sectors such as engineering, pharmaceuticals, food processing and textiles. Situated on the Malwa Plateau, Indore is a water-stressed city, facing frequent drought, heatwaves, and floods. Indore faces high vulnerability in terms of water resources, estimated using indicators such as water availability, crop water stress, and extreme events of flooding and drought. It has a higher baseline vulnerability value for drought. A study highlighted Indore as one of India's cities that would face acute water risk due to water stress and population growth[1], and called for urgent measures to enhance its resilience to climate-related risks. According to the climate change vulnerability assessment of Madhya Pradesh done by EPCO, the variability of rainy days in Indore is greater in July and August, and these two monsoon months show a decreasing trend during the period 1951-2018. The maximum temperature in April and May shows a significant increasing trend with sharp heat waves.

Given the challenges faced by Indore city and the back-drop of the Smart Cities Mission, the Ministry of Housing and Urban Affairs (MoHUA) has initiated the Climate Smart Cities Assessment Framework (CSCAF) for smart cities. The framework aims to provide a roadmap for cities to combat climate change through mitigation and adaptation measures, while planning their development actions and policies. It is made up of 28 indicators across five sectors, viz. Energy and Green Buildings, Urban Planning, Green Cover and Biodiversity, Mobility and Air Quality, Water Resource Management, and Waste Management. By taking appropriate measures, cities can make a significant contribution to mitigating climate change and become resilient to its impacts. Indore has been amongst the top nine performing cities under the CSCAF, scoring particularly well on sanitation.

In this context, WRI India is providing technical support to EPCO, and the Madhya Pradesh State Government Departments of Environment and Urban Development & Housing. This includes planning adaptation and mitigation strategies and building city climate action plans (CAP) for Indore and other cities. These climate action plans are informed by the GHG emissions profile and vulnerability assessment of each city. They identify gaps through a review of data submitted by cities under the CSCAF and identify key entry points in terms of recommendations to achieve the cities' sectoral priorities through a low-carbon and climate-resilient pathway. The CAP action points address future climate risks across five thematic areas. The CAP also proposes an institutional framework which is necessary to implement the recommendations outlined in the plan.

Climate Action Planning Process

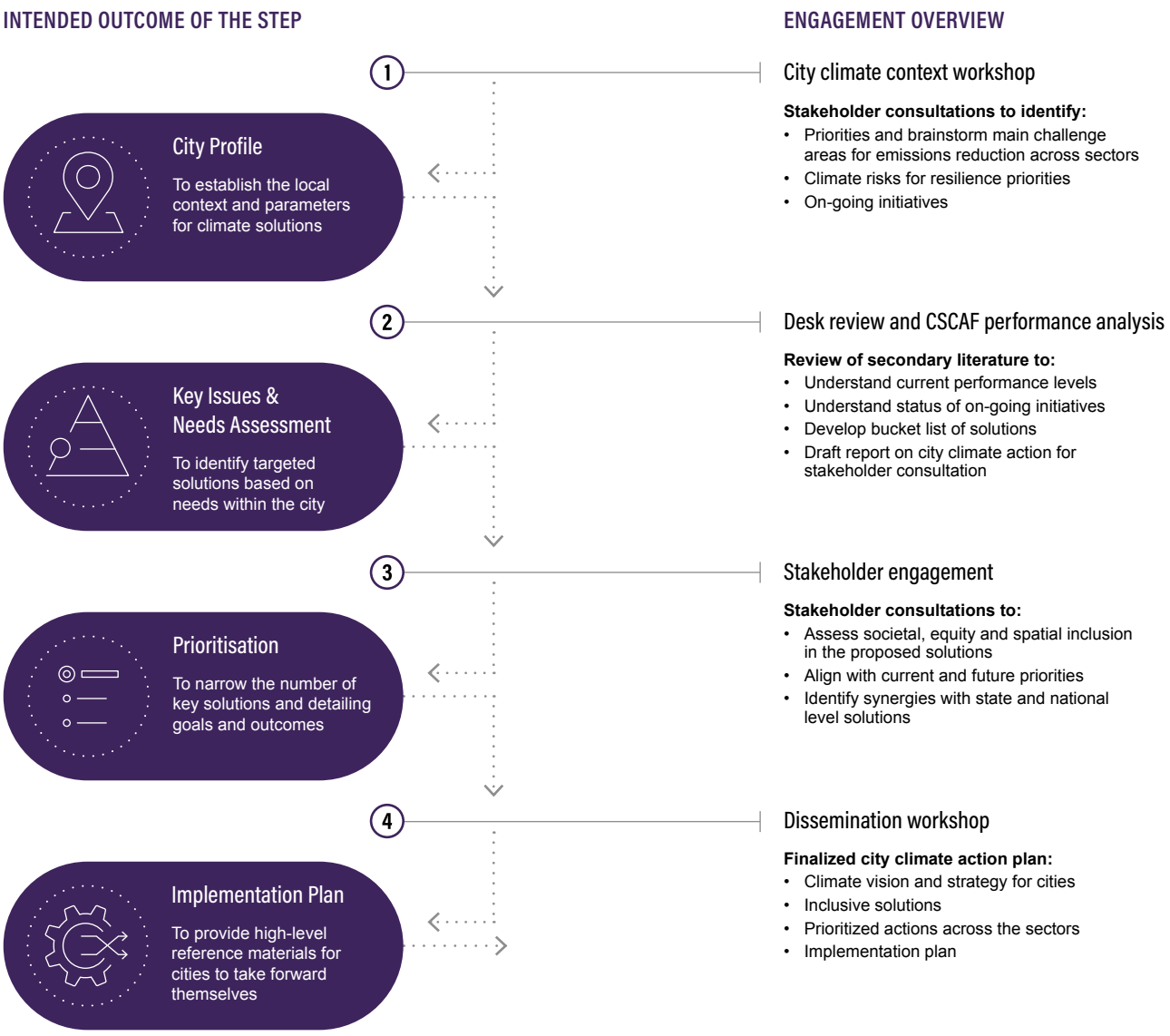
WRI India adopted a four-pronged approach in the entire process of preparing the CAP as illustrated in the figure below.

- A planning-cum-launch workshop was organized in Bhopal on 20 February 2020, with participation from state and city officials, academicians, and civil society organizations. The idea of the workshop was to apprise participants of the importance and relevance of developing city-level plans, to brainstorm and identify prominent development challenges and key climate risks in urban areas in MP, and to understand ongoing initiatives in order to establish a local context for climate solutions.
- This was followed by an extensive desk review of the smart city proposal to identify the vision and key sectoral priorities for Indore city. A thorough review of submissions made by Indore Smart City Development Corporation Limited as a part of CSCAF, sectoral plans, government reports and other documents was done to identify key issues and gaps in achieving the sectoral priorities. A detailed climate profile of Indore city was developed, including temperature and rainfall projections, baseline and projected GHG inventory, and a climate vulnerability assessment. This helped identify future climate risks and potential areas for reduction of GHG emissions. The review and analysis led to the development of a list of sectoral goals and actions, which are enumerated in the climate action plan.

[1] In 'Smart City' Indore, some are more equal than others when it comes to accessing water, *Science The Wire, 2020*

- As the next step, in order to facilitate holistic brainstorming on key priorities and sectoral actions, a stakeholders' consultation workshop was organized in Indore in September 2021. City officials, sectoral experts and civil society representatives participated, and provided feedback on the preliminary sectoral findings on key priority areas, as well as inputs on the goals and actions proposed for Indore to adopt a low-carbon and climate-resilient development pathway.
- The final CAP provides prioritized sectoral actions along with an implementation plan and CAP governance mechanism for effective coordination and monitoring of implementation.

ES Figure 1: CAP development process *(Source: WRI India)*



Baseline Assessment

As highlighted in Step 2 of the CAP planning process, a climate profile for the city was developed using analysis from the CSCAF along with an emissions inventory and vulnerability assessment of key urban climate risks.

Climate Smart Cities Assessment Framework Analysis for Indore

Indore has been performing well under the CSCAF 2.0, particularly in waste management and urban planning. It ranked as the cleanest city in India for five consecutive years. However, there is scope for improvement in sectors such as energy and green buildings, and water management.

Greenhouse Gas Emissions Inventory

As per the 2019 greenhouse gas emissions inventory prepared for Indore using the CIRIS tool, as per GPC standards, total emissions for Indore were 3.6 million tons of CO_2e. Of these, 59% came from stationary energy, 30% from transportation, and 11% from waste management. Per capita emissions were 1.6 tCO_2e (including manufacturing and industrial emissions).

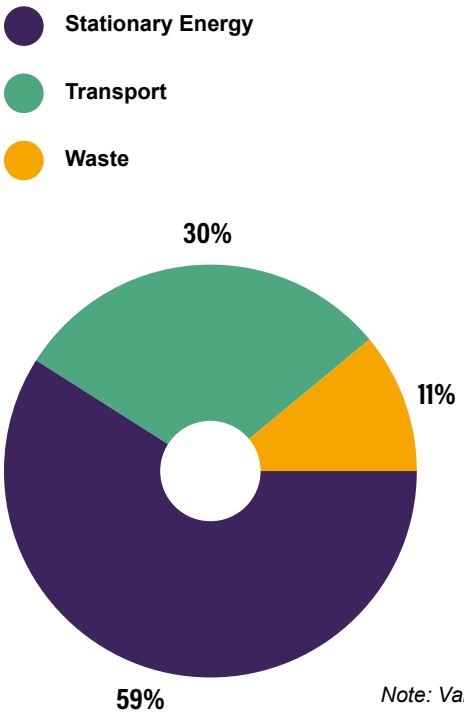
ES Table 1: CSCAF analysis *(Source: CSCAF data from the city)*

Overall Score as per CSCAF 2.0	Energy and Green Buildings	Urban Planning, Green Cover and Biodiversity	Mobility and Air Quality	Water Management	Waste Management
★★★★	★★★	★★★★★	★★★★	★★★	★★★★★
CSCAF 2.0 Score	330.5	404	362	350	581
Current measures being undertaken in the city	• 98% LED streetlights. • The city is promoting adaptive reuse of older buildings. • 65% of terraces of redeveloped buildings to have solar PV. • Pioneering a floating solar funding model	• 20% of the municipal area is under green cover. • Vertical gardens on the rivers / nullah bridges, Miyawaki plantations being implemented.	• 10% of public buses run on low-carbon fuel. • Metro is proposed. • Clear Air Action Plan is in place. • Shared scooter service in the city.	• 629 traditional water supply sources along with wetlands being restored. • City has a water resources management plant and has identified future water demand.	• 100% of door-to-door collection. • 92% of dry waste is recycled • Bioremediation already in practice in Devguradia trenching ground, 550 TPD plant inaugurated in February 2022[2]
Areas of improvement	• Reducing high Transmission and Distribution losses which is currently 24%. • Increasing power generation from RE sources, which is currently 0.8%.	• Inequitable green and open spaces. • Need to integrate green infrastructure within lake redevelopment.	• Augmenting bus fleet and NMT coverage • Improving last-mile connectivity • Increasing uptake of EVs particularly for shared mobility and public transport (10% of buses run on clean fuels)	• Reducing NRW (currently 30%). • Poor access of tap water, 46% as of 2019[3]. • Increasing use of treated water (currently 11% wastewater is recycled)	• Biomedical waste treatment to be made scientific. • Capturing of methane gas from STPs.

[2] PM Modi inaugurates state-of-the-art 550 tons per day capacity Bio-CNG plant set-up by MP Government in Indore, *The Statesman, 2022*

[3] ABD Water Supply & Sewerage Project, *Indore Municipal Corporation, 2019*

ES Figure 2: GHG emissions profile for Indore, 2019 *(Source: WRI India analysis using primary data)*



Note: Values in tons CO_2e

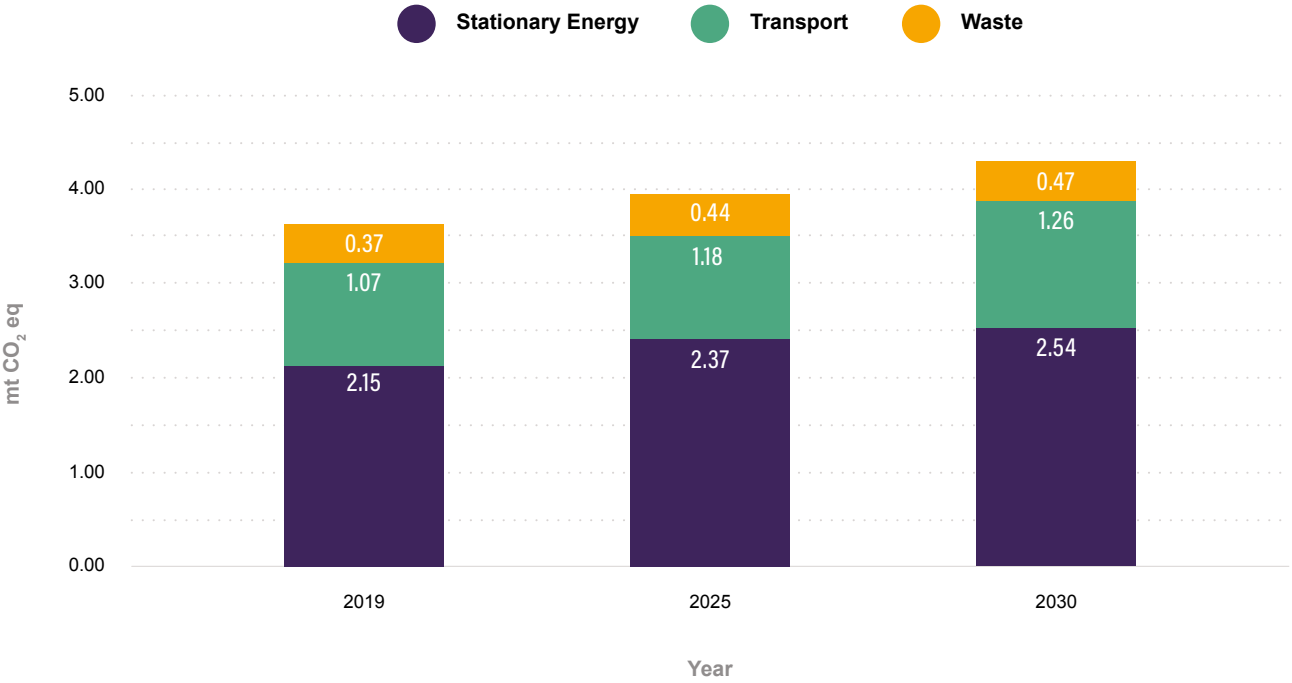
The majority of these emissions comes from energy and electricity use in commercial and institutional buildings, followed by residential buildings. Emissions from electricity consumption account for 57% of total emissions.

The business-as-usual emissions for Indore are projected to increase by 10% by 2025 and 18% by 2030, as compared with baseline emissions in 2019 (see ES Figure 3). Thus, the city urgently needs to implement the measures presented in the report in order to achieve its vision of low carbon and climate-resilient development.

Emissions Scenario Modeling for Indore

An emissions scenario analysis was developed using the Climate Action for Urban Sustainability (CURB) tool, an interactive Excel-based tool designed by the World Bank in partnership with C40 Cities Climate Leadership Group, Global Covenant of Mayors, and AECOM Consulting. It helps cities develop emissions reduction targets for key sectors, assess the investments required, and prioritize low-carbon interventions based on cost, payback period, feasibility and impact on energy consumption and emissions reduction[4].

ES Figure 3: Projected emissions for Indore *(Source: WRI India analysis using primary data)*



[4] CURB tool: Climate Action for Urban Sustainability (Vol.2): User guide, *World Bank, 2020*

This tool was used to develop three main scenarios:

- **Business-as-usual scenario:** This predicts the GHG emissions reduction if no action is taken for mitigation. In this scenario, emissions are expected to rise 1.5 times from 2019 to 2050.

- **Existing and planned scenario:** This scenario uses existing or planned city, regional and national actions, policies, and programs to demonstrate the emissions reductions trajectory for the city until 2050. As per this scenario, the city has the potential to achieve a 44% reduction in emissions by 2050 as compared to the BAU scenario. Key targets include 35% electricity from renewables from 2050, electrifying 40% of 4-wheelers and 2-wheelers and 70% of buses, and achieving a 38% mode share for public transport by 2050.

- **Ambitious scenario:** In most cases, existing and planned policies leave a significant gap in relation to the 1.5°C Paris Agreement and Deadline 2020 trajectory. This scenario analyzes emissions reduction due to actions that are ambitious yet achievable. It can take guidance from proposed projects, state-level targets, etc. The targets were then vetted through stakeholder consultations with city-level experts. In this scenario, the city has a potential to achieve 78% emissions reduction by 2050, mainly due to the increased adoption of rooftop solar, energy-efficient heating and cooling solutions in buildings, and decarbonizing of the electricity grid.

Vulnerability Analysis for Indore

As per the vulnerability analysis for the city, if current trends continue, the mean temperature is expected to increase by 1.3°C by the 2030s and to go up to 2.6°C by 2050. If this trendline continues, the city may see 32 more warm days by 2050, up to 45 more warm nights and an increase in total rainfall up to 22% by 2050.

- Indore's climate varies considerably from year to year, particularly rainfall. Thus, even in the absence of anthropogenic climate change, this Smart City needs to be resilient to this natural variability.

- Records for the Indore region over the last few decades show a clear trend towards higher temperatures and more frequent high temperature extremes.

- Climate projections show a strengthening of the observed temperature trends, particularly with higher GHG emissions, as well as a tendency towards more frequent intense rainfall.

If global warming is restricted to 2°C or less above preindustrial levels, the impacts of climate change would be substantially reduced for Indore, particularly in the second half of the century.

ES Table 2: Climate change and potential risks *(Source: CEEW)*

Projected Climate Changes	Potential Impacts and Risks[5]
Warmer conditions, including more intense and frequent hot extremes and heat wave days	• Human heat stress and other negative health effects, including potential increases in mortality, particularly if air quality also declines. • Increase in water stress and drought-like events. • Negative impacts on labor productivity, particularly on outdoor workers. • Potential increase in demand for air conditioning, which would increase energy consumption. • Increased water stress and high groundwater exploitation.
Higher annual rainfall totals and more frequent heavy rainfall events	• Potential increase in flood risk. • Possible implications for water balance, and the quantity and quality of water resources (also taking into consideration the likely persistence of long dry spells and increased evaporation with warmer conditions).

[5] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*

Goals and Sectoral Strategies

ES Table 3 on the next page summarizes the goals and actions which can help the city become low carbon and climate-resilient while also addressing concerns of inequality and inclusivity in development.

ES Table 3: Summary of goals and actions for Indore *(Source: WRI India)*

Goals	Actions	Outcomes
Goal 1 From water-stressed to water-resilient Indore	• Mandate to use treated wastewater to cool thermal power plants and for other industrial uses • Integrated flood and storm water management plan • Mandate to reuse treated water for urban gardens, parks, and rooftop gardens • Installing smart water meters and implementing a demand management plan for optimal usage of resources • Developing a contingency plan for municipal water supply • Instituting a non-revenue water cell • Implementing green walls in buildings for grey water reuse • Reviving local lakes and ponds, and rejuvenating polluted river stretches though desilting, aquifer recharging and river rejuvenation projects	• Increased access to potable water • Reduced NRW losses, increased flood resistance • Better sewage management • Reduced water distribution costs and more equitable access • Rejuvenation of natural water supply sources
Goal 2 Promoting low-carbon transport and reducing private vehicle usage	• Improving last-mile connectivity of planned metro • Converting i-ride service into electric scooters • Increasing the public transport fleet and incorporating passenger communication initiatives • Initiatives to increase the share of e-vehicles and charging infrastructure for passenger transport • Initiatives to increase the share of e-vehicles and charging infrastructure for freight transport	• Reduced congestion and private vehicle use • Improved public transport infrastructure
Goal 3 People-friendly Indore	• Creating a city-level NMT cell • NMT-focused urban street design guidelines • Reviving Indore's Public Bicycle System, i-bike	• Reduction in GHG emissions from transport • Improved road safety • Improved air quality and access to mobility infrastructure
Goal 4 Transforming Indore into a green city	• Action plan for increasing green cover • Incorporating green infrastructure within lake redevelopment projects	• Improved air quality • Increased carbon sequestration • Lowered flood risk, reduction in urban heat island effect • Increased proportion of green cover • Conservation of biodiversity species

Goals	Actions	Outcomes
Goal 5 Powering Indore through renewables	• Developing a local RE procurement plan • Mandating installation of solar water heaters in new buildings under the municipal area • Increasing the use of solar and CNG in slums • Conversion of municipal buildings into net zero energy buildings • Retrofitting buildings under the Pradhan Mantri Awas Yojana scheme with climate sensitive components • Institutional measures to promote green buildings	• Reduced GHG emissions from buildings • Reduced energy costs and improved access for slum dwellers • Improved air quality and reduced negative health effects • Reduced conventional energy demand and use in buildings • Increased share of RE in buildings
Goal 6 Sustainable waste management in Indore	• Power generation from wastewater • Community compost pits in each zone based on land availability • Introducing incentive-based take back programs for dry waste • Eco-bricks from plastic waste	• Reduced energy costs for sewage treatment • Reduced contamination of water bodies • Improved green cover • Increased participation for waste management

The city authorities can select actions and recommendations provided in this plan to develop a detailed implementation plan for pilot projects that can be rolled out in the short, medium, and long term. The city's GHG emission profile included in the plan may be used as a guide to prioritize the implementation of actions in different sectors. The plan also provides guidance on mainstreaming actions in existing policies, schemes, and programs to facilitate the convergence of implementation.

Lastly, this plan must be treated as a dynamic document, and must be updated periodically with the latest emissions profile of the city. Instituting a climate change cell at the city level with representation from relevant ULB departments, Smart City, citizen forums, academic institutions, and civil society is necessary to lead and coordinate this process. Organizing periodic stakeholder consultations would help strengthen the plan as the city's requirements evolve.

INTRODUCTION

Cities are significant contributors to climate change and are also vulnerable to its consequences. By taking appropriate measures, cities can make a significant contribution to mitigating climate change and can become resilient to its impacts. State Action Plans for Climate Change (SAPCCs) are the primary policy documents guiding climate actions at the sub-national level, and city-level climate actions must be in synergy with them. The actions that cities take would not only help India meet its international commitments in the form of NDCs but also help the country achieve its SDGs.

In this context, World Resources Institute India has partnered with the State Knowledge Management Centre on Climate Change, EPCO, Department of Environment, Government of Madhya Pradesh, to support the state's Department of Urban Development and Housing and seven smart cities to build capacity to plan adaptation and mitigation strategies and to create a city climate action plan in line with the Climate Smart Cities Assessment Framework launched by Government of India's Ministry of Housing and Urban Affairs.

Vision of Indore Climate Action Plan

The Indore Climate Action Plan envisions a world-class city of the future – a vibrant, equitable city, strengthened through its diversity; a city that provides real quality of life; a city that provides sustainability for all its citizens; a low-carbon, climate-resilient and adaptive society. The role of the Indore City Climate Action Plan is about more than reducing negative effects on the environment; it is about making holistic improvements to Indore's community and way of life.

Taking cues from the risks that climate change presents to future generations in the city, the CAP recognizes that actions must be taken on a priority basis for six goals to provide community benefits in the following areas:

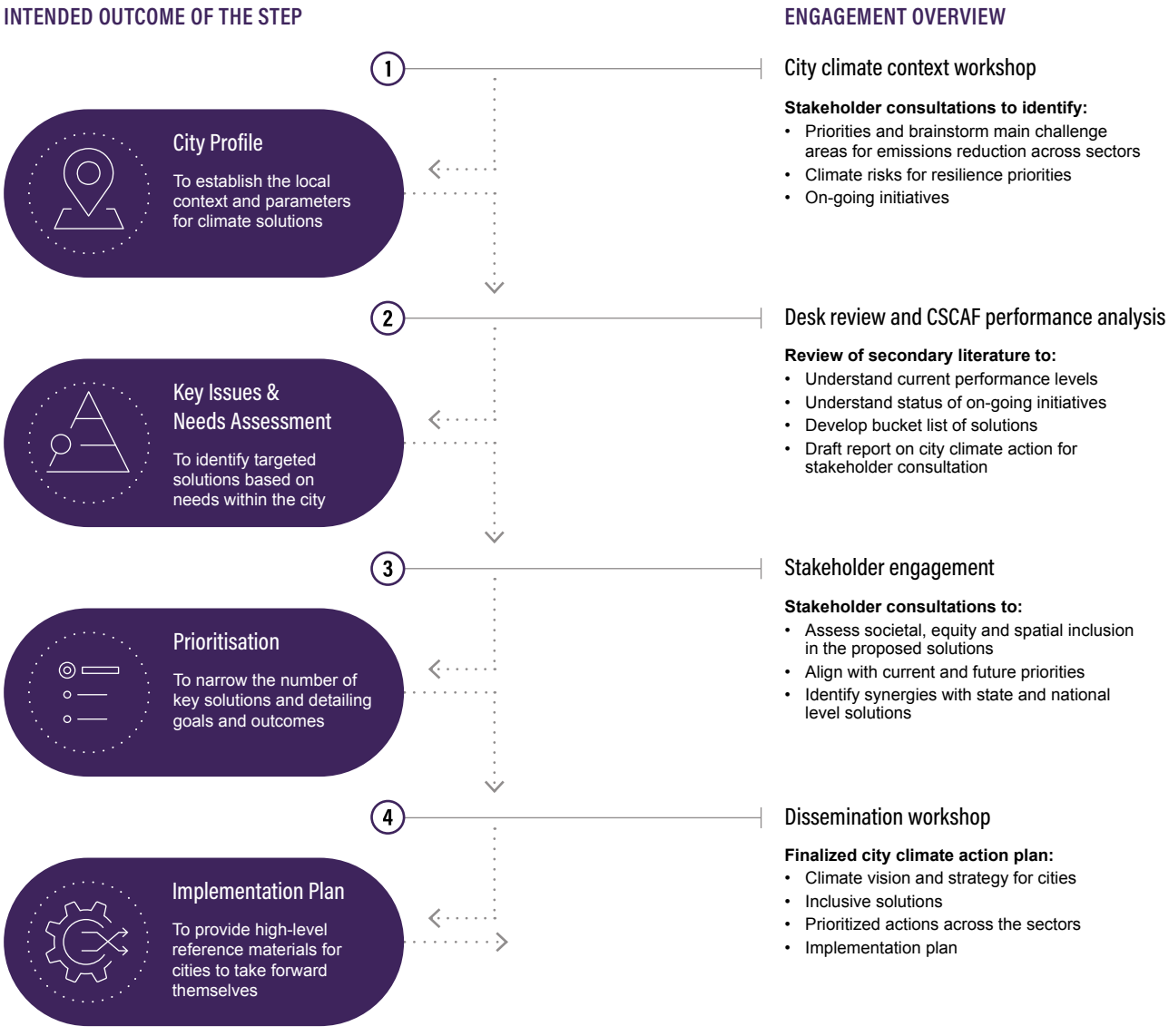
Figure 1: Vision for Indore *(Source: WRI India)*

Climate Action Planning Process

WRI India adopted a four-pronged approach to prepare the CAP, as illustrated in Figure 2.

- To kick-start the process of developing the CAP, a planning-cum-launch workshop was organized in Bhopal on 20 February 2020 with participation from state and city officials, academicians, and civil society organizations. The idea was to apprise the participants of the importance and relevance of developing city level plans, to brainstorm and identify prominent development challenges and key climate risks in urban areas in MP, and to understand ongoing initiatives and establish a local context for climate solutions.
- This was followed by an extensive desk review of the Smart City proposal to identify the vision and key sectoral priorities of Indore city. A thorough review of submissions made by Indore as part of CSCAF, sectoral plans, government reports and other documents was done to identify key issues and gaps in achieving sectoral priorities. A detailed climate profile of Indore city was developed, which included temperature and rainfall projections, baseline and projected GHG inventory. The climate vulnerability assessment carried out by EPCO has been referred to identify future climate risks and a scenario modeling exercise was conducted to identify potential areas for

Figure 2: CAP development process *(Source: WRI India)*



reduction of GHG emissions in the short and long term. This review and analysis helped in drawing up a list of sectoral goals and actions which are outlined in the climate action plans.

- As the next step, in order to narrow the number of sectoral actions and to detail goals and outcomes, a stakeholders' consultation workshop was organized in Indore in September 2021, with participation from city officials, sectoral experts and civil society representatives, to present the preliminary findings and seek inputs on the goals and actions proposed for Indore to adopt a low-carbon and climate-resilient development pathway. These consultations also provided inputs for bringing inclusion principles to the actions, and for aligning actions with the current and future priorities of Indore city as well as with state and national programs.

- The final CAP outlines prioritized sectoral actions, an implementation plan and a governance mechanism for effective coordination and monitoring of implementation of the CAP.

CITY PROFILE

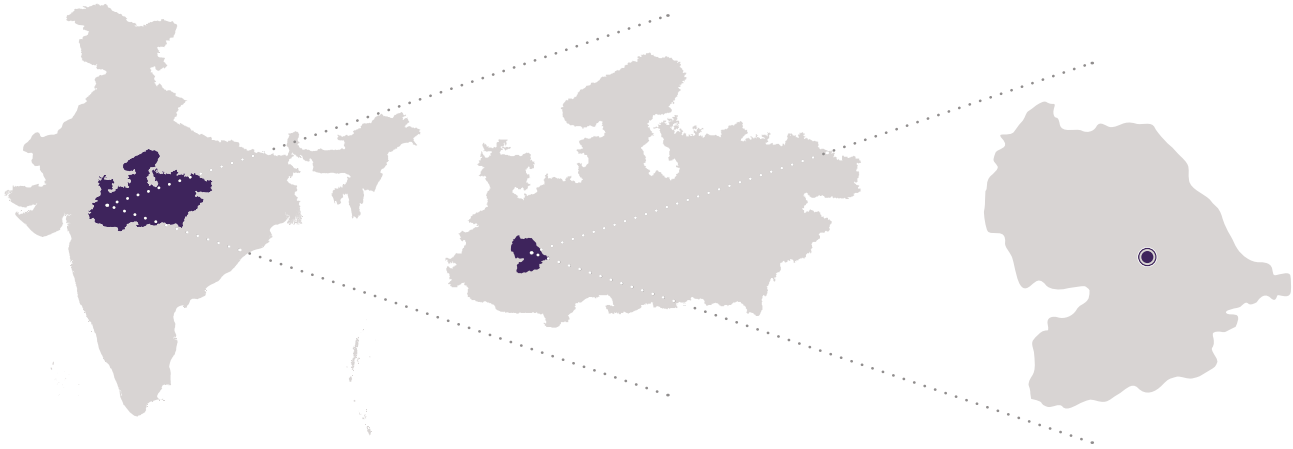
Indore is in western Madhya Pradesh (approx. 76° E, 23° N), on the southern edge of the Malwa plateau, on the Saraswati and Kanh rivers, which are tributaries of the Kshipra River. The average elevation of Indore is 553 meters above mean sea level. It is located on an elevated plain, with, the Vindhya range to the south. The two main rivers are Chambal to the west (which originates from the Vindhya range south of Mhow) and Kshipra, a tributary of Chambal, to the east. Other small rivers include Gambhir and Kanh[6].

Indore has been shortlisted for the implementation of smart solutions in the first phase of the Smart Cities Mission on the basis of its Smart City Proposal (SCP).

It is the largest city in Madhya Pradesh by population and GDP, and the state's commercial capital. It accounted for around 6.8% of the state's GDP in FY 2016-17[7]. It is well connected with the rest of India by road, rail, and air transport services. Indore is also a tourist destination and is thus well connected with proper regional transport channels[8].

The city's economic priorities are expanding and include both traditional agro-industries and modern corporate and IT companies. With the flourishing of Indore's economy, a number of management and engineering schools have been opened in the city in order to meet the growing demand for professionals[9].

Figure 3: Map of Indore (*Source: WRI India*)



Demography

The city primarily has a young demographic due to the presence of premier educational institutions (46%) and sees migration from surrounding rural areas due to the excellent overall quality of life and moderate cost of living (about 15-20% lower as compared to the metros).

The population of Indore city increased from approximately 1.5 million to almost 2 million between 2001 and 2011. The decadal growth rate of 32.4% during that period is higher than the state figure of 20.3%. As Figure 4 below shows, population growth has been the highest in the last decade, indicating inward migration due to economic opportunities in the city.

As per the data provided by Indore Smart City, the population of the city was 2.57 million in 2020. The city area is 505.35 sq. km., and the municipal area is 276.80 sq.km., making Indore a densely populated city, with around 5,092 people per sq. km. Demographic indicators based on last two census rounds are presented in Table 1.

[6,9] Introduction, *Smart City Indore Portal*

[7] Estimates of District Domestic Product, Directorate of Economics & Statistics, *GoMP, 2019*

[8] Linkages, Connectivity and Excursions, *Smart City Indore Portal*

Figure 4: Population growth in Indore from 1981-2020 *(Source: Census of India)*

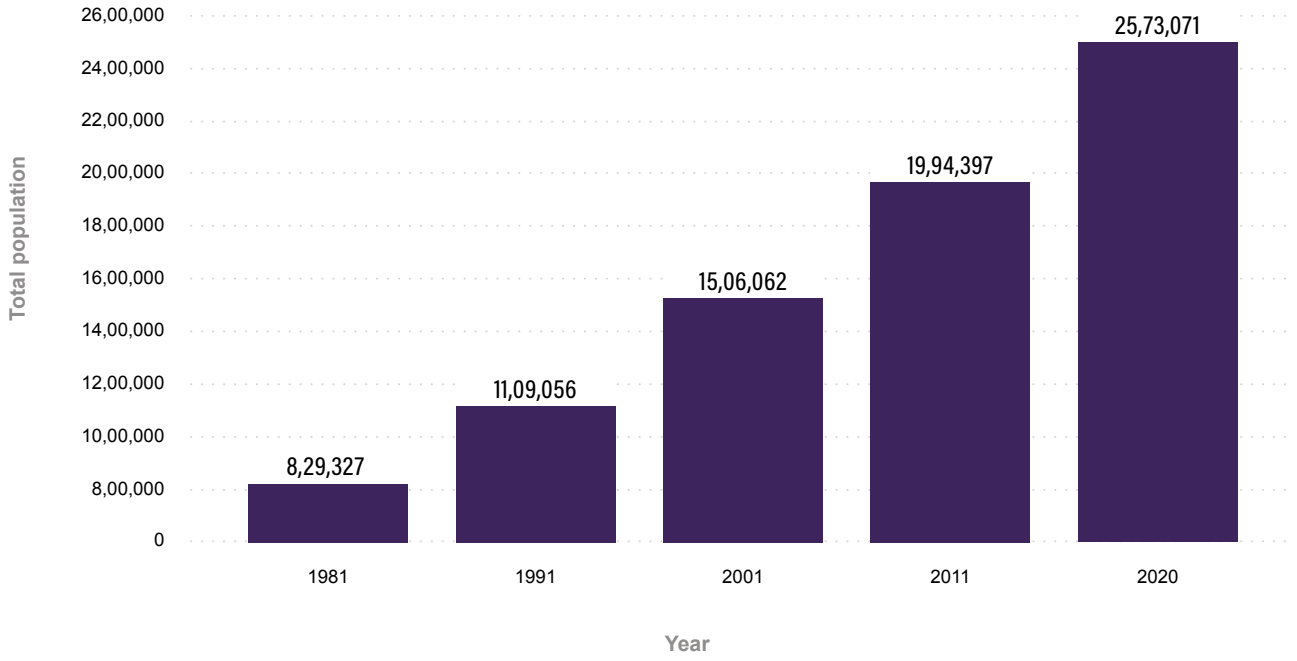


Table 1: City statistics *(Source: Census of India)*

Particulars	2001[10]			2011[11]		
	Total	Males	Females	Total	Males	Females
Population	1,506,062	790,840	715,222	1,994,397	1,035,912	958,485
Literates	1,081,021	608,072	472,949	1,503,842	817,237	686,605
SC Population	209,101	108,601	100,500	310,080	160,035	150,045
ST Population	39,658	21,509	18,149	54,217	2,860	25,610
Total Workers	282,586	396,735	76,822	725,271	571,144	154,127
Number of Households	282,586			405,090		
Slum Households	77,064 (27.27% of total households)			114,048 (28.15% of total households)		

[10] District Census Handbook: Part A&B, Indore District, *Census of India, 2011*

[11] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*

Climate Profile

Indore is located in Central India and has a moderately extreme climate. During winter (Nov-Feb), the night low temperature is around 10°C while in summer (April-June) the days are hot, with temperatures ranging between 35°C and 40°C. The peak summer (May) daytime temperature sometimes reaches 45°C. Due to Indore's location on the southern edge of the Malwa Plateau, however hot the day, evening brings a cool and pleasant breeze, referred to as 'Shab-e-Malwa'.

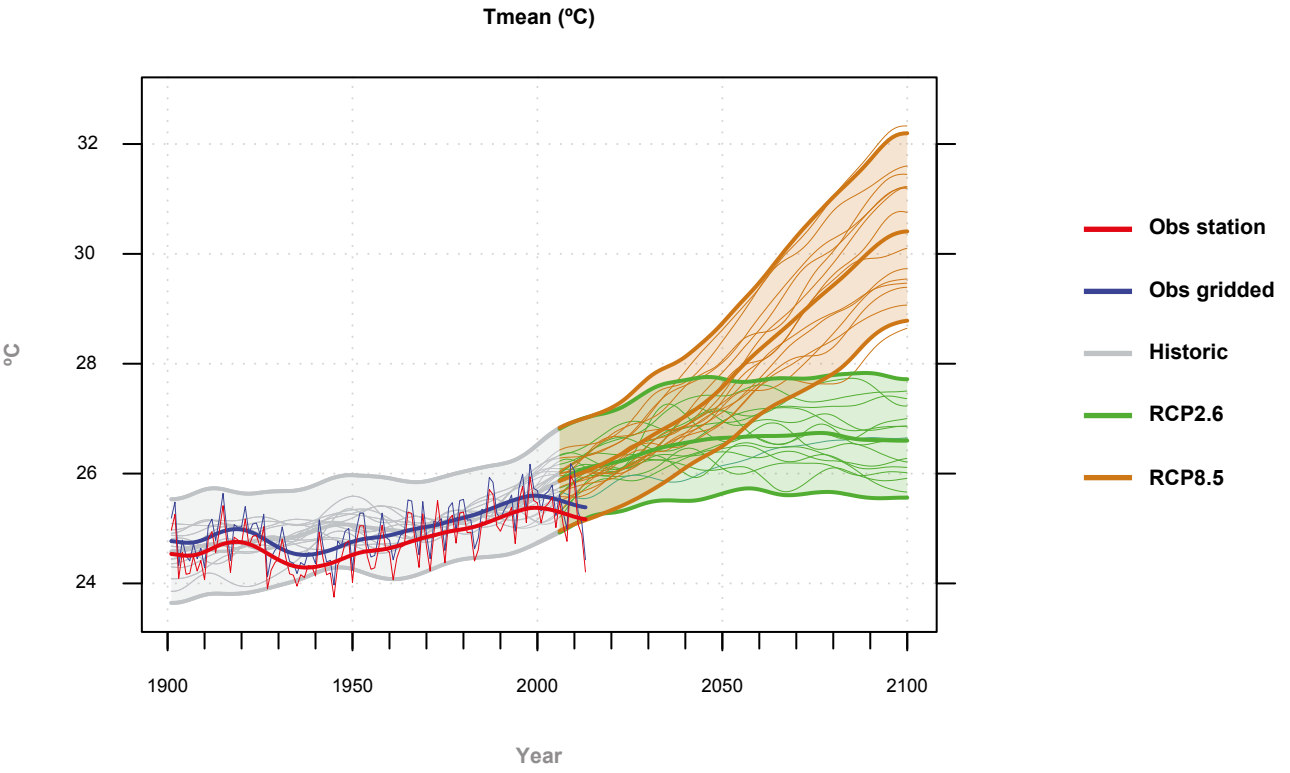
Indore is in the catchment area of the river Chambal. It receives the majority of its rainfall through the south-west monsoon. It is in the rain shadow of the Western Ghats, which indicates that the city's climate is semi-arid. The mean monsoon seasonal total rainfall in Indore is around 810 mm. The number of rainy days (a day with rainfall of 2.5 mm or more) varies from 9 to 14 in the monsoon months. The city receives more rain in July and August than in other months, with a good number of rainy days. In this season, Indore generally receives more than 900 mm of rainfall for more than 45 days.

Temperature

Both observations and simulations show an upward trend in mean annual temperature. In a high-emissions scenario, this trend is projected to continue until the end of the century, with a rise of 4.3°C on average from 1981-2010 to 2071-2100. If emissions decrease rapidly, this rise is limited to about 1.1°C on average[12].

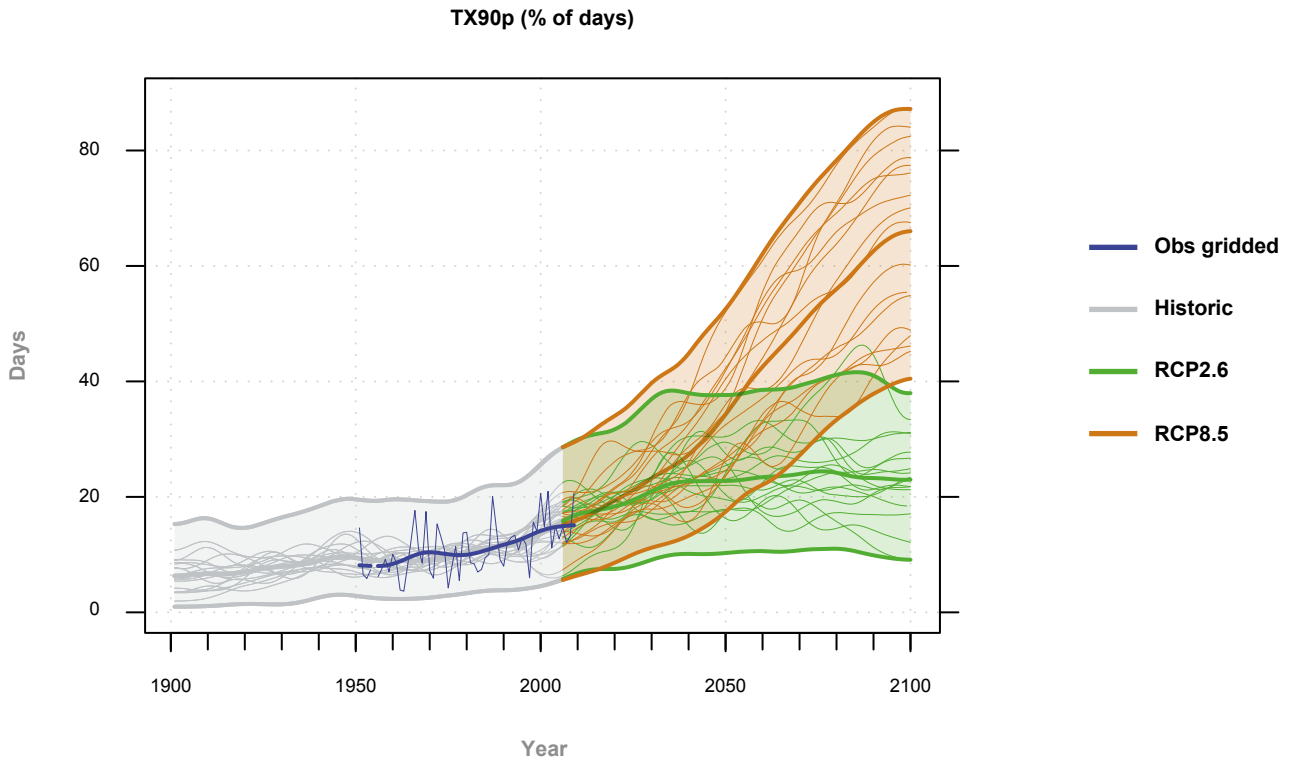
The observations and simulations consistently indicate more high temperature extremes (warm days and warm nights, days of heat wave) and fewer cold temperature extremes (cold days and cold nights, days of cold wave). The number of warm days (shown in Figure 5), for example, is projected to increase by about 50 days on average from 1981-2010 to 2071-2100 in a high-emissions scenario (RCP 8.5), and the number of heat wave days is projected to increase by around 170 days on average. If emissions decrease rapidly (RCP 2.6), the increase in warm days is limited to about 10 days on average (and the rise in heat wave days is about 30 days on average[13].

Figure 5: Increase in mean temperature for Indore *(Source: CEEW)*



[12, 13] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*

Figure 6: Increases in temperature extremes for Indore *(Source: CEEW)*



Rainfall

The observations are dominated by large decade-to-decade and year-to-year variability. The simulations show a general tendency towards increasing total annual rainfall, although variability is large. In a high-emissions scenario, total annual rainfall is projected to increase by about 15% (about 150 mm) on average from 1981-2010 to 2071-2100. If emissions decrease rapidly, this rise is limited to about 70 mm on average[14].

The observed record of heavy rainfall events tends to be dominated by decade-to-decade and year-to-year variability. For the projections there is a tendency towards more frequent heavy rainfall events. The number of days per year with rainfall greater than 20 mm (shown in Figure 7, for example, is projected to increase by about 7 days on average from 1981-2010 to 2071-2100 in a high-emissions scenario. Some models indicate increases well outside the range of observed variability, indicating an even greater increase in risk. On the other hand, the number of consecutive dry days shows little change (even with a slight increase in emissions) from an average of about 125 days, with continuing large year-to-year variability[15].

Table 2 shows the projected changes in 30-year averages, with respect to a present-day baseline of 1981-2010, for the '2030s' (2021-2050), the '2050s' (2035-2064) and the '2080s' (2071- 2100). The average of gridded observations is also shown for 1981-2010.

The average change is shown in each case, together with an indication of the uncertainty range across the models (the 90% range). For temperature, the lower end of the range is always positive, indicating a robust pattern of change towards higher temperatures. For rainfall, the lower end of the range is almost always negative, with larger positive changes at the upper end of the range. This indicates greater uncertainty in both the direction and magnitude of rainfall change than in the case of temperature.

For the 2030s and 2050s, only projections for the higher RCP 8.5 emissions scenario are given. There is very little difference between the two scenarios for the next couple of decades. By the 2080s, changes under the lower RCP 2.6 emissions scenario (last column) are considerably reduced compared with the high-emissions scenario.

[14, 15] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*

Figure 7: Increases for mean precipitation for Indore *(Source: CEEW)*

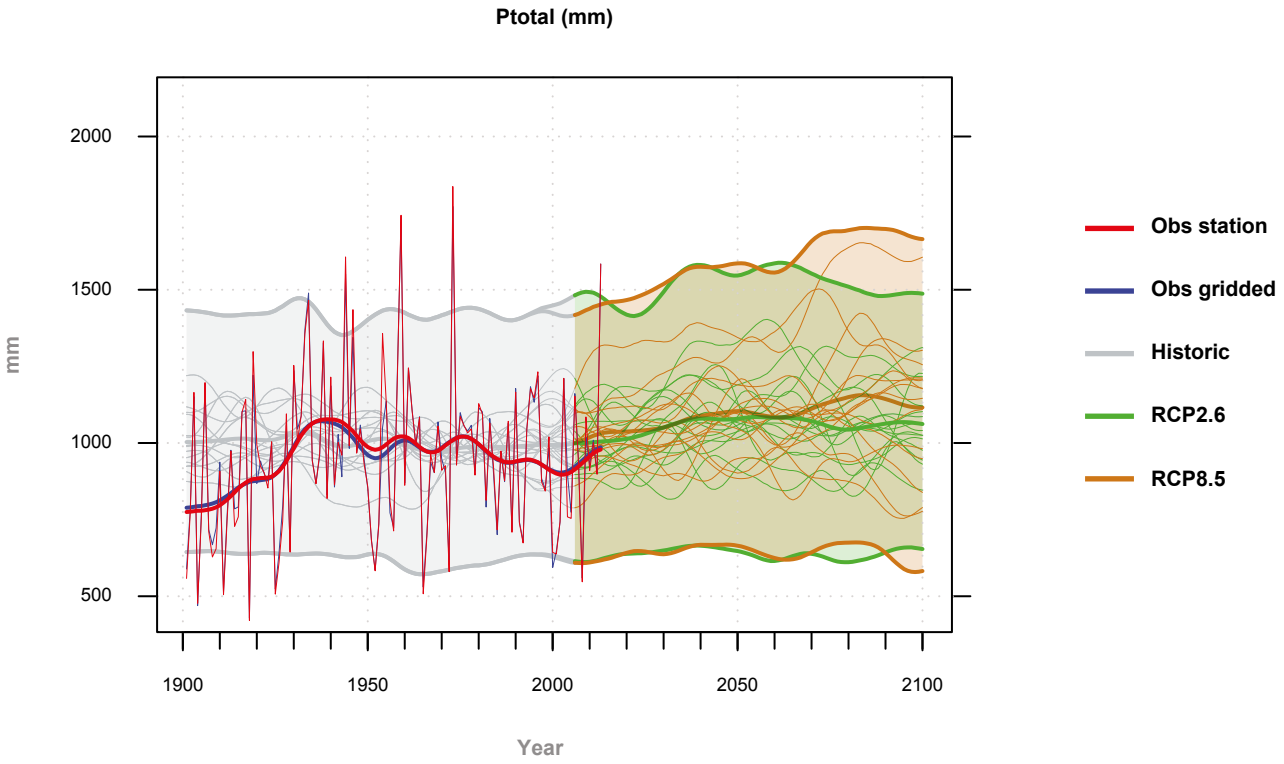


Figure 8: Number of heavy-rainfall days for Indore *(Source: CEEW)*

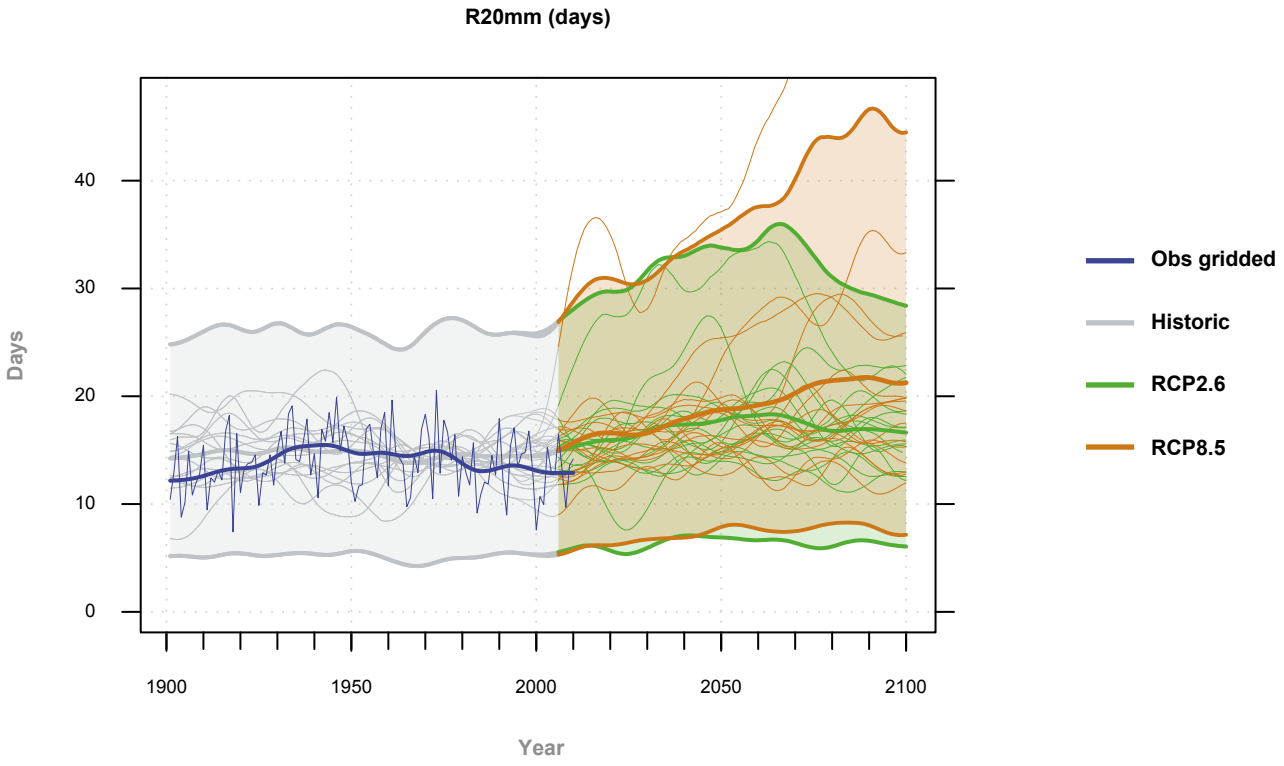


Table 2: Observed and projected changes for temperature and rainfall for Indore *(Source: CEEW, 2020)*

	Observed 1981-2010	2030s RCP8.5	2050s RCP8.5	2080s RCP8.5	2080s RCP2.6
Temperature					
Mean Temperature	25°C	+1.3 (0.9 to 1.7) °C	+2.1 (1.5 to 2.6) °C	+4.3 (3.0 to 5.4) °C	+1.1 (0.4 to 1.8) °C
Warm Days	13 days	+12 (7 to 19) days	+21 (12to 32) days	+47 (29 to 64) days	+10 (3 to 20) days
Warm Nights	13 days	+21 (13 to 30) days	+34 (23 to 45) days	+63 (52 to 76) days	+17 (6 to 28) days
Rainfall					
Total Rainfall	787 mm	+8 (-3 to +21) %	+10 (-3 to +22) %	+15 (-12 to +37) %	+7 (-7 to +21) %
Heavy Rainfall Days	12 days	+3 (0 to +9) days	+4 (+1 to +13) days	+7 (-1 to +23) days	+3 (-1 to +8) days
Consecutive Dry Days	90 days	+4 (-15 to +24) days	+5 (-19 to +28) days	+6 (-16 to +37) days	-1 (-17 to +15) days

Key messages and implications for climate change risk assessment for Indore[16].

- Indore's climate is subject to large year-to-year variability, particularly for rainfall. Thus, even in the absence of anthropogenic climate change, this Smart City needs to be resilient to this natural variability.
- Observed records for the Indore region over the last few decades show a clear trend towards higher temperatures and more frequent high-temperature extremes.
- Climate projections indicate a strengthening of observed temperature trends, particularly with higher greenhouse emissions and a tendency towards more intense and frequent rainfall extremes.
- If global warming can be constrained to 2°C or less compared to preindustrial conditions, the impacts of climate change will be substantially reduced for Indore, particularly in the second half of the century.

Table 3: Climate change and potential risks *(Source: CEEW)*

Projected Climate Changes	Potential Impacts and Risks
Warmer conditions, including more intense and frequent hot extremes and heat wave days	• Human heat stress and other negative health effects, including potential increases in mortality, particularly if air quality also declines. • Increase in water stress and drought-like events. • Negative impacts on labor productivity, particularly on outdoor workers. • Potential increase in demand for air conditioning, which would increase energy consumption. • Increased water stress and high groundwater exploitation.
Higher annual rainfall totals and more frequent heavy rainfall events	• Potential increase in flood risk. • Possible implications for water balance, and the quantity and quality of water resources (also taking into consideration the likely persistence of long dry spells and increased evaporation with warmer conditions).

[16] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*

Socio-Economic Profile of Indore

The sex ratio of Indore city stands at 925 females per 1,000 males as per the 2011 census. This is lower than the state average of 931 and national average of 940. The city has a literacy rate of more than 75%, with male literacy rate at around 79% and female literacy rate at 71.6%. Despite the high female literacy rate, only 16% of women are employed in Indore[17].

Around 28% of the city's population lives in slums, and 2.8% are physically challenged[18]. The spread and growth of slums makes it difficult to provide services to the urban poor[18]. Hence Indore needs to ensure that its climate actions address impacts on these vulnerable groups in an inclusive manner.

Around 10% of households in the city are semi-permanent and 1.21% households are temporary structures, indicating inherent vulnerabilities to climate risks such as heatwaves, urban flooding, and health disorders. Also, in 17% of households cooking is done inside a house with no kitchen, which poses health and safety risks.

Indore is one of the largest cities in MP in economic terms and has been nicknamed Mini-Mumbai. It has the largest economy in central India, with a GDP of $14 billion[20]. It is the commercial and trade capital of the state, with significant footprints in commerce, finance, media, art, fashion, research, technology, education, and entertainment. It fuels the economic engine of the state together with the neighboring industrial towns of Dewas and Pithampur, also called the Detroit of India for its automobile industries. National Association of Software and Services Companies (NASSC) has assessed Indore as one of the top 10 Tier-2 cities and promising business locations for the IT-BPM industry in India[21]. Home to the regional headquarters of banks, multinational corporations, financial services, and other service provider companies.

Indore's economy is also diversified by a well-established network of businesses around cotton textiles, iron and steel, chemicals, pharmaceuticals, readymade garments, solvent plants, and machinery. Indore accounts for one-third of India's total namkeen production (the turnover of the namkeen industry cluster is around INR 4.2 billion)[22].

Indore is home to large infrastructure projects, including those promoted by GoMP, such as Crystal IT Park, Super Corridor (a high-density corridor being developed on TOD principles), Pithampur Special Economic Zone, Pithampur-Dhar-Mhow Investment Region of Delhi Mumbai Industrial Corridor (DMIC), and National Automotive Testing and R&D Infrastructure Project (NATRiP) a state-of-the-art automotive testing track and R&D facility.

Indore offers excellent quality of life, and the cost of living is about 15-20% lower than in the metros. This has ensured the availability of senior professionals and skilled workers at competitive rates. The city also attracts large investments and generates employment. Vacmet has invested INR 20 billion, and Reliance Industries has invested Rs. 460 billion in the Indore region. Globally reputed software solution providers such as Infosys, TCS, Yash Technologies, Computer Sciences Corporation (CSC), Impetus, Cyber Infrastructure (CIS), Infobeans, Yes-Pay and Premier Biosoft (India) have made Indore their home.

City Typology

To ensure that the CAP identifies relevant actions for vulnerable groups, a socio-economic profile of the city has been developed. The methodology is adapted from the World Resources Report "Towards A More Equal City"[23] and contextualized for cities in MP. The method uses following parameters to categorize the cities.

- Decadal population growth
- Decadal income growth
- Ratio of income growth to population growth

Based on the above three parameters, the cities are classified into four categories as shown in Figure 9.

- **Aspiring Cities** have a low GDP per capita today, and a low ratio of projected income growth to projected population growth during 2021-2030, as compared to other cities. We classify these as start-up cities because they are likely to soon experience more rapid population growth than economic growth, pointing to an impending resource gap.

- **Emerging Cities** have a low income today, and a high ratio of income growth to population growth during 2021-2030, as compared to other cities. While their economic strength is low today, their projected economic growth is greater than their projected

[17] District Census Handbook: Part A&B, Indore District, *Census of India, 2011*

[18] Climate Informed Environmental Planning for Smart Cities of Madhya Pradesh-Indore, *SPA Bhopal, 2019*

[19, 20, 22] The Smart City Challenge: Smart City Proposal, *India Smart City Mission*

[21] IT-BPM Sector in India, Decoding Digital: Strategy Review, *NASSCOM, 2019*

[23] WRI Ross Center for Sustainable Cities, *2016*

Figure 9: City socio-economic classification *(Source: Adapted from World Resources Institute)*

x-Axis:
Income Today

y-Axis:
Income Growth Relative to Population

Growth base year: 2021-30

population growth, indicating increase in economic productivity. These cities are more likely to have the capacity to overcome current resource constraints and strengthen their position globally.

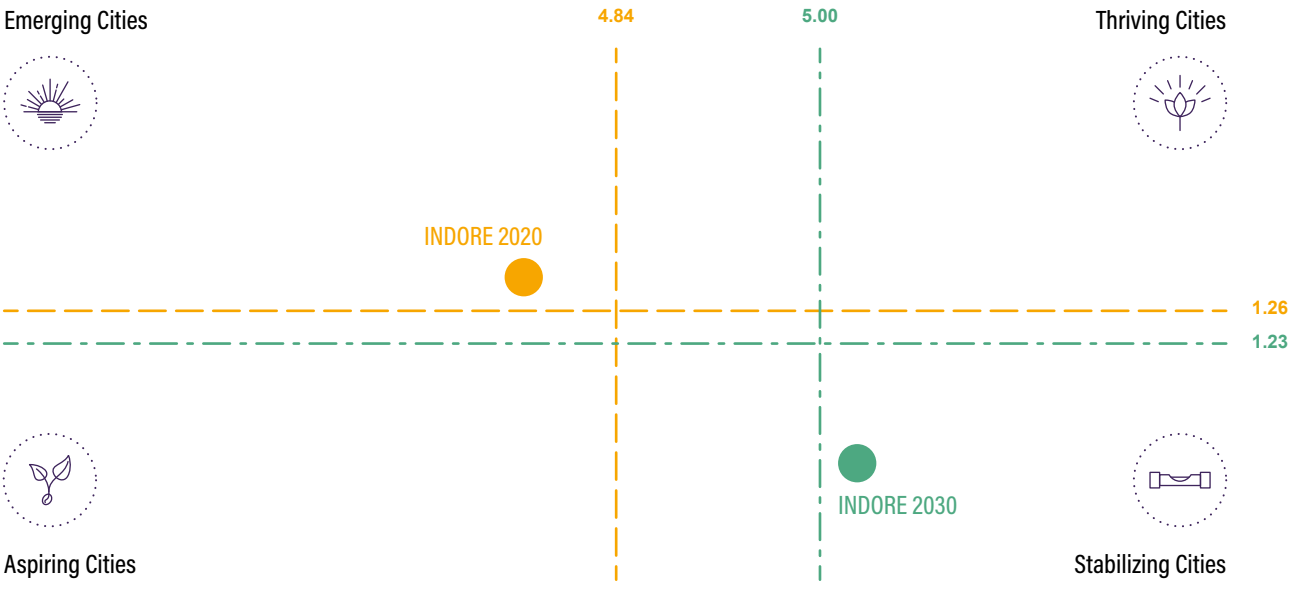
- **Thriving Cities** are not only economically strong today, but their economic growth is also projected to outpace their urban population growth during 2021-2030. These cities are growing and thriving.

- **Stabilizing Cities** are economically strong today, but their economic growth is expected to be lower relative to their population growth during 2021-2030 as compared to emerging or thriving cities. In that sense, these cities are starting to stabilize, and, in some cases, their economies are starting to shrink.

This socio-economic profiling of the city helps identifying both, challenges in providing urban services, and opportunities to avoid locking in unsustainable patterns of urban development.

Indications are that Indore will stabilize over this decade (2021-30). While the city's economic growth will stabilize by 2030, its projected economic growth relative to population growth will be lower than that of a thriving city. The city can capitalize on its current economic strength to plan for implementing proposed actions in mission mode, and simultaneously engage in awareness-raising and capacity-building for the optimal utilization of resources and to inculcate behavioral change in its residents.

Figure 10: Socio-economic typology of Indore *(Source: WRI India)*



BASELINE ASSESSMENT

CSCAF Analysis

Indore has performed well in the first two rounds under CSCAF. It has done exceedingly well on waste management, and this is reflected in its Swachh Survekshan rankings. The city also has an exemplary public bus rapid transit system, which catered to a daily ridership of around 70,000 on average in 2019[24]. However, it needs to improve its score and performance indicators in other sectors. Some current initiatives and possible areas of improvement are discussed in Table 4.

Table 4: CSCAF analysis *(Source: CSCAF 2.0 Indore assessment)*

Overall Score as per CSCAF 2.0	Energy and Green Buildings	Urban Planning, Green Cover and Biodiversity	Mobility and Air Quality	Water Management	Waste Management
★★★★	★★★	★★★★★	★★★★	★★★	★★★★★
CSCAF 2.0 Score	330.5	404	362	350	581
Current measures being undertaken in the city	• 98% LED streetlights. • The city is promoting adaptive reuse of older buildings. • 65% of terraces of redeveloped buildings to have solar PV. • Pioneering a floating solar funding model	• 20% of the municipal area is under green cover. • Vertical gardens on the rivers / nullah bridges, Miyawaki plantations being implemented.	• 10% of public buses run on low-carbon fuel. • Metro is proposed. • Clear Air Action Plan is in place. • Shared scooter service in the city.	• 629 traditional water supply sources along with wetlands being restored. • City has a water resources management plant and has identified future water demand.	• 100% of door-to-door collection. • 92% of dry waste is recycled • Bioremediation already in practice in Devguradia trenching ground, 550 TPD plant inaugurated in February 2022
Areas of improvement	• Reducing high Transmission and Distribution losses which is currently 24%. • Increasing power generation from RE sources, which is currently 0.8%.	• Inequitable green and open spaces. • Need to integrate green infrastructure within lake redevelopment.	• Augmenting bus fleet and NMT coverage • Improving last-mile connectivity • Increasing uptake of EVs particularly for shared mobility and public transport (10% of buses run on clean fuels)	• Reducing NRW (currently 30%). • Poor access of tap water, 46% as of 2019. • Increasing use of treated water (currently 11% wastewater is recycled)	• Biomedical waste treatment to be made scientific. • Capturing of methane gas from STPs.

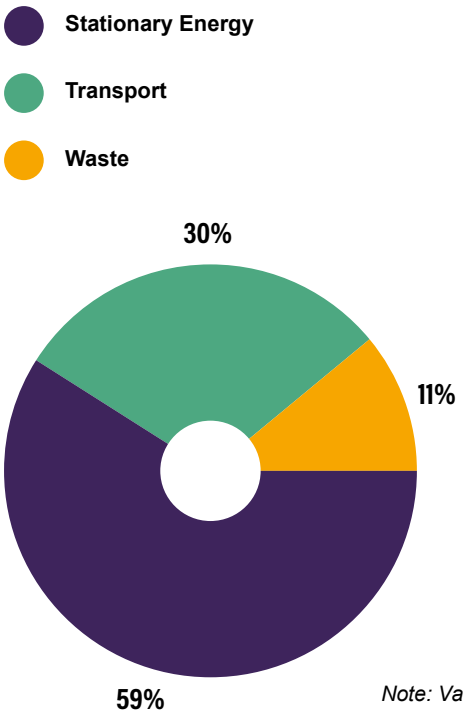
[24] Problems for Small & Medium Towns and Introduction of Public Transport System, *Urban Mobility India Conference, 2019*

Greenhouse Gas Emissions Profile

The greenhouse gas emissions inventory for Indore has been compiled in accordance with the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC) standard[25], using C40's City Inventory Reporting and Information System (CIRIS) tool. The inventory includes an analysis of GHG emissions from transportation, waste, and stationary energy. The inventory covers scope 1 emissions (emissions due to activities within the city mainly from fuel combustion), scope 2 emissions from grid supplied electricity and scope 3 emissions (only for waste), which includes emissions due to treatment of waste generated within the city but treated outside the city boundary. A citywide GHG inventory is a critical piece of any climate action plan. It establishes which sources of activity contribute to emissions and allows the city to develop mitigation policies and strategies.

Critical Sources

Figure 11: GHG emissions profile for Indore, 2019
(Source: WRI India analysis using primary city data)



Note: Values in tons CO_2e

In 2019, Indore's GHG emissions were 3.658 $mtCO_2e$, amounting to per capita emissions of 1.65 tCO_2e (including manufacturing and industrial emissions). Transportation accounted for 30%, stationary energy for 59%, and the remaining 11% was due to waste (see Figure 11).

The majority of emissions comes from energy and electricity use in residential buildings followed by manufacturing industries. Electricity consumption accounts for 57% of total emissions. This is because the city's electricity is predominantly generated from high-emitting fossil fuels such as coal, oil, and gas. However, there is a data challenge on the absolute coal consumption for electricity generation within the city.

[25] Greenhouse Gas Protocol, Global Protocol for Community-Scale Green House Gas Inventories, An Accounting and Reporting Standard for Cities (Version 1.1), *Greenhouse Gas Protocol, 2021*

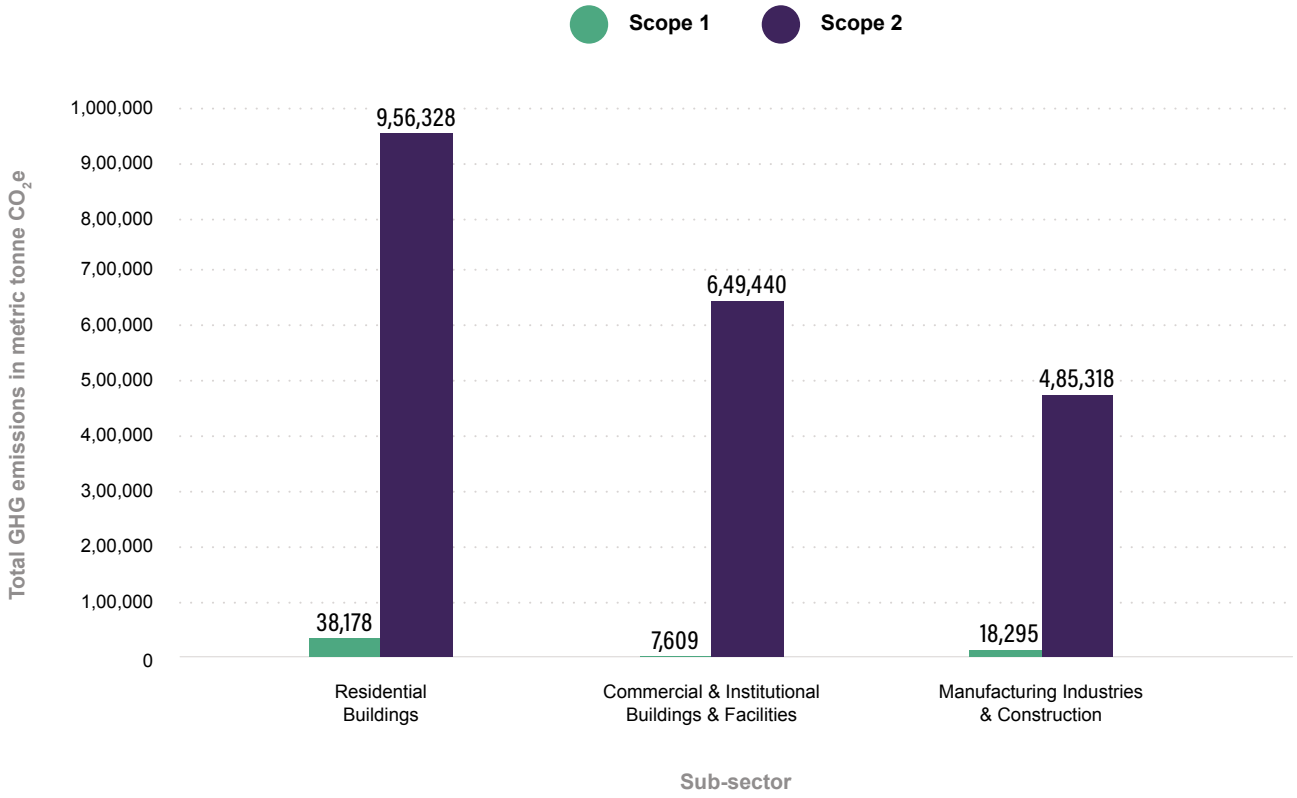
Stationary Energy Emissions

The stationary energy sector consists of electricity and fuel consumption from

- Residential buildings
- Commercial and institutional buildings
- Manufacturing industries and construction

Total electricity consumption in Indore city was 2561 GWh in 2019. This sector accounts for 64,082 tonnes CO_2e of Scope 1 and 20,91,086 tonnes CO_2e of Scope 2 emissions making it a total of 2.15 mtCO_2e of emissions. These include emissions from grid connected electricity consumption and fuel consumption including PNG, LPG, and kerosene. Figure 12 shows the distribution of stationary energy emissions of Scope 1 and 2.

Figure 12: Distribution of stationary energy emissions by sub-sector *(Source: Primary data from DISCOM)*

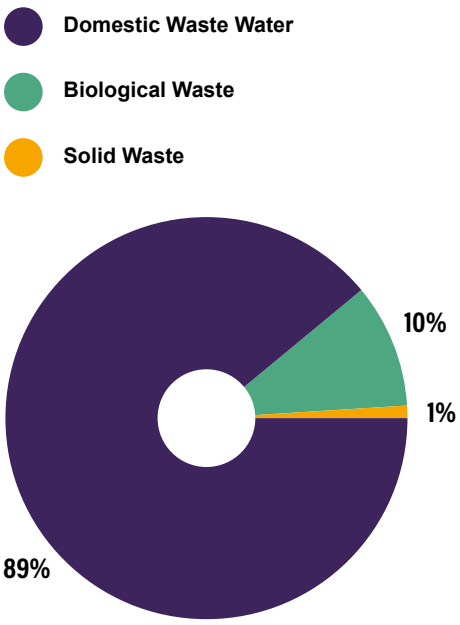


Transportation Sector Emissions

The transport sector accounts for 1.07 mtCO_2e of emissions, due to the consumption of petrol and diesel in road transport. Data was obtained from fuel agencies such as IOCL, BPCL and HPCL. Sub-sectors such as railways and waterways were not included, as they are not present in the city.

Waste Sector Emissions

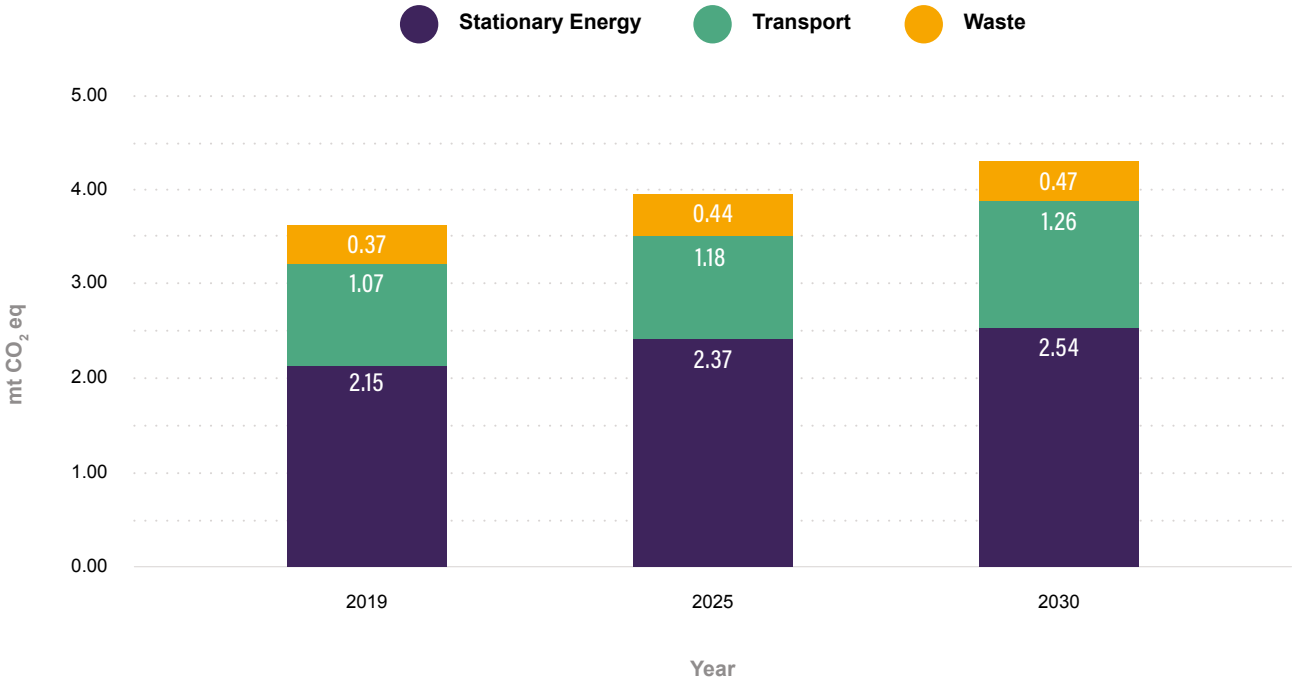
Figure 13: Distribution of waste sector GHG emissions by sub-sector *(Source: WRI India analysis using primary city data)*



Waste accounts for 0.4 mtCO_2e of emissions. Of these, 89% are from emissions due to wastewater treatment, while 10% can be attributed to the composting of wet waste (see Figure 13). Indore landfills receive 16,279 tons of waste per year. This contributes 1% to total emissions, thanks to efficient gas collection and scientific landfill management.

The business-as-usual projected emissions for Indore are presented in Figure 14. Emissions are projected to increase by 10% by 2025, and 18% by 2030, compared with baseline emissions of 2019. Thus, there is an urgent need for the city to implement measures presented in the report for achieving its vision of low carbon and climate-resilient development.

Figure 14: Projected emissions for Indore *(Source: WRI India analysis using primary city data)*



Emissions Scenario Modeling for Indore

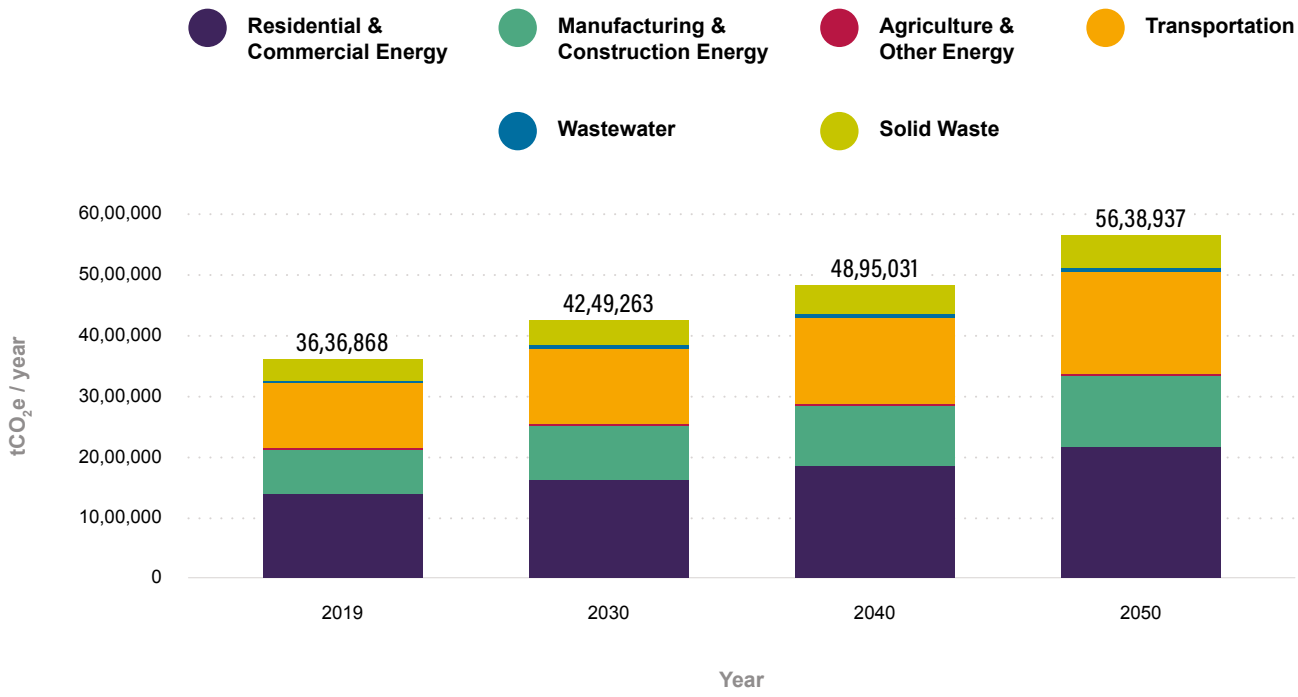
An emissions scenario modeling analysis was done for Indore using the Climate Action for Urban Sustainability (CURB) tool. CURB is an interactive Excel-based tool designed by the World Bank in partnership with the C40 Cities Climate Leadership Group, the Global Covenant of Mayors, and AECOM Consulting. It helps cities develop emissions reduction targets for key sectors, assess the investments required, and prioritize low-carbon interventions based on cost, payback period, feasibility, and impact on energy consumption and emissions reduction[26]. This tool was used to develop three main scenarios.

- **Business-as-usual scenario:** Predicts emissions reductions if no action is taken to mitigate GHG emissions.
- **Existing and planned scenario:** Uses existing or planned city, regional and national actions, policies, and programs to demonstrate the emissions reductions trajectory for the city until 2050. This scenario should only consider data from government policy and project documents, and not from secondary literature.
- **Ambitious scenario:** In most cases, the existing and planned policies leave a significant gap in the 1.5°C Paris Agreement and Deadline 2020 trajectory. This scenario analyses emissions reductions due to actions that are ambitious yet achievable. It can take guidance from proposed projects, state-level targets, etc. However, it is crucial that this scenario be vetted by city-level stakeholders to ensure that targets are feasible.

Business-As-Usual (BAU) Scenario for Indore

The CURB analysis shows that if the city does take no action, emissions will rise 1.5 times from 2019 levels, by 2050. The greatest contribution would be from residential and commercial buildings.

Figure 15: BAU scenario emissions profile for Indore *(Source: WRI India analysis using primary city data)*



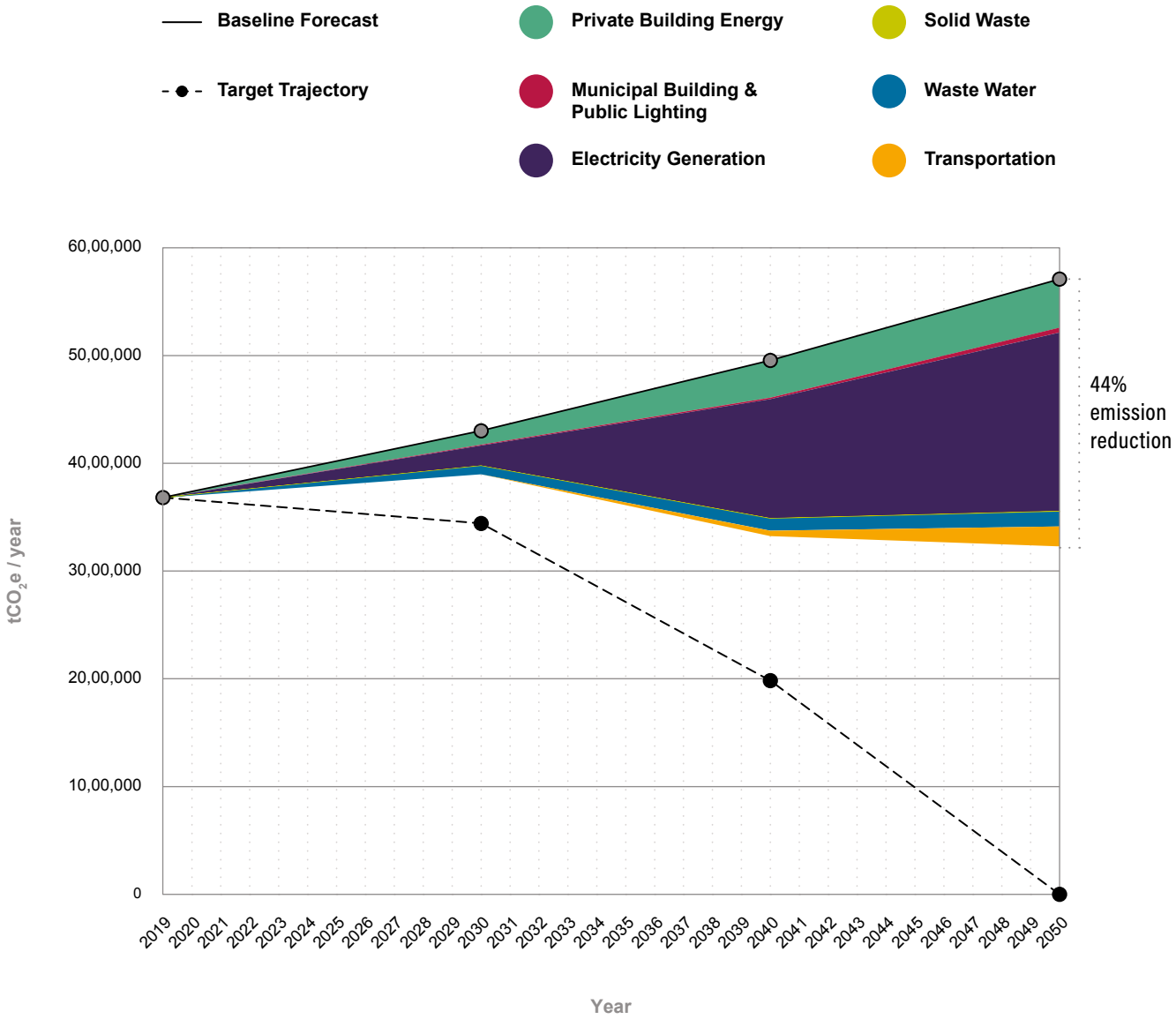
[26] CURB tool: Climate Action for Urban Sustainability (Vol.2): User guide, *World Bank, 2020*

Existing and Planned Scenario for Indore

The existing and planned scenario for Indore was modeled using assumptions based on existing and planned city-level targets and projects such as:

- **Energy and Buildings:** Planned projects such as the 670 KW plant on the Devi Ahilya Vishwavidyalaya (DAVV) campus[27], 10 MW tender floated for residential solar PV projects[28], and Indore Municipal Corporation's plans to install 100 MW solar under the Central Public Sector Undertaking (CPSU) phase II scheme by the Solar Energy Corporation of India (SECI)[29]. It is also informed by current trends in solar rooftop uptake, which has increased by three times in the past two years[30]. The city has also been identified to be developed as a 'Pilot solar city' under the Solar City Program[31]. The city currently has less than 1% share of renewables in the grid.

Figure 16: Potential for emissions reductions from E&P scenario *(Source: WRI India Analysis using primary data from stakeholder consultations and secondary literature)*



[27] Indore: DAVV's rooftop solar plant to be biggest in city, *EQ International, 2019*

[28] Madhya Pradesh floats tender for 10 MW residential rooftop solar projects, *Solar Quarter, 2022*

[29] Selection of 1500 MW Grid-connected Solar PV Power Projects under CPSU Scheme, Phase-II (Tranche-II), *SECI, 2019*

[30] Indore rooftops generating solar increase three times in two years, *The Free Press Journal, 2022*

[31] Annexure 2, *Indore Smart City Proposal*

- **Waste and Wastewater:** Targets are informed by planned initiatives such as running the solid waste transport fleet on CNG, for which the tendering process is ongoing for 25 CNG waste collection vehicles in phase 1[32]. A committee has been set up to auction old vehicles and use the revenue to buy new ones. Currently Indore has two UASB (up flow anaerobic sludge blanket) reactors without biogas capture[33], which was taken as the baseline to inform targets in the scenarios.

- **Transport:** Indore currently has less than 1% electric vehicles in its fleet, and this scenario assumes that it increases by 10% every year, reaching 50% in 2050, given the existing fleet size and infrastructure availability. The mode share for the metro was assumed to be 22% by 2050, in alignment with the detailed project report (DPR), which was targeted for 2030. However, given that most cities in India have fallen short of their proposed metro ridership targets, this was taken as the value for 2050 in the existing and planned scenario[34]. Inputs were also taken from the city's comprehensive mobility plan and Indore Development Plan 2021[35].

The emissions reductions from the E&P scenario are depicted in Figure 15. As per this scenario, the city has the potential to achieve 44% reductions in emissions by 2050 compared to the BAU scenario.

Ambitious Scenario for Indore

This scenario included ambitious yet achievable targets across the sectors of energy and buildings, waste, wastewater and water, transport, and energy generation. The aim is to bridge the gap between the existing and planned scenario, and help the city set net zero targets in line with Paris agreement goals. These targets were based on some city- and state-level plans as well as proposed projects and vetted by stakeholders to assess their feasibility.

This scenario has a potential to achieve a 78% reduction in emissions by 2050 (see Figure 17). This means that the city would have a residual emission of 23% in achieving its target of 100% emissions reduction by 2050. This could be attributed to the technology lock-in to CNG, with Indore investing in a 20-year agreement to run its new bio-CNG plant. This would slow down the transition to electricity, particularly in the transport sector. Furthermore, residual emissions can also be linked to continued LPG use for heating, particularly in informal settlements with limited scope to shift to solar or electric heaters. Further research would be required to gauge the reduction of all long-term residual emissions.

Table 5: Selected targets for E&P scenario *(Source: WRI India analysis using data from local consultations and secondary literature)*

Energy	• 40% shift to LEDs from incandescent in high-income houses by 2050 • 10-15% houses to have solar PV by 2050 based on income type • 35% of energy from renewables in 2050
Transport	• 38% mode share for public transport by 2050 • 40% electrification of passenger 4-wheeler and 2-wheeler fleets by 2050 • 70% electrification for buses
Waste	• 65% digestion of food and yard waste by 2050 • Conversion of 300 solid waste pickup vehicles to bio CNG by 2050
Water	• Improving 70% of water pumps to 80% efficiency by 2050 • Non-revenue water reduction to 25% by 2050

[32] Indore: New CNG vehicles to collect garbage door-to-door, *The Times of India 2020*

[33] Performance Evaluation of Sewage Treatment Plants (STPs) in Madhya Pradesh (Constructed under NRCP), *Central Pollution Control Board Bhopal, 2011*

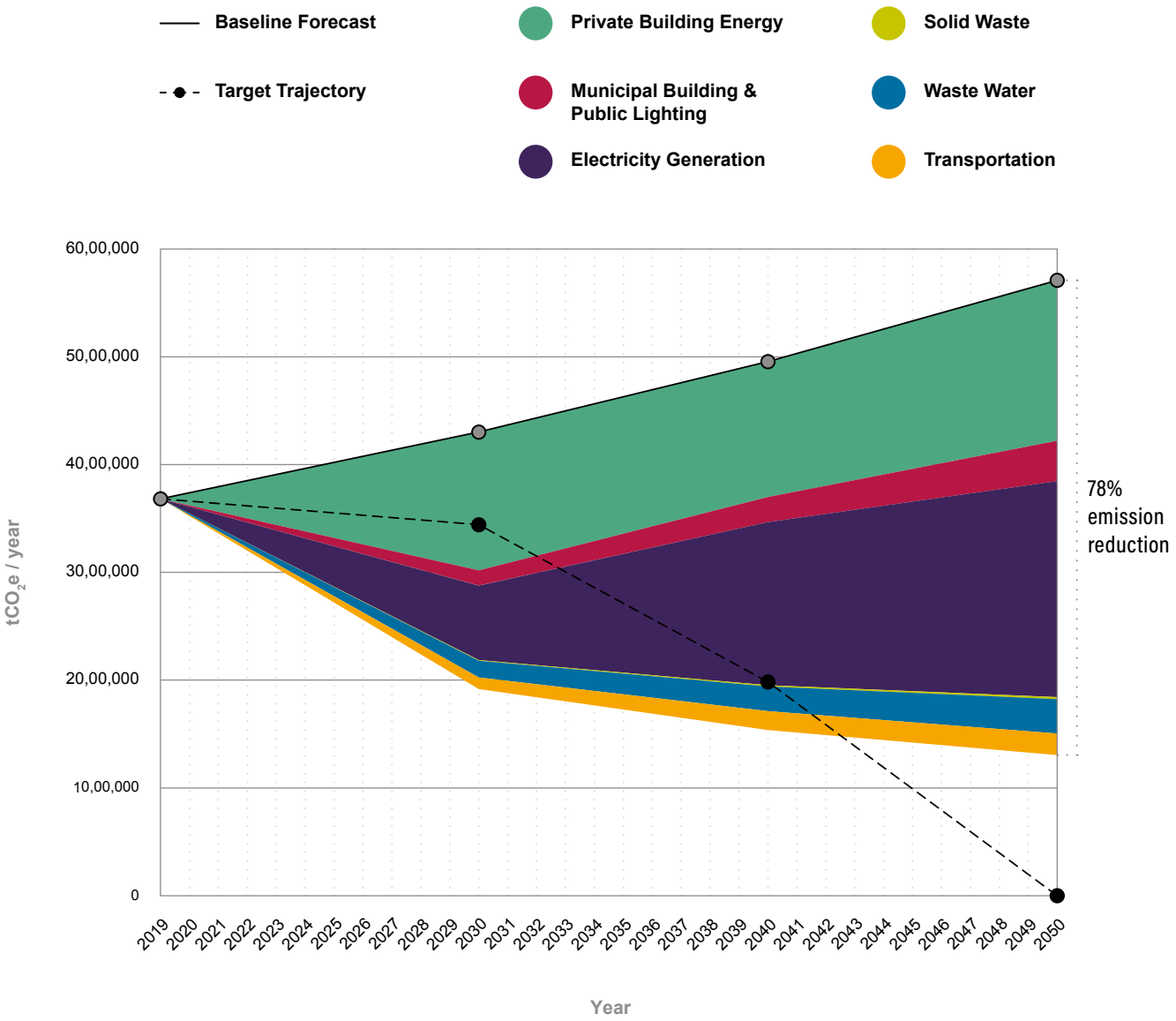
[34] Traffic Pre-feasibility Study for Indore Metro, *Delhi Metro Rail Corporation Limited, 2013*

[35] Smart Mobility Plan of Indore, *Atal Indore City Transport Services Ltd, 2016*

[36] Energy Compact Overview, *United Nations, 2022*

- **Energy Generation and Buildings:** Targets from the Energy Compact, a voluntary commitment to progress towards meeting SDG 7 and the Paris Agreement goals[36], were used to determine ambitious targets. For example, Indore had a target of 7% renewable energy mix in the grid by 2023. The city is also planning for a 120 MW solar power plant. This ambitious level was used to set a target of 80% renewables in the grid by 2050. However, this was reduced to 60% after the consultations, as found feasible by stakeholders. A target of 100% solar PV in municipal buildings and 70% in residential buildings was taken for 2050.
- **Transport:** Targets for the transport sector were aligned with the metro DPR, which predicts 18% mode share for the metro by 2030. This was assumed in the ambitious scenario. Initially, 100% electrification of buses and light-duty vehicles by 2050 was set as the target for this scenario based on the targets under the Madhya Pradesh Electric Vehicle Policy 2019[37]. However, after consultations, it was lowered to 80% by 2050, with 20% of the fleet running on bio-CNG. This was attributed to the recently inaugurated 550 TPD bio-CNG plant, which is set to run 400 new buses[38]. Motorcycle electrification targets were taken from

Figure 17: Emissions reduction potential for ambitious scenario *(Source: WRI India)*



[37] Madhya Pradesh Electric Vehicle (EV) Policy, *Urban Development and Housing Department, Government of Madhya Pradesh, 2019*

[38] 400 buses in Indore to run on bio-CNG generated from waste; PM to virtually inaugurate plant on Feb 2019, *The Economic Times, 2019*

the ICCT India Emissions Model in which, as per the goal of 30% EV sales by 2030, sixty percent of two-wheelers must be electrified by 2040, and 100% by 2047[39].

- **Waste and Wastewater:** Targets for this sector were taken based on current baseline and planned initiatives such as the collaboration with between MP and Energy Efficiency Services Limited (EESL) to promote energy efficient water pumping and sewerage[36]. The city also plans to run 25 solid waste transport vehicles by bio-CNG by the end of this year. It was assumed that 100% vehicles would run on bio-CNG by 2050. Other targets for this sector include reducing non-revenue water to 2% by 2050 and shifting towards treatment with gas capture.

Table 6: Ambitious scenario targets for Indore *(Source: WRI India analysis using data from local consultations and secondary literature)*

Target	2030	2040	2050
Energy and Buildings			
Share of total grid electricity from renewables (%)	25	43	60
Total residential high-income buildings with solar PV installed (%)	30	60	90
Residential water flow technology in existing residential buildings (% low flow fixtures)	40	60	90
LED lighting in existing commercial and residential buildings (%)	50	70	100
Solar PV in municipal buildings (MW)	120	200	300
Share of existing municipal buildings with LED (%)	30	50	90
Transport			
Mode share for public transport (%)	23	35	50
Electrification of passenger automobiles (%)	35	60	96
Electrification of light duty freight (%)	30	50	80
Electrification of buses (%)	30	50	80
Waste			
Share of organic waste composted (%)	80	90	100
Share of CNG transport vehicles (%)	40	60	100
Wastewater			
Share of NRW (%)	20	40	80
Share of pumps with improved efficiency (%)	60	90	100
Treatment with gas capture (%)	46	70	100

[39] Battery capacity needed to power electric vehicles in India from 2020 to 2035, *International Council on Clean Transportation, 2021*

[40] State Energy Efficiency Index 2020, *Ministry of Power, 2021*

Vulnerability Assessment

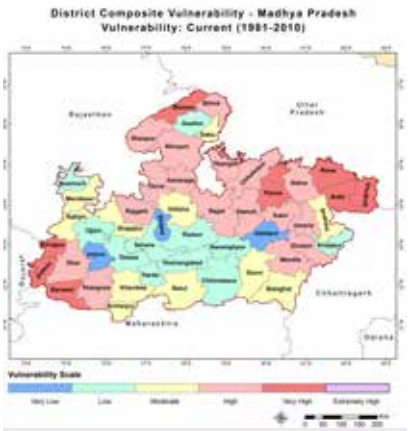
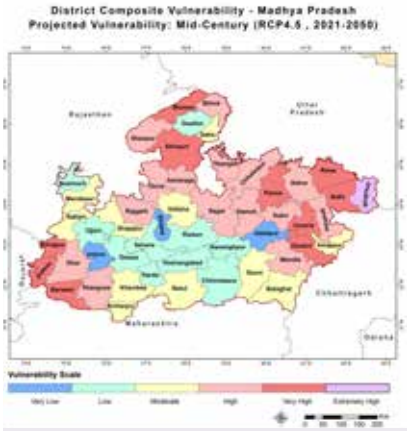
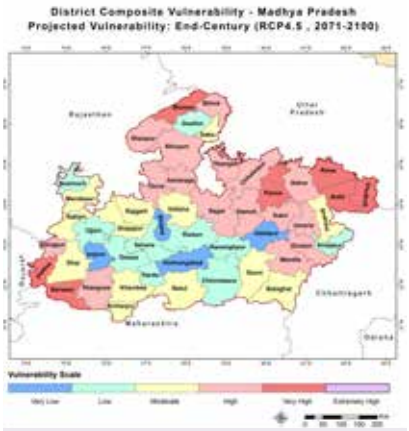
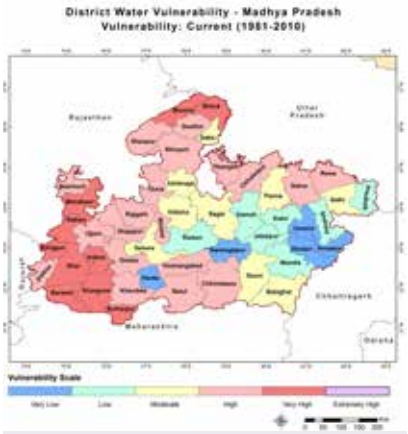
EPCO has carried out a detailed climate change vulnerability assessment for Madhya Pradesh's 52 districts[41]. As per the assessment, monsoon rainfall shows no significant trend over monthly or seasonal cycles. Additionally, in recent years the trend has shifted towards a greater number of dry days during the rainy season. July and August are the principal rainy months for Indore. It is observed that the variability in rainy days is greater in July and August, and these two months show a decreasing trend in precipitation during the period 1951-2018.

Maximum temperatures in April and May show a significant increasing trend, due to sharp heat waves.

The mean percentages of warm days are more pronounced in recent years and show an increase of around 9% during the period 1986-2005[42].

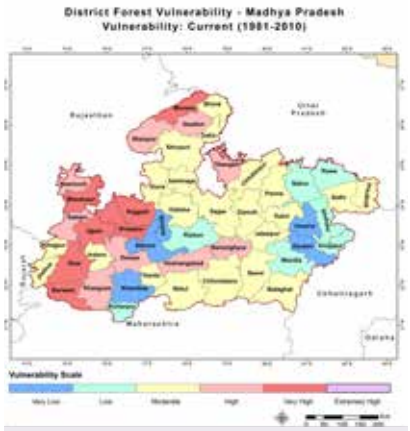
Projections for precipitation in Indore show an increase in the quantum of rainfall during the monsoon months and season as a whole. There may be an increase in precipitation of 7% to 21% under RCP 4.5, and 16% to 42% under RCP 8.5, towards the end of the century. The number of rainy days is also projected to increase during the monsoon, and July and August in particular will have more rainy days[43].

Figure 18: Climate change vulnerability assessment *(Source: Madhya Pradesh Climate Change Knowledge Portal)*

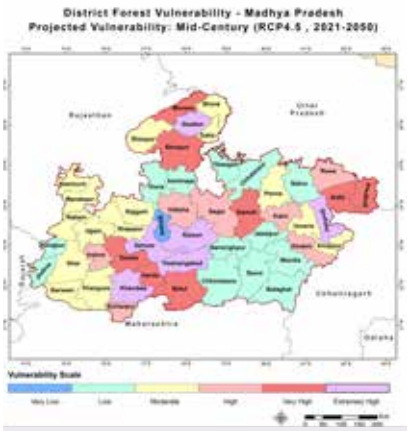
Baseline	RCP 4.5 Mid-Century	RCP 4.5 End-Century
Composite Vulnerability		
		
Very Low	**Very Low**	**Very Low**
Water Resources Vulnerability		
		
Very High	**High**	**High**

[41, 42, 43] Climate Change Vulnerability Assessment for Madhya Pradesh, *EPCO, 2017*

Forest Vulnerability



Moderate

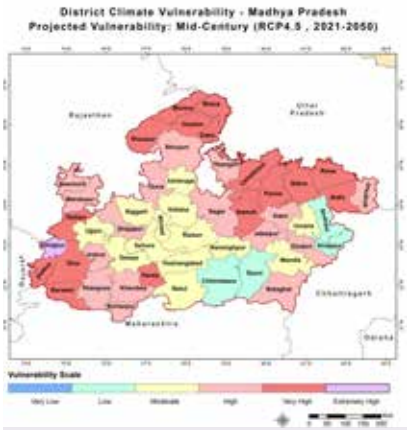


High

High

Climate Vulnerability

Moderate



High

Moderate

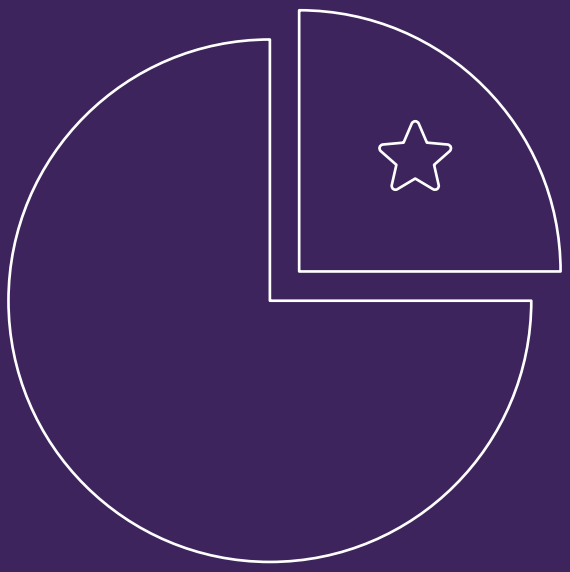
The projections in different time epochs show that the maximum temperatures may rise (1°C to 2.5°C under RCP 4.5, and 1.5°C to 4.5°C under RCP 8.5) over Indore. In particular, May temperatures are higher compared to the remaining months. These rising temperatures may have an adverse impact on biodiversity, forests, water resources, and human and animal health. The percentage of warm days may increase over Indore in the future, especially towards the end of the century. In the winter, minimum temperatures may also show an increasing trend, and the number of cold days (%) is decreasing drastically in all epochs under changing climate conditions. The vulnerability assessment shows a clear increase in temperature towards the end of the century[44]. A glimpse of the vulnerability assessment of different sectors in presented below in Figure 18.

Indore faces high vulnerability in terms of water resources, estimated using indicators such as water availability, crop water stress, extreme events of flooding and drought. The city has a higher baseline vulnerability value for drought, but it reduces towards mid-century. The city also faces increasing vulnerability to reduced surface water availability during the SW and NE monsoons. It will also face increasing water stress. It is estimated to have an increased vulnerability due to the reduced availability of groundwater. The city's groundwater is already severely exploited, and its natural water resources, such as the Kanh and Saraswati rivers, are in poor condition. Groundwater in the area is of medium to high salinity and unfit for drinking.

Further, the increasing trend in temperature leading to extreme heat wave conditions will result in higher energy demand for cooling purposes. This gives an opportunity to tap renewable energy sources and create supporting infrastructure to meet most of this excess demand through cleaner fuel sources.

[44] Climate Change Vulnerability Assessment for Madhya Pradesh, *EPCO, 2017*

SECTORAL PRIORITIES



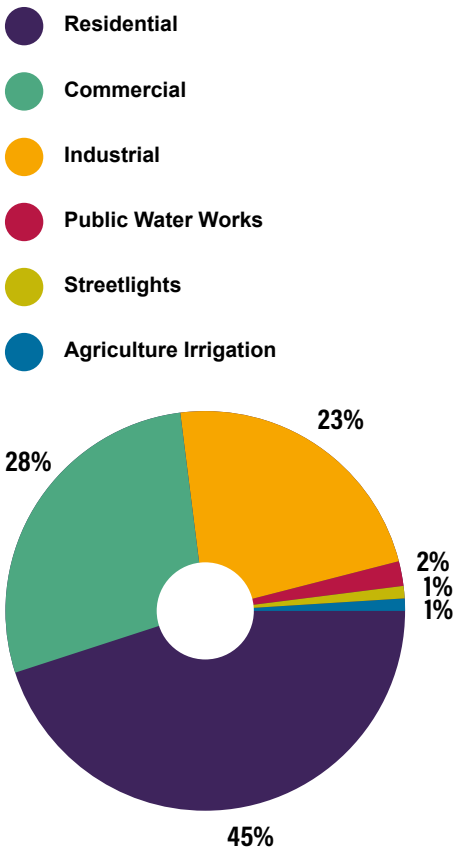
This section provides a detailed description of Indore city's current performance on different indicators under the CSCAF, based on which sectoral goals have been identified to address the gaps and challenges in making the city low-carbon and climate-resilient.

Sectoral Assessment

Energy and Green Buildings

Based on electricity consumption data from the state energy distribution company for 2019, the total electricity consumption in Indore city is 25,61,625 MWh. Per capita electricity consumption was 1100 kWh in the calendar year 2019. This is below the national average of 1,208 kWh[45]. The distribution of electricity consumption by consumer category is presented in Figure 19.

Figure 19: Distribution of electricity consumption
(Source: Primary data from DISCOM)



The residential sector accounts for the bulk of the electricity consumption, followed by manufacturing industries and commercial consumers. With projected growth in economic activity and population, consumption will grow further, calling for considerable energy efficient measures to be put in place. Further, the city also has 24% T&D losses, calling for better power distribution and loss prevention measures. According to the latest data from Indore under CSCAF, electricity generation from renewable energy sources was 31,272 MWh in 2020, which accounts for just 0.8% of the city's total electrical energy generation.

Indore aspires to become a solar city and has so far installed 160 kW on building rooftops[46]. The city has also invested in green Masala bonds worth INR 5 billion for a 100-120 MW solar power plant. There are 10 garbage transfer facilities in the city, and the daily power consumption at each of these is nearly 30 kW. To meet this demand, the civic body aims to install a rooftop solar power plant with a capacity of 20-25 kW on each garbage transfer station. The Gobar-Dhan plant has already been inaugurated[47]. Installation of 58 kW rooftop capacity has been planned on the AICTSL building[48]. A 1.5 MW solar-powered STP is also operational. In addition to this, all BRTS traffic signals are solar-powered, and all new traffic signals in the city are as well. Besides, 25 public gardens in the city have got solar-powered lights.

EESL has a target of converting 79,000 sodium and metal lights to energy efficient LED for achieving the goal of 100% energy efficient lighting in the city. Almost 98% of the city's street lighting is LED and energy efficient[49]. There is also a need to increase smart metering services to reduce T&D losses and focus on integrating energy efficiency in buildings[50]. The fuel-wise breakup of fossil fuel consumption in the city in 2019 is given below in Table 7.

[45] Growth of electricity sector in India from 1947-2020, *Central Electricity, Authority, Ministry of Power, GoI, 2020*
[46] Completed Projects, *Smart City Indore Portal*
[47] HDFC Bank finances Asia's largest waste to energy plant in Indore, *Business Standard, 2022*
[48] Indore: With complete infrastructure and plan, AICTSL will soon provide i-bus services 24 hours, even at night, *The Free Press Journal, 2022*
[49] Indore Smart City, *Climate Smart Cities Assessment Framework, 2020*
[50] Annexure 2, *Indore Smart City Proposal*

Table 7: Break-up of fossil fuel consumption in Indore (Source: primary data from fuel agencies)

Type of Fuel	Consumption
Domestic LPG	1,05,937 Mt
Commercial LPG	19,234 Mt
Industrial LPG	65 Mt
Residential PNG	31,02,010 SCM
Commercial PNG	8,78,061 SCM
Industrial PNG	84,89,478 SCM
Residential Kerosene	4500 kl

Figure 20: Piped natural gas (PNG) consumption, 2019 *(Source: Primary data from fuel agencies)*

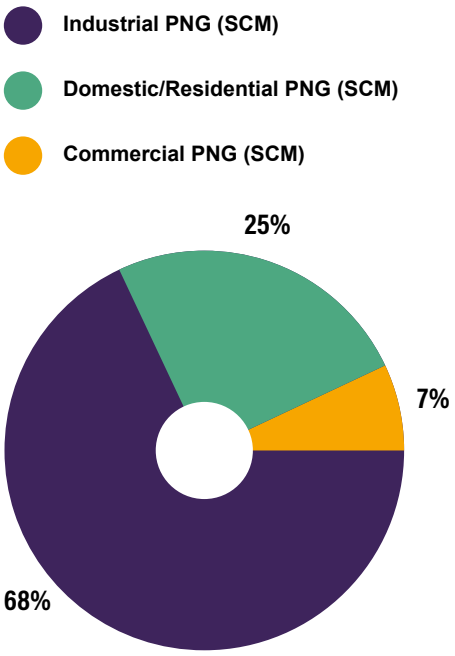
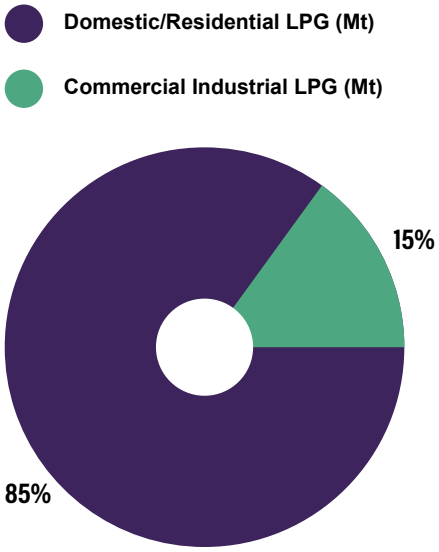


Figure 21: Liquified petroleum gas (LPG) consumption *(Source: Primary data from fuel agencies)*



The industrial sector accounts for 68% of the total consumption of PNG (see Figure 20), followed by the residential sector, which accounts for 25%. LPG dependency is higher in the residential sector, which accounts for 85% of the city's LPG consumption (see Figure 21). The city also depends on other fossil fuels, namely kerosene. Thus, there is a need to reduce this dependency, and power the city through renewables.

Currently, they have undertaken initiatives like adoption of RWH as per MP's Bhumi Vikas Adhiniyam 2012 rule 81.

Indore Municipal Corporation plans to sign an MoU with the Indian Green Building Council (IGBC) to initiate awareness and promotional programs on green buildings. The city is constructing 21,000 affordable houses at various locations under PMAY, with green building considerations such as the use of fly ash bricks and solar-powered LED lighting on the streets and in common areas. Indore Municipal Corporation has formed a committee comprised of representatives from the ULB, town planners, IGBC, the Confederation of Real Estate Developers' Associations of India (CREDAI) and local real estate developers to promote green building adoption in the city. As a result of these initiatives, more than 10% of new buildings sanctioned under green certification have received third-party pre-certification[51].

The ABD area has been planned with smart net metering facility and has allotted 5% free premium FSI for buildings with green norms. There is a need for additional incentives outside the ABD area to reduce the cost of green buildings and to boost awareness about and adoption of green building.

Urban Planning, Green Cover and Biodiversity

The per capita green space in Indore is 16 sq m[52], above the threshold under URDPFI guidelines, constituting 20% of the total municipal area[53]. The city is also taking steps to conserve water bodies such as Sirpur and Yashwant Sagar lake, and to restore wells and stepwells.

The green cover is not evenly distributed, and a major challenge for the city remains poor urban planning with inadequate supporting infrastructure, including public green and open spaces. This, along with congestion, contributes to high levels of air pollution and negative health effects.

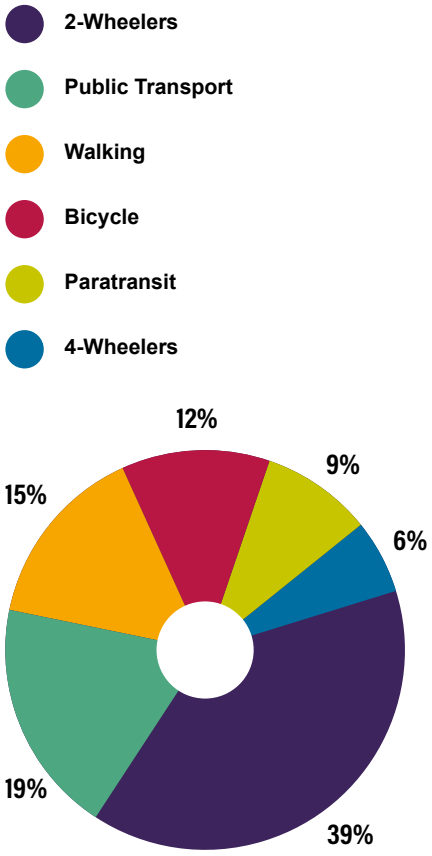
Mobility and Air Quality

Atal Indore City Transport Service Ltd., previously called ICTSL, is Indore's main public transport operator. Based on CSCAF 2.0 data, AICTSL operated a 2438 buses as of 2020, and 10% of the public bus fleet ran on low-carbon fuels. Around 40% of shared vehicles run on clean fuels. The modal share of Indore city transport is presented in Figure 22[54].

It can be seen that 2-wheelers dominate the modal share, followed by public transport.

Around 15% of the modal share consists of pedestrians, which is possible due to the fact that almost one-fourth of roads support NMT infrastructure. Indore's public transport has 95 buses per 100,000 population[55]. Indore has a good BRTS, which needs to be further developed. Average daily ridership in 2019 was 60,000. However, it has stagnated of late in terms of incremental changes in ridership, mainly due to lack of network expansion and lack of integration with metro[56].

Figure 22: Indore city modal share of transport
(Source: WBCSD Sustainability 2.0)



[51, 53, 55] Indore Smart City, *Climate Smart Cities Assessment Framework, 2020*

[52] Climate Informed Environmental Planning for Smart Cities of Madhya Pradesh-Indore, *SPA Bhopal, 2019*

[54] Sustainable Urban Mobility, Project Report for Indore City, *WBCSD Mobility, 2016*

[56] Transforming Cities With Bus Rapid Transit (BRT) Systems: How to Integrate BRT, *Volvo Research & Educational Foundations, 2019*

Figure 23: Composition of total vehicle fleet registered between 2015-2020 *(Source: RTO Indore)*

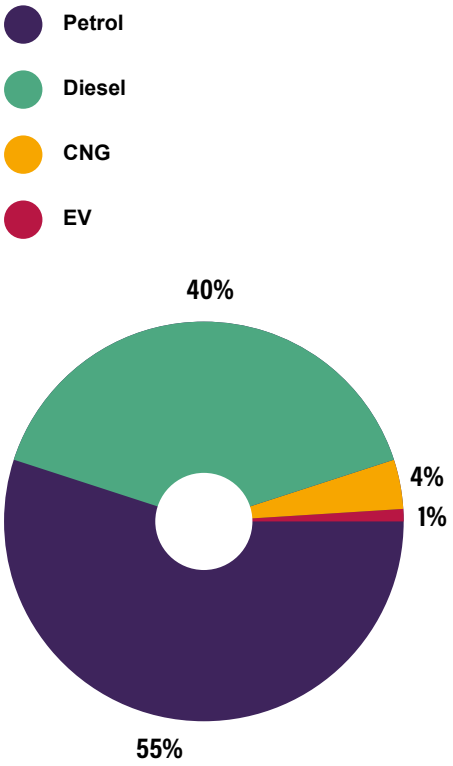
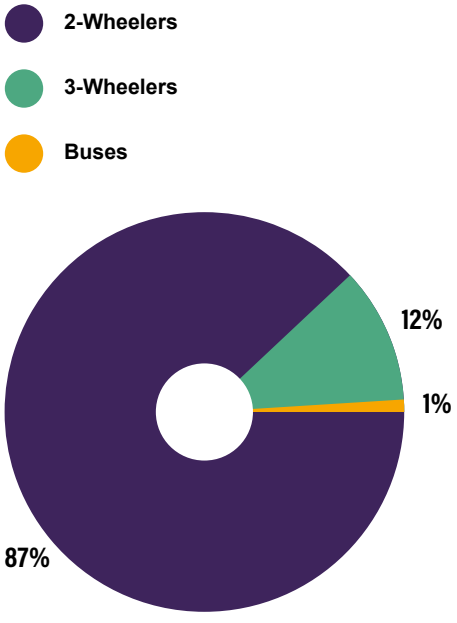


Figure 24: Distribution of electric vehicles registered between 2015-2020 *(Source: RTO Indore)*



Based on data from Indore Regional Transport Office (RTO), 55% of the total vehicles registered between 2015 and 2020 run on petrol, 40% on diesel, and only 4% on CNG. Just 1% of vehicles registered in this period are electric, and 4-wheelers and buses account for the smallest proportion of these electric vehicles.

The dominance of fossil-fuel based transportation results in poor air quality, mainly due to vehicular emissions. The city's average PM_{10} values are higher than PCB standards.

As part of its action plan[57] to reduce air pollution, the city has completed the following:

- Phasing out of diesel buses older than 15 years.
- Conversion of entire bus fleet to CNG, while autos and taxis are allowed to run only on CNG.
- Regular pollution checks for vehicles.
- Plantation work on road dividers, gardens, parks and community places, schools and housing societies, and roadsides is being done regularly by Indore Municipal Corporation. About 100,000 plantations were done in 2017- 2018.
- Mandate banning open burning of biomass and garbage.

Water Management

Geomorphology and hydrogeology play an important part in how precipitation can form ground water. Most of the city is under the range of 30-80 m deep wells with a yield of 100-200 liters per minute. However, Central Ground Water Board (CGWB) reports suggest that the Indore block is over-exploited by 148%[58].

Ground water is highly saline and unfit for drinking. Only 46% of the population has access to tap water[59]. The rivers in the city are exploited and not well maintained[60]. Due to distant water resources and the need to transport water over long distances, the cost of water is high (INR 18/kl, compared to INR 8-10/kl in other cities).

As per the CSCAF 2.0 report, the city currently has 30% of non-revenue water, and does not have a metering policy. Hence it is difficult to estimate water consumption at household level and the physical loss in the city[61].

[57, 60] Action Plan for Control of Air Pollution in Non-Attainment City of Madhya Pradesh (Indore), *Madhya Pradesh Pollution Control Board, 2019*

[58] Climate Informed Environmental Planning for Smart Cities of Madhya Pradesh-Indore, *SPA Bhopal, 2019*

[59] ABD Water Supply & Sewerage Project, *Indore Municipal Corporation, 2019*

[61] Proposed Master Plan, *Smart City Indore Portal*

Regular flooding and water-logging due to low-lying areas and lack of adequate drainage facilities remain a major challenge to the city. Indore is located on the Kanh River basin and faces regular flooding. There is a need for an integrated flood control and storm water drainage plan. The city faces contamination of natural drainage paths along the Kanh river due to waste dumping, leading to water logging and flooding risks[62], especially in slums. Thus, there is a need to commission water treatment plants before the run-off enters the rivers[63].

Inputs received during stakeholder consultations indicate that the city has a 245 MLD sewage treatment plant at Kabit Khedi. Treated water is supplied to farmers for irrigation. It is also supplied to overhead tanks, from where it is transmitted to 101 gardens and 35 hydrants, from which IMC tankers are filled for various purposes. From decentralized STPs, treated water is pumped to 70 gardens, 38 hydrants and four lakes, viz. Pipliapala, Naytamundala, Pipliyahana and Bijalpur.

The GHG emissions from wastewater treatment for Indore was 0.3 mtCO_2e for 2019. According to the data submitted, the city has saved over INR 3 million through energy-efficient water supply systems until November 2019. It was highlighted during the consultations, however, that periodic energy audits for the water supply system should be carried out, and energy consumption and savings tracked and assessed more consistently.

Waste Management

Indore has consistently bagged first rank in Swachh Bharat Mission in the five years since 2017, making it the cleanest city in the country. The city is pioneering measures to reduce, reuse and recycle its waste, and has created a waste-to-wealth model through its waste management plan.

The total waste generation in Indore was 1029 TPD in 2021. Organic waste constituted the largest share[64]. Of the total waste generated, 100% is collected through door-to-door pick-up, and 92% of the dry waste collected is recycled into fractions such as cartons, grey board, plastics, paper, and glass, in two material recovery facilities[65]. Domestic hazardous waste is incinerated at the Central Biomedical Waste Treatment Facility.

IMC has installed a recycling plant in the trenching ground for construction and demolition (C&D) waste and has five dedicated collection centers. Fines are levied on those who dump C&D waste elsewhere. The city's municipal solid waste (MSW) output for the year 2019 resulted in the generation of a total of 1810 tonnes of methane[66].

[62] The Smart City Challenge: Smart City Proposal, *India Smart City Mission*\

[63] Climate Informed Environmental Planning for Smart Cities of Madhya Pradesh-Indore, *SPA Bhopal, 2019*

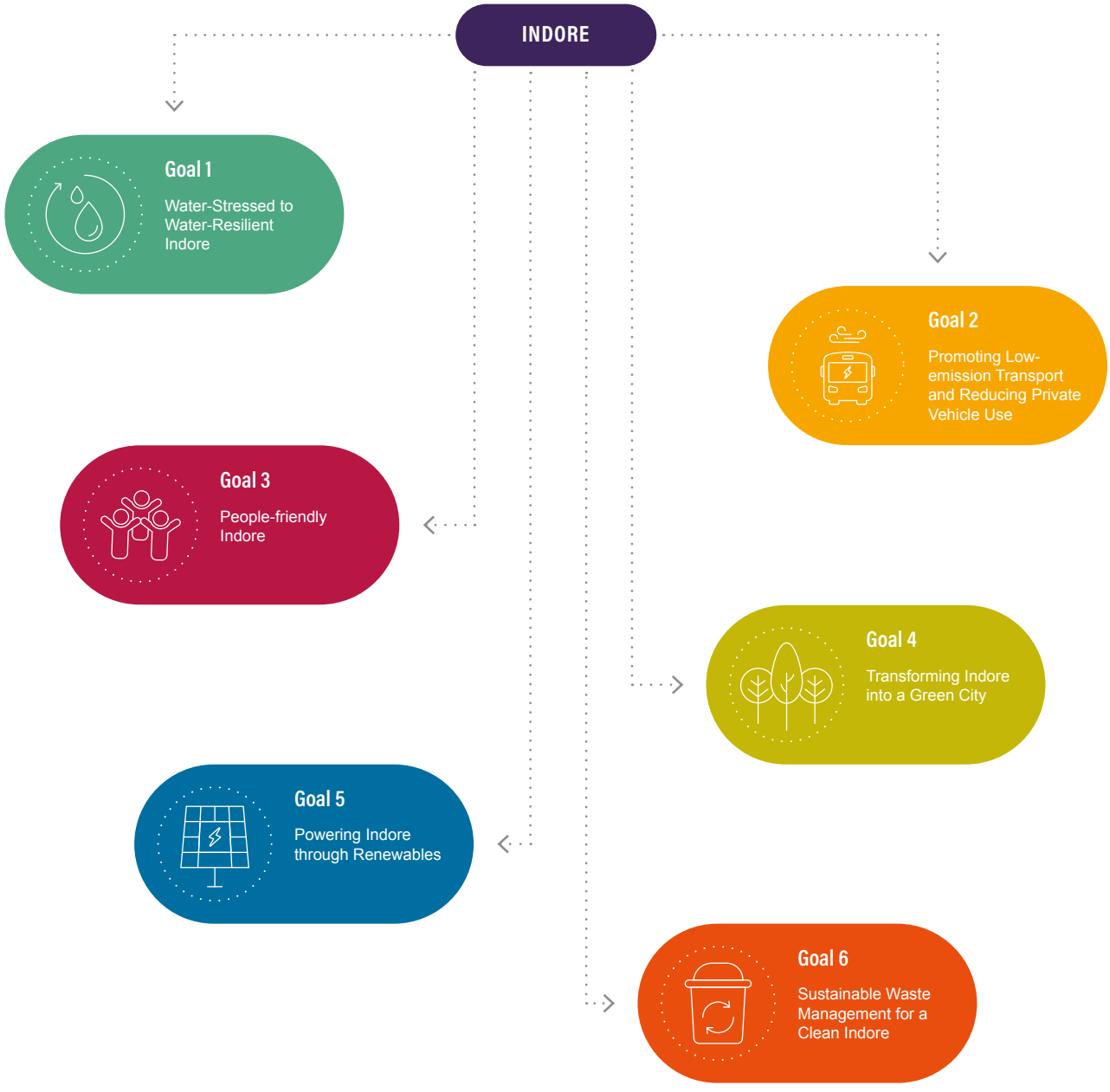
[64, 65] Solid Waste Management, *Smart City Indore Portal*

[66] City GHG Inventory, 2019

Sectoral Goals

The sectoral goals identified for Indore city are aligned with the priorities of existing sectoral departments to ensure the efficient implementation of the Indore CAP. However, there is considerable scope to establish convergence and dovetailing across sectors, establish collaborations across departments, and reap the co-benefits of holistic solutions. The six goals identified are discussed in Figure 25.

Figure 25: Sectoral goals for Indore



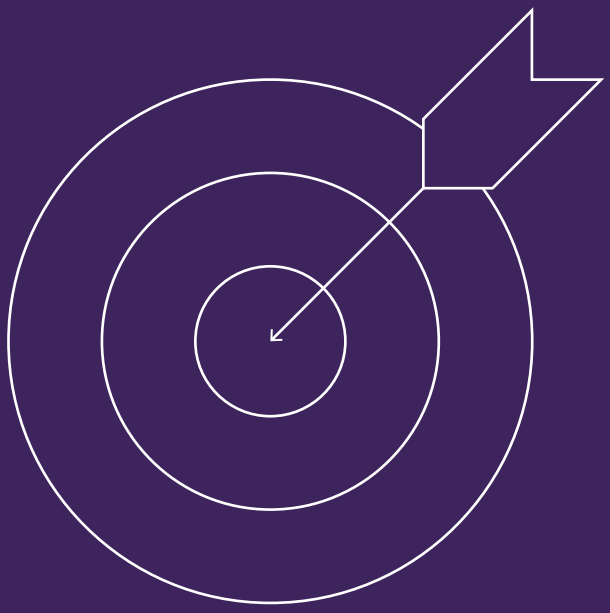
Mainstreaming Inclusivity in the Indore Climate Action Plan

Indore's Climate Action Planning process stresses the importance of inclusive planning. An inclusivity analysis has been included for each sectoral action to ensure that the action has equitable benefits for all identified impact groups. The analysis has been adopted from the guidance document on "How to tackle climate change and inequality jointly: practical resources and guidance for cities" prepared by World Resources Institute Ross Centre for Sustainable Cities and C40 cities in 2019[67]. As a first step towards mainstreaming inclusivity, cities must ensure that inclusivity is embedded in processes, policies and impacts (Figure 26). Inclusivity of process ensures that each policy making process involves engagement with stakeholders, especially the ones most vulnerable to climate change. Inclusivity of policies should ensure that policies are designed with people at the centre of decision making. Finally, the actions proposed should include clear indicators and monitoring frameworks to measure the inclusivity of impacts across each impact group. Impact groups can include elderly, children, disabled, religious minorities, informal communities, temporary workers, etc.

Figure 26: Inclusive climate action planning *(Source: C40 Cities & WRI India)*

[67] Inclusive Planning Executive Guide, How to tackle climate change and inequality jointly, *C40 Cities & WRI Ross Centre for Sustainable Cities*

SECTORAL CLIMATE ACTIONS



Goal 1: Water-Stressed to Water-Resilient Indore

Indore faces several water-related challenges that need to be addressed. The city imports most of its water and has high non-revenue water losses during transmission. This, coupled with infrastructure gaps in slum communities, has resulted in severe water-sanitation inequity in the city. By adopting robust water resource management policies to reuse water, increase percolation, and harvest rainwater, additional and local sources will be explored. The city will also work to introduce nature-based solutions to strengthen the drainage network and to increase the percolation and holding capacity of existing infrastructure.

Thus, the actions under this goal aim to promote sustainable urban water management and enhance Indore's water security, improve flood and drought resilience, increased equity, and access to potable water, and enable better demand management and monitoring.

Identified Actions

Action 1: Mandate to use treated wastewater to cool thermal power plants and for other industrial uses

- **Challenges addressed at the city level:** Indore is a water-scarce city. Most of its water is pumped from the Narmada River, around 70 km from Indore, which implies a high pumping cost[68]. Besides, many blocks of the city are in over-exploited pockets as far as groundwater is concerned.

- **Description:** Following Maharashtra's example[69], Indore can issue a city-level mandate or urge the state of MP to mandate that industries within the Indore Municipal Corporation (IMC) area use treated wastewater to cool thermal power plants and for other non-potable purposes. This will also push IMC to install more tertiary treatment plants, which are currently lacking in the city. In Nagpur[70], the Nagpur Municipal Corporation (NMC) entered into a 30-year contract with a privately owned thermal power plant, under which the NMC provides wastewater and the company, which invested in a treatment plant, utilizes the water, thus reducing its costs. The Nagpur thermal plant pays INR 3.4 instead of INR 9.6 per cubic meter of water, while NMC uses the revenue generated to run other wastewater treatment plants in the city. Similarly, reusing treated wastewater in Indore would be prudent, given the city's water scarcity.

- **Inclusivity analysis:** This must be accompanied by increased awareness on demand management measures and efficient water consumption. Reduced water costs from such initiatives must be equitably distributed to low-income and informal groups who use the least amount of water but face highest stress.

- **Implementing stakeholders:** Indore Municipal Corporation (Lead), Indore Smart City, MP Pollution Control Board (MPPCB), water utilities, thermal power plants, industries

- **Timeframe:** Short term (1-2 years)

- **Mainstreaming with policies, schemes, and programs:** AMRUT - Funding for projects reusing wastewater, Ministry of Power's Power Tariff Policy of 2006, mandating thermal power plants within 50 km of sewage treatment plants to use treated sewage water[71], Jawaharlal Nehru National Urban Renewal Mission on Urban Infrastructure and Governance; Common Effluent Treatment Plant (CETP) for Medium & Small – Scale industries; Online Monitoring of Industrial Emission & Effluent (OCEMS); Swachh Bharat Mission Urban.

- **Indicators:** Reduced freshwater use, reduced utility costs for industries, number of tertiary treatment plants set up

- **Alignment with CSCAF indicators:** Indicator 3 (wastewater recycle and reuse) within water management.

Action 2: Develop and implement an integrated flood and storm water management plan

- **Challenges addressed at the city level:** In 2020, Indore witnessed severe urban flash floods, with roads submerged under as much as 12 inches of water, due to heavy showers[72]. The city faces a major issue of pollution of water bodies due to improper sewerage channels. The Central Ground Water Board (CGWB)

[68] What Makes Indore's Narmada Water Project One of the Costliest in the Country?, *The Bastion, 2022*

[69] Industrial units, thermal plants to use only treated water: Maharashtra government, *Hindustan Times, 2017*

[70] Wastewater: From Waste to Resource, A case study from Nagpur, India, *Water Global Practice, World Bank Group, 2019*

[71] Why better policies are needed for sewage water use in thermal power plants, *Down To Earth, 2020*

[72] Rainfall in Indore breaks 39 year record, city gets flooded, *Knock Sense, 2020*

report also indicates that that the Indore block is over-exploited in terms of groundwater extraction, which adds a challenge to the city's water scarcity issues[73].

- **Description:** An integrated flood and storm water management plan is essential to reduce the risk of urban flooding. A storm water management plan[74] would help:
  - Reduce road and building flood risks
  - Incorporate storm water considerations into new developments
  - Improve water reuse and water security
  - Reduce infiltration of untreated sewage into water bodies
  - Enhancing and recharging the ground water table
  - Improve coordination and planning for flood risk management

  The city can also incorporate Sustainable urban drainage systems[75], often regarded as a sequence of management practices, control structures and strategies designed to drain surface water efficiently and sustainably, while minimizing pollution and managing the impact on water quality in local water bodies. Examples include permeable paving on driveways and footpaths, garden beds designed for infiltration (raingardens), lawns and vegetation, swales, and soak wells, etc.[76]. This storm water management plan can include actions at the city and individual levels.

- **Inclusivity analysis:** Low-income communities, informal residents and workers, and migrants are highly impacted due to climate change-induced urban flooding. Nature-based solutions such as green infrastructure (GI) projects for residential properties, which typically have high one-time installation costs and inflexible payment schemes, may be expensive for these communities. GI on public property, such as more street trees, green roofs, and bioswales, may also raise nearby real estate prices, outpricing low-income residents and unintentionally ushering in "green gentrification".

- **Implementing stakeholders:** Indore Municipal Corporation (Lead), Indore Smart City, Indore Development Authority, Resident Welfare Associations (RWAs) and communities, Water Resources Department MP

- **Timeframe:** Medium term (3-5 years)

- **Mainstreaming with policies, schemes, and programs:** AMRUT - thrust areas such as sewerage facilities and septage management, and storm water drainage management; Madhya Pradesh Urban Services Improvement Project by ADB

- **Indicators:** Reduced flooding frequencies, reduced water stagnation, improved vegetation, and recharged water table, reduced infiltration of untreated sewage into water bodies

- **Alignment with CSCAF indicators:** Indicator 4 (Flood/water stagnation risk management) within water management. In accordance with Level 5 under the climate action plan indicators, water-sensitive urban design[77] considerations can also be incorporated into the city's master plan.

Action 3: Mandate to reuse treated water for the management of parks, urban and rooftop gardens

- **Challenges addressed at the city level:** As per CSCAF 2.0, only 11% of wastewater is recycled.

- **Description:** Indore is planning to implement a 25 km line to supply treated water to gardens[78]. This can be done for parks and rooftop gardens and can be mandated. Examples in India[79] include the Sangamam Housing Project on the outskirts of Auroville. It has a Decentralized Wastewater Treatment (DWWT) system in which an anaerobic upflow reactor is used for primary treatment, which is then followed by a root zone secondary treatment system, and finally treated in maturation ponds. The treated wastewater is used for flushing toilets, gardening, etc. The demand for freshwater has reportedly reduced by 120 liters per capita per day. Such an action can first be implemented in Indore's municipal buildings to showcase municipal commitment.

- **Inclusivity analysis:** This must be accompanied by increased awareness amongst communities on the need to replenish ground water and optimize water usage.

[73] Climate Informed Environmental Planning for Smart Cities of Madhya Pradesh-Indore, *SPA Bhopal, 2019*

[74] Manual on Storm Water Drainage Systems, *Central Public Health and Environment Engineering Organization (CPHEEO), 2019*

[75] Sustainable Drainage, *SusDrain*

[76] Require Planning for Strong Storm water Management in India, *Econaur, 2019*

[77] Water sensitive urban and building design, *Climate Adapt, 2016*

[78] 25-km pipeline to supply treated water to gardens, *The Times of India, 2019*

[79] Water reuse in India: Current perspective & future potential, *Science Direct, 2020*

Low-income and informal communities tend to use the least amount of water per capita but face the highest levels of water stress. Reduced water costs from such initiatives must be equitably distributed to low-income and informal groups who use the least amount of water but face high stress.

- **Implementing stakeholders:** Indore Municipal Corporation (Lead), Indore Smart City, Indore Development Authority, RWAs, and communities
- **Timeframe:** Short term (1-2 years), and implementation and monitoring will be medium-to-long term.
- **Mainstreaming with policies, schemes, and programs:** Govt. of Madhya Pradesh State Level Policy (2017) for Wastewater Recycle and Reuse; AMRUT - Funding for water reuse projects; Smart Cities Mission.
- **Indicators:** Reduced water costs, increase in green cover
- **Alignment with CSCAF indicators:** Indicator 3 (wastewater recycle and reuse) within water management, and Indicator 2 (proportion of green cover) under urban planning, green cover, and biodiversity.

Action 4: Instal smart water meters and implement a demand management plan for optimal usage of resources

- **Challenges addressed at the city level:** As per stakeholder consultations and CSCAF 2.0 data, the city does not have a metering policy to install water meters at the consumer's tap connection. Hence it is difficult to estimate the quantity of water consumed and the physical loss.
- **Description:** According to CSCAF, the city should assess the water usage in different sectors. A demand management plan must also be implemented for the best utilization of available resources. For example, Pune Municipal Corporation, in collaboration with Sensus, had installed 325,000 meters in the city[80]. The smart meters at the household level help residents reduce water consumption and allow water suppliers to charge according to usage rather than levying a uniform rate. In Indore, such a step would facilitate consumer water management and help conserve the city's decreasing water supply, especially in high water-stress areas. Housing societies can use this information to further come up with water conservation strategies. AI-based water meters will enable remote readings. The apps can also help consumers see where they stand in comparison to their neighbors. Such meters can be installed first in municipal buildings. Standards for meter quality and design must be established. The city is planning is planning to implement radio frequency smart water meters in 24,000 houses. This can be scaled up further after testing the uptake[81].

  Smart / automatic water pumps can also be introduced and promoted in the city to avoid water loss due to overflowing tanks. It is important to raise awareness among citizens in this regard.
- **Implementing stakeholders:** Indore Municipal Corporation (Lead), Indore Smart City, MP Jal Nigam, Madhya Pradesh Public Health Engineering Department (MP PHED), Department of Urban Development and Housing, water utilities, RWAs and communities.
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** Smart Cities Mission; Smart Meter National Program; Madhya Pradesh Urban Services Improvement Project.
- **Indicators:** Reduced water usage and tariffs for consumers, monitoring water losses, reduced demand.
- **Alignment with CSCAF indicators:** Indicator 1 (water resources management) within water management.

Action 5: Develop a water supply contingency plan

- **Challenges addressed at the city level:** Climate change has resulted in drastic precipitation anomalies, with a higher incidence of drought. Indore faces a high risk of drought and increasing vulnerability to reduced surface water availability during the SW and NE monsoons as per CORDEX data. The city will also face increasing crop water stress.
- **Description:** The Water Shortage Contingency Plan is a document describing how a water agency should respond at various stages of a drought or prolonged water shortage caused by some other event. In 2016,

[80] Smart meters are helping residents slash water use, *The Times of India, 2019*

[81] 24k 'old city' households to get smart water meters, *The Times of India, 2022*

the Maharashtra government had to supply water tankers through the railways to drought-affected areas of state[82]. The contingency plans should entail strategic actions that need to be rolled out in a stage-wise response to mitigate the water shortage to avoid drastic effects[83].

Indore Municipal Corporation may consider relying more on traditional water supply sources. There are more than 600 wells in the city, which can cater to the needs of more than 30,000 families. Local communities may also use the water for purposes such as construction, gardening, etc.

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Smart City, water utilities.
- **Timeframe:** Short term (1-2 years).
- **Mainstreaming with policies, schemes, and programs:** AMRUT - Funding for projects strengthening water supply, Madhya Pradesh Urban Services Improvement Project, State Disaster Management Policy MP
- **Indicators:** Reduced drought vulnerability, increased water availability
- **Alignment with CSCAF indicators:** Indicator 4 (Flood/water stagnation risk management) within water management.

Action 6: Implement green walls in buildings for grey water use

- **Challenges addressed at the city level:** There is only 20% green cover in Indore as per CSCAF 2.0 data. The city also gets very hot in the summer, creating an urban heat island effect. Therefore, vertical gardens and green walls may be developed by irrigating them using grey water. Few cities in India have developed this concept.
- **Description:** Green walls, also known as living walls, are self-sustaining vertical gardens with significant potential to manage water. Vegetated green walls can serve as a biofiltration system to treat grey water from buildings[84]. Indore Municipal Corporation can develop pilots to study the small-scale use of green walls that rely on grey water from households or buildings[85]. Such walls also serve to reduce the urban heat island effect and improve indoor air quality, both of which will benefit Indore. NaWaTech conducted a pilot study in Pune[86] on the use of vertical gardens for decentralized water treatment.
- **Inclusivity analysis:** This action must be accompanied by increasing communities' awareness about the need to replenish ground water and optimize water usage.

  Green walls can also be created in informal areas at municipal costs or through collaboration with private agencies through corporate social responsibility funds or other models to ensure equitable access to those lacking infrastructure.
- **Implementing stakeholders:** Indore Development Authority (lead), Indore Smart City SPV, Indore Municipal Corporation, builder associations, RWAs, gardens department.
- **Timeframe:** Medium term (3-5 years)
- **Mainstreaming with policies, schemes, and programs:** AMRUT - funding for reuse of water projects; Swachh Bharat Mission Urban; Smart Cities Mission.
- **Indicators:** Reduced water tariff for buildings with green walls.
- **Alignment with CSCAF indicators:** Indicator 3 (wastewater recycle and reuse) within water management.

Action 7: Institute a non-revenue water cell

- **Challenges addressed at the city level:** Non-revenue water (NRW) losses remain a major problem for Indore as per CSCAF 2.0 data. The city lacks efficient monitoring of consumption, leakage, and illegal exploitation of water.
- **Description:** Following the example of Navi Mumbai[87], Indore can develop a cell to manage the issue of non-revenue water losses. The cell can include private and public stakeholders and would identify the causes of and solutions for non-revenue water losses through leakage mapping, designing for leakage reduction, and

[82] Contingency plan needed to deal with erratic monsoon, *DNA India, 2018*

[83] Water shortage contingency plan, *Las Virgenes Municipal Water District, 2016*

[84] Green Walls as an Approach in Grey Water Treatment, *IOP Conference Series: Materials Science and Engineering, 2017*

[85] Vertical Gardens Factsheet, *Indo-European Project NaWaTech, 2012*

[86] Vertical Gardens for greywater treatment and recycling in dense urban areas: a case-study in Pune, *Masi et al 2015*

[87] NRW Reduction Strategy, *Water Supply Department (Navi Mumbai)*

management strategies including a review of network connections to determine physical losses, a review of commercial practices to determine losses due to billing and tariffs, etc.[88]. This cell can also be responsible for regularly calculating Indore's infrastructure leakage index.

- **Inclusivity analysis:** Inequitable distribution of water remains a major issue in urban areas. Here, the NRW ends up at 30%. Low-income and informal communities tend to use the least amount of water per capita, but face the highest levels of water stress, from intermittent service to relying on expensive private vendors. The city should identify overlapping responsibilities or jurisdiction gaps between water and sanitation authorities, and coordinate short-, medium- and long-term plans to address service gaps, decrease non-revenue water and increase reuse. Addressing the issue of NRW helps ensure equitable access to piped water supply to low-income and vulnerable households.
- **Implementing stakeholders:** Indore Municipal Corporation (Lead), Indore Smart City, Indore Development Authority, research organizations, private sector, citizen forums.
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** AMRUT; Swachh Bharat Mission Urban.
- **Indicators:** Reduced NRW loss.
- **Alignment with CSCAF indicators:** Indicator 2 (Extent of non-revenue water) within water management.

Action 8: Revive local lakes/ponds and rejuvenate polluted river stretches through desilting, aquifer recharging and river rejuvenation projects

- **Challenges addressed at the city level:** Indore gets 75% of its water supply from the Narmada River, about 70 km from the city, making its water energy-intensive and costly[89]. To check the wastage of drinking water, Indore Municipal Corporation has linked water distribution to Supervisory Control and Data Acquisition (SCADA) system. Even so, the demand remains unfulfilled.
- **Description:** While IMC and other authorities are making energy-intensive and high-cost efforts to ensure adequate water supply, the city's demand should be supplemented through the other sources. Surface water availability can be enhanced by making it pollution-free and potable. The city would benefit from thinking of projects along these lines.

  Reviving the Yashwant Sagar dam and using water from Sirpur lake would take pressure off the Narmada water supply in terms of the cost of pumping and energy conservation.
- **Inclusivity analysis:** Low-income groups would be able to use water from natural resources. The rejuvenation of polluted water supply sources may also address the gap of inequitable access to potable water.
- **Implementing stakeholders:** Indore Municipal Corporation (Lead), Indore Smart City, Indore Development Authority, MP State Wetland Authority, research organizations.
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** AMRUT - Funding for projects strengthening water supply; Smart Cities Mission; Climate Change Action Program; MP SAPCC.
- **Indicators:** Reduced water loss, reduced drought vulnerability, increased water availability.
- **Alignment with CSCAF indicators:** Indicator 1 (water resources management) within water management. Indicator 2 (Extent of non-revenue water) within water management.

[88] Designing an Effective Leakage Reduction and Management Program, Performance Improvement Planning, *Water and Sanitation Program, 2008*

[89] What Makes Indore's Narmada Water Project One of the Costliest in the Country? *The Bastion, 2022*

Goal 2: Promoting Low-Emission Transport and Reducing Private Vehicle Use

The city will work towards integrated modes of transport, increase ridership in public transport and promote EVs and increased EV infrastructure. It will also aim to enhance the mode share of non-motorized trips and to improve NMT infrastructure while ensuring increased pedestrian safety and last-mile connectivity,

Overall, actions under this goal aim to promote low-emission transport, strengthen public transport and disincentivize private vehicle use in Indore.

Identified Actions

Action 1: Improve last-mile connectivity of the planned metro in Indore

- **Challenges addressed at the city level:** Indore aims to complete its metro by 2024[90]. Data shows that the average ridership of Chennai's metro was 900 riders/km as of 2017, which was only 4.8% of planned ridership[91]. The ridership during the first four years of operation for the Delhi Metro remained consistently around 25% of the intended ridership, in line with global trends. An important factor leading to low ridership was poor last-mile connectivity. Indore can ensure right from the planning stage that its upcoming metro has good last mile connectivity and ensure adequate funding for it.

- **Description:** As metro rail systems are expanding across India, 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[92]. Indore can ensure that its metro has good intermodal connectivity during its planning stages. Examples of initiatives can be:
  - Linking metro routes with iBus (BRTS) stations or scooter/cab services (e.g., Ahmedabad metro[93])
  - Public bike-sharing rentals outside metro stations
  - Autorickshaw depots close to the starting and ending points of metro routes
  - Feeder bus services (e.g., Delhi[94])

- **Inclusivity analysis:** Access for low-income groups may be hampered when there is no safe infrastructure such as proper pavements, pedestrian crossings, pick-up/drop-off areas and access ramps for last-mile access to transit stations on modes they typically use (walk, bike, informal and paratransit). Mobility options must integrate facilities for the disabled and elderly. Women's safety should also be addressed in the metro and other modes, through women-only compartments, helpline numbers, seats reserved for women, and the provision of panic buttons, made compulsory by the national government in 2019. Indore already has live monitoring in BRTS stations. Integrated fare cards are being planned, and the front portion of buses is reserved for women.

- **Implementing stakeholders:** MP Metro Rail Corporation Limited (Lead), Atal Indore City Transport Services Limited (AICTSL), private companies, Indore Municipal Corporation, Indore Smart City, Transport Department (GoMP), Department of Urban Development and Housing (GoMP)

- **Timeframe:** Short term (1-2 years)

- **Mainstreaming with policies, schemes, and programs:** AMRUT - Funding for non-motorized urban transport projects; FAME scheme: promote electric last mile services; National Urban Transport Policy 2006

- **Indicators:** Increase in metro ridership, increase in use of feeder service, modal shift away from private transport.

- **Alignment with CSCAF indicators:** Indicator 4 (level of air pollution) within mobility and air quality.

[90] We aim to complete Bhopal and Indore Metro Projects in next 3-4 years: CM Shivraj Chouhan, *Zee News, 2020*

[91] Enhancing Ridership of Chennai Metro, *Chennai Metro Rail*

[92, 93] As Metro Networks Expand, Government Shifts Focus To The Last Mile Connectivity, MCML Projects Pvt. Ltd.,

[94] Metro Feeder Buses - Service Availability, *Delhi Metro Rail Portal*

Action 2: Convert i-ride service into electric scooters

- **Challenges addressed at the city level:** The transport sector accounts for 1.08 mtCO_2e emissions, coming from the consumption of petrol and diesel in on-road transport. Thus, Indore needs to shift towards electric vehicles particularly in private vehicle segments. Less than 1% of scooters registered from 2015 to 2020 were electric[95], stressing on the need to increase the fleet of electric 2-wheelers.

- **Description:** The AICTSL (Atal Indore City Transport Services Limited) manages Boom Bikes or i-ride, which is a rental scooter service (sports bike, general bike, and Honda Activa). The petrol costs had to be borne by the rider[96]. The city can convert these into electric scooters, leveraging the country's booming scooter-sharing economy. The government can also encourage freight services like Zomato, Swiggy, Amazon, etc to electrify their fleets through subsidies, mandates in contracts, higher tipping fees for waste collection fleets, etc.

- **Inclusivity analysis:** Renting electric scooters can generate significant cost reductions for people who use them[97]. It is important to provide easy loans for low-income groups to reduce upfront costs of EVs.

- **Implementing stakeholders:** Atal Indore City Transport Services Limited (AICTSL) (lead), Indore Municipal Corporation, citizens' forums, communities, Transport Department (GoMP).

- **Timeframe:** Medium term (3-5 years)

- **Mainstreaming with policies, schemes, and programs:** FAME Phase II; Madhya Pradesh EV Policy, 2019; National Electric Mobility Mission Plan; Smart Cities Mission; National Urban Transport Policy, 2006.

- **Indicators:** Increase in modal share of electric vehicles, increase in sales of e-scooters, increased ridership per day.

- **Alignment with CSCAF indicators:** Indicator 1 (clean technologies for shared vehicles) within mobility and air quality and Indicator 3 (fossil fuel consumption in the city) under energy and green buildings.

Action 3: Increase public transport fleet and incorporate passenger communication initiatives

- **Challenges addressed at the city level:** The transport sector accounted for 1.08 mtCO_2e emissions in 2019-2020, due to the consumption of petrol and diesel in on-road transport. Shifting towards public transport would help reduce per capita emissions from road transport. Buses cater to only 19% of passenger trips in the city. Moreover, as per CSCAF 2.0 data, the city has only 0.95 buses per 1,000 people, not enough to cater to the estimated demand. It is predicted that 5.5-million-person trips per day will be generated in 2025, of which public transport would meet the demand for 2.75 million trips[98]. Thus, Indore needs to work on expanding public transport infrastructure availability and accessibility.

- **Description:** The city can implement initiatives to improve the quality and quantity of the bus services and identify the shortcomings of the BRTS and further expand it. The city can take inspiration from the "Bus Karo" guidebook[99], focusing on service planning and operations, fuel efficiency, infrastructure, ICT integration, demand management incentives, and financing. The guidebook also includes city-wise analysis and recommendations. This can be coupled with passenger communication initiatives such as real-time dashboards that give information on bus arrival, capacity, etc.

- **Inclusivity analysis:** Buses should have ramps for persons with disabilities, women-friendly features such as panic buttons, and training for women drivers. Fare integration and routes in low-income areas are also important to ensure equitable access.

- **Implementing stakeholders:** Atal Indore City Transport Services Limited (AICTSL) (lead), Indore Municipal Corporation, Indore Development Authority, Urban Development and Housing Department (GoMP), Transport Department (GoMP).

- **Timeframe:** Start in the short term (1-2 years).

- **Mainstreaming with policies, schemes, and programs:** AMRUT- urban transport component; National Urban Transport Policy 2006; Smart Cities Mission.

[95] Primary data, *Indore RTO*

[96] AICTSL launches i- bike, i- ride, *The Free Press Journal, 2019*

[97] Should I rent or buy an electric micromobility vehicle?, *somEV, 2013*

[98] Indore Factsheet, *AiCTSL City Bus*

[99] Bus Karo 2.0 Case Studies from India, *WRI Ross Centre, 2011*

- **Indicators:** Increase in modal share of public transport, increase in passenger use of buses.

- **Alignment with CSCAF indicators:** Indicator 2 (availability of public transport) within mobility and air quality.

Action 4: Increase the share of e-vehicles and charging infrastructure for passenger transport

- **Challenges addressed at the city level:** Currently, transport accounts for 30% of GHG emissions in the city, mostly attributed to fossil fuel consumption. As per data from the Regional Transport Office (RTO), electric vehicles account for just 1% of Indore's total fleet, which consists of 87% two-wheelers, 12% three-wheelers and less than 1% buses and 4-wheelers. Thus, there is a need to further promote EVs, particularly 4-wheelers, through incentives, awareness and charging infrastructure.

- **Description:** Indore Municipal Corporation can tie up with private players such as Ola to increase the fleet of electric cars, buses, and rickshaws. For example, Nagpur took up the state's first multimodal e-mobility project with Ola, which launched a fleet of 200 EVs, primarily buses, taxis, and e-rickshaws in the city. Indore currently has 37 charging stations and plans to install 100 more.

  Indore Municipal Corporation can also implement initiatives to facilitate the uptake of EVs, such as:
  - Preferential access to EVs for parking, and access to bus lanes, carpool lanes, and toll roads
  - Mandate to make a percentage of parking lots EV-ready in residential complexes, commercial establishments, and government buildings
  - Discounts in parking fees and toll charges for electric vehicles up to 2028
  - The MP EV policy provides e-rickshaws with free permits, exemption, or reimbursement from road tax/vehicle registration fees for five years, and 100% wavier on parking charges at any municipal corporation-run parking facility for five years[100].
  - Promoting access to finance such as MUDRA loan
  - Piloting EV chargers on urban infrastructure such as streetlights

- **Inclusivity analysis:**
  - Easy loans and other incentives can be provided for reducing the upfront costs of EV buses particularly for low-income drivers and small businesses.
  - Renting electric scooters can generate significant cost reductions for people who use them occasionally[101], thus increasing low-cost access to micro mobility solutions
  - Loans for vehicle purchase can be made more easily available for low-income groups and small businesses.
  - There is a need to raise awareness or sensitize the citizens about the benefits of low-carbon buses and e-scooters, particularly amongst low-income or less educated groups, to increase uptake[102].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Atal Indore City Transport Services Limited (AICTSL), Indore Smart City, RTO.

- **Timeframe:** Medium term (3-5 years), start immediately.

- **Mainstreaming with policies, schemes, and programs:** FAME Phase II, Madhya Pradesh EV Policy 2019, National Electric Mobility Mission Plan, Smart Cities Mission, AMRUT, National Urban Transport Policy, 2006.

- **Indicators:** Improved air quality, increased modal share of electricity in transport

- **Alignment with CSCAF indicators:** Indicator 1 (clean technologies for shared vehicles), Indicator 4 (level of air pollution) within mobility and air quality, and Indicator 3 (fossil fuel consumption in the city) under energy and green buildings.

Action 5: Increase share of e-vehicles and charging infrastructure for freight transport

- **Challenges addressed at the city level:** Of the total traffic entering the city, freight vehicles account for 23%, followed by slow vehicles and cars (14.4%)[103]. They are a key contributor of emissions from transport. Freight decarbonization initiatives need to be implemented to reduce emissions.

[100] Review of State EV Plans Across India Amidst COVID-19, *NRDC, 2020*

[101] Value Champion Portal,

[102] Roadmap Inclusive Planning: Policy Recommendations, *C40 Cities, 2018*

[103] AiCTSL City Bus, *Indore Factsheet*

- **Description:** The city should study the freight movement and fuel composition of freight vehicles in the city, calculate emissions from freight through fuel sensors, real time emission sensors, etc. Initiatives to promote electrification can include:
  - Preferential parking spots in freight collection centers and logistics hubs with charging ports
  - Reduced parking fees and road taxes, and flexible timings for e-freight
  - Incentives to agencies using electric/CNG vehicles for solid waste management, e.g., higher tipping fees for e-vehicle fleet
  - Piloting electrification of vehicles carrying vegetables and fruits from mandis: incentives such as preferential parking for EVs in mandis, waiving mandi entry and parking fees.

- **Inclusivity analysis:**
  - Easy Loans and other incentives can be provided to reduce the upfront costs of EV buses, particularly for low-income drivers and small businesses.
  - Renting electric scooters can generate significant cost reduction for people who use them occasionally[104] thus increasing low-cost access to micro mobility solutions
  - There is a need to raise awareness about the benefits of low-carbon buses and e-scooters, particularly amongst low-income or less educated groups, to increase uptake[105].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Atal Indore City Transport Services Limited (AICTSL), Indore Smart City.

- **Timeframe:** Short-term (1-2 years).

- **Mainstreaming with policies, schemes, and programs:** FAME Phase II; Madhya Pradesh EV Policy, 2019; National Electric Mobility Mission Plan; Smart Cities Mission; AMRUT; National Urban Transport Policy, 2006.

- **Indicators:** Improved air quality, increased modal share of electricity in transport.

- **Alignment with CSCAF indicators:** Indicator 1 (clean technologies for shared vehicles), Indicator 4 (level of air pollution) within mobility and air quality, and Indicator 3 (fossil fuel consumption in the city) under energy and green buildings.

[104] Value Champion Portal

[105] Roadmap Inclusive Planning: Policy Recommendations, *C40 Cities, 2018*

Goal 3: People-Friendly Indore

Private vehicle use is on the rise in Indore, even for short trips, due to poor pedestrian infrastructure and inefficient public transport. Walking had a 15% mode share, with a road length of 1,911 km in 2019. Currently, 77% of roads have footpaths and cycling tracks as per CSCAF 2.0 data. The city can further increase NMT infrastructure to reduce congestion and increase the modal share of walking, cycling, and public transport. These actions will in turn result in added benefits such as improved air quality and physical health.

Identified Actions

Action 1: Create a non-motorized transport cell or division

- **Challenges addressed at the city level:** Walking had a 15% mode share, with a road length of 1,911 km in 2019. Increasing non-motorized transport is the key to reducing emissions from the transport sector, with more people shifting away from private, fossil fuel-driven modes.

- **Description:** According to MoHUA's guidance document[106] for NMT strategies in cities, the first step is the establishment of a NMT cell to enable policy- and planning-level interventions. The cell should include representatives from various city agencies, local government departments, academic institutions, NGOs, and the private sector. It is important to engage political leaders, policy makers and decision-makers in goal setting and vision-building to establish commitment to NMT. This will also enable Indore to adhere to the COVID integrated transport development advisory issued by the central government recently[107].

  Engagement techniques may include:
  - Visioning workshops in collaboration with central government agencies, state agencies, and NGOs/ advocacy groups
  - Integrating NMT principles as the backbone of all city-level policy discussions across agencies related to transportation, land use and economic development
  - Public outreach processes as part of master planning activities.
  - Identify technical leadership preferably from city staff, representatives from NGOs or local advocacy groups dedicated to the planning process.
  - Brainstorm on an NMT roadmap for short-, medium- and long-term interventions[108].

- **Inclusivity analysis:** This central coordination will enable inclusive development and planning for increased walking and cycling networks in the city and will increase access for the disabled and other vulnerable groups. (e.g., wheelchair access from the road to the curb, separate bicycle tracks with clear signage, separate lane on the curb for disabled access, and removal of encroachments). It is important to use a variety of engagement channels to reach different audiences with diverse needs. Stakeholder engagement must also be regularly tracked, monitored, and improved[109].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Atal Indore City Transport Services Limited (AICTSL), private transport providers, research institutions, citizen forums, Indore Development Authority, Urban Development and Housing Department (GoMP), Roads and Buildings Department (GoMP).

- **Timeframe:** Short term (1-2 years).

- **Mainstreaming with policies, schemes, and programs:** National Urban Transport Policy 2006, transport service level benchmarks, AMRUT- funding for projects promoting NMT, Smart Cities Mission: streets for people challenge.

- **Indicators:** Increase in percentage of walking and cycling lanes out of total road length, increase in modal share of NMT.

- **Alignment with CSCAF indicators:** Indicator 3 (percentage of coverage of NMT network (pedestrian and bicycle) within mobility and air quality.

[106] NMT Guidance Document: Consultancy Services for Developing Guidance Documents for Transit Oriented Development (TOD), Non-Motorised Transport (NMT) and Public Bicycle Sharing (PBS), *MoHUA, GoI, 2016*

[107] Advisory on the measures to be taken by States/UTs/Cities/Metro Rail companies in view of Covid-19 for providing Urban Transport Services, *MoHUA, 2020*

[108] Non-Motorised Transport Policy in India: The need for a reform agenda, *Sustainable Urban Transport Project, 2015*

[109] C40 Cities Playbook: Inclusive Community Engagement, *ARUP*

Action 2: NMT-focused urban street design guidelines for Indore city

- **Challenges addressed at the city level:** In a 2022 survey, 43% of respondents in Indore said personal safety was an issue while walking, and 66% said the city needed better sidewalks and paved paths[110]. The survey recommended more sidewalks and paved paths in the city center, residential areas, near schools, in industrial areas, and in parks.

- **Description:** Indore city can implement urban street design guidelines to define and initiate a process to ensure that appropriate street types and street design elements are implemented so that streets support both non-motorized and private transport modes. Cities such as Pune, Delhi, Mumbai, and Ahmedabad already have such guidelines in place[111,112]. These guidelines act as binding documents that mandate all urban professionals involved in street planning and urban renovation to include elements of inclusivity during the designing phases, such as use of curb ramps in pedestrian areas for increased access to all vulnerable groups.

- **Inclusivity analysis:**
  - Strict measures to tackle vendor encroachment should be followed, along with relocation measures.
  - Incorporation of safe and efficient infrastructure for cycling and walking, to ensure services for groups such as low-income and racial, ethnic, and religious minority communities, which primarily rely on these modes[113].
  - Bicycle tracks must be physically segregated from roads, and there should be clear signages to ensure the safety of cyclists[114].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Atal Indore City Transport Services Limited (AICTSL), private transport providers, researchers, citizens, Indore Development Authority, Urban Development and Housing Department (GoMP), Public Works Department (GoMP).

- **Timeframe:** Short term (1-2 years).

- **Mainstreaming with policies, schemes, and programs:** AMRUT, Smart Cities Mission: streets for people challenge.

- **Indicators:** Increased space for walking and cycling, roads conducive for use by people and vehicles, increasing modal share of NMT modes.

- **Alignment with CSCAF indicators:** Indicator 3 (Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city) within mobility and air quality.

Action 3: Expand Indore's PBS i-bike

- **Challenges addressed at the city level:** A road safety survey in 2022 found that 19% of respondents use a bicycle as their preferred mode of transport[115]. The Indore's public bicycle sharing system was revived recently. The city must develop a plan to scale up this service in order to encourage bicycling as a zero-emission mode of transport [116].

- **Description:** Some recommendations include[117]:
  - Conducting a gap assessment study to understand what the challenges and public perception of the current i-bike system are.
  - Mapping the entire network of bicycle rental shops that could be used as stations and repair hubs and integrating existing cycle rental establishments with the new public bike-sharing (PBS) system.
  - GPS-based tracking and unique numbering system for the bikes
  - Rebranding and effective marketing of cycle lanes, and linking them to green areas, lakes, and other recreational spots.
  - Exploring the electrification of the PBS, similar to that in Bhopal[118].
  - The municipal corporation can set an example by providing free electric bikes to field officers.

- **Inclusivity analysis:** Ensuring that cycle tracks and access modes like QR code or system with physical operator are conducive for low-income groups[119].

[110, 115, 116] Citizen Spotlight: Road Safety in Indore, *USAID & JSI, 2022*

[111] Street Design Guidelines for Greater Mumbai, *EMBARQ India, 2014*

[112] Urban Street Design Guidelines Pune, *Pune Municipal Corporation, 2016*

[113, 119] Roadmap Inclusive Planning: Policy Recommendations, *C40 Cities, 2018*

[114] Segregated Cycle Lanes, *Traffic Choices BS1, City of Bristol*

[117] Reviving Indore's Bicycle Sharing System, *WRI India, 2016*

[118] Bike sharing project to go electric in Bhopal, Bhopal, *The Times of India, 2019*

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Atal Indore City Transport Services Limited (AICTSL).
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** FAME Phase II; Madhya Pradesh EV Policy, 2019; National Electric Mobility Mission Plan; Smart Cities Mission; AMRUT; National Urban Transport Policy, 2006.
- **Indicators:** Increase in ridership for the PBS, number of bike stands installed.
- **Alignment with CSCAF indicators:** Indicator 3 (Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city) within mobility and air quality

Goal 4: Transforming Indore into a Green City

Urban green cover helps minimize the mean rising temperature, reduce the effect of heat waves, and arrest urban flooding. The city needs to work to enable all residents to have access to green spaces, undertake conservation, and extend biodiversity to protect itself from the impacts of climate change. The city should also aim for even spatial distribution of urban green spaces. This goal can be achieved by increasing the vegetation cover and reducing the heat island effect, and by increasing permeable surfaces in the city streetscape. The city will also benefit from implementing a greening plan.

Identified Actions

Action 1: Increase Indore's green cover

- **Challenges addressed at the city level:** The per capita green space in Indore is 16 sq.m, above the threshold specified by the URDPFI guidelines, constituting 20% of the total municipal area as per CSCAF 2.0. However, it is not evenly distributed, and a major challenge for the city remains poor urban planning with inadequate supporting infrastructure, including public green and open spaces. Increased green cover will help reduce heat stress. Data from climate models suggests that temperatures in Indore are likely to increase by 1.3°C by the mid-century[120]. Increasing green cover would also help mitigate flood risks.

- **Description:** A strategy is needed for planned green spaces and their integration with urban development. The city should geotag its trees and develop a tree census. The strategic plan should include a broad goal to increase green cover within a timeframe, sub-targets for the benefits of urban green cover for equity, transport, health, etc, zones for protection, and green corridors. This strategy can include actions such as green roofs, urban gardens, and urban forests.

  Examples of best practices include:
  - Action plan for increasing green cover in Agra by 15%[121].
  - Melbourne's urban forest strategy, 2012-2032[122].
  - Green Thane initiative[123].
  - Urban forests.
  - Taking guidance from MoHUA's urban greening guidelines[124] (2014).

- **Inclusivity analysis:** Engaging residents to increase social inclusivity of urban green cover projects is important. An equity index can be developed to help incorporate equity in the spatial distribution of these forests. The risk of "green gentrification" must be studied to reduce negative impacts on low-income groups.

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Development Authority, citizens, State Knowledge Management Centre on Climate Change (SKMCCC), MP Forest Department, MP State Biodiversity Board.

- **Timeframe:** Development (medium term, 3-5 years), Implementation (long term, >5 years).

- **Mainstreaming with policies, schemes, and programs:** AMRUT: 2.5% of project cost is funded for development of parks conducive for children and senior citizens, National Afforestation Program (NAP), Compensatory Afforestation Fund Management and Planning Authority (CAMPA), Green India Mission (GIM), Nagar Van Project

- **Indicators:** Increased percentage of green cover, increased biodiversity, improved air quality.

- **Alignment with CSCAF indicators:** Indicator 2 (proportion of green cover) within urban planning, green cover, and biodiversity.

Action 2: Incorporate green infrastructure (GI) within lake redevelopment projects

- **Challenges addressed at the city level:** Indore is working to develop the waterfront around Sirpur Lake, by cleaning up encroachments, and introducing local species and Miyawaki forests. The city can incorporate green infrastructure techniques into these projects to

[120] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*
[121] (Draft Report) Action plan for increasing green cover by 15% in Agra, *NIUA*
[122] Urban Forest Strategy: Making a Great City Greener 2012-2032, *City of Melbourne, 2012*
[123] NIUA Portal
[124] Urban Greening Guidelines, *Ministry of Urban Development, GoI, 2014*

slow the rate of run-off, increase infiltration, recharge ground water, and control water quality. This would also reduce the risk of floods, which regularly cause water logging and economic damage to livelihoods in the city[125].

- **Description:** Green infrastructure techniques include permeable pavements, vegetated swale, restored wetlands, infiltration trenches, rain gardens, rain barrels, down spout disconnection and green roofs[126]. For example, permeated pavements can be used for the planned forest trail and pedestrian pathway around the lakes, rain gardens can be incorporated into the open green spaces by the water bodies, and incentives can be provided for incorporating green roofs in new lakefront developments.

- **Inclusivity analysis:**
  - Public participation and involvement are crucial at every stage of the process. The city can also develop "lake watch committees" such as in Bangalore, to oversee sustainable lakefront development and pollution management[127].
  - Effective green infrastructure for public property should be at-scale, well-designed, and informed by climate risk. If the city does not regularly collect census data on informal, migrant, and low-income communities, these measures may fail to capture the magnitude of risk for these communities.
  - GI on public property, such as more street trees, green roofs, and bioswales, may also lead to a rise in nearby real estate prices, and thus outprice low-income residents and unintentionally usher in "green gentrification".
  - Incentives can be provided for developing such infrastructure in slums, for example subsidized kits for terrace gardens like in Madurai[128], Tamil Nadu[129] and Bihar[130].

- **Implementing stakeholders:** Indore Smart City Development Corporation Limited and Indore Municipal Corporation (lead), councilors, local experts, residents, EPCO.

- **Timeframe:** Short term (1-2 years)

- **Mainstreaming with policies, schemes, and programs:** AMRUT: 2.5% of the project cost is funded for development of parks with features designed for children and senior citizens, as well as linked to projects under water supply and rejuvenation of ground water; Funding under the Jal Jeevan Mission announced during the 2021 Budget, particularly for rejuvenation of water bodies and augmenting freshwater supply through the creation of sponge cities and green spaces[131].

- **Indicators:** Length of permeable pavements, number of green roofs, lake pollution levels, water stagnation after rain and reduced run-offs.

- **Alignment with CSCAF indicators:** Indicator 2 (proportion of green cover) and Indicator 1 (rejuvenation and conservation of water bodies and open areas) within urban planning, green cover and biodiversity, and Indicator 1 (water resources management) under water management.

[125] Rains leave Indore flooded with woes, *The Times of India, 2020*

[126] Guidelines to sustainable planning and restoration of lakes, *WIT Transactions on Ecology and The Environment, 2013*

[127] Water warriors at work, *India Water Portal, 2016*

[128] Lush green urban terrace gardens flourish here, thanks to government, *The Times of India, 2016*

[129] Subsidies for terrace gardens: New plans to start, *LiveChennai.com, 2013*

[130] 70 people apply for roof-top farming project in Gaya, *Hindustan Times, 2019*

[131] Jal Jeevan Mission (URBAN) to Provide Universal Coverage of Water Supply, *Press Information Bureau, 2021*

Goal 5: Powering Indore through Renewables

Achieving this goal calls for increasing the availability of RE mix energy generation, improving energy efficiency in new and existing infrastructure, promoting green buildings, integrating passive design strategies for thermal comfort in affordable housing projects, and ensuring equity in energy access.

Indore also aims to become a solar city, implementing initiatives that promote the use of solar power such as the pioneering floating solar funding model. The city also aims to promote the integration of green initiatives and climate considerations in all buildings, private and public infrastructure initiatives. Thus, the actions under this goal aim to help Indore increase the share of renewable energy usage and accelerate the uptake of green buildings.

Identified Actions

Action 1: Develop a local renewable energy procurement plan

- **Challenges addressed at the city level:** High scope 2 emissions - 9,56,328 tonnes CO_2e emissions from the residential buildings sector, and 4,85,318 tons from manufacturing industries and MSMEs.

- **Description:** Indore is already working towards several renewable energy initiatives. A long term renewable energy procurement plan would mitigate risks from fluctuating market prices through retail contracts. A Renewable Energy Procurement plan should encompass detailed, time bound and feasible solutions to help the city government invest in large-scale, long-term renewable energy projects. Indore must first assess its energy needs and future energy requirements, identify appropriate governance structures for procurement planning and decision making and collaborate with key stakeholders. For example, as part of Melbourne's Renewable Energy Project, the city hired energy market advisors to track risks due to changing markets, analyze tender structures and advise on a structure with least cost and risk.

  Some criteria to consider for procurement can include[132]:
  - Access to land or rooftops for large installations and use of existing grid network.
  - Availability of funds for building renewable energy assets and long term operation and maintenance.

- **Inclusivity analysis:** Low-income communities may be excluded from participating in distributed renewable projects due to potentially high upfront installation and operating costs. Inflexible payment schemes can aggravate this issue. Utilities, developers, and investors may not opt for distributed projects in low income areas of the city for fear of a low rate of return on their investment. The city should create institutional and policy mechanisms to make renewable energy projects easily accessible and affordable for such segments[133].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Development Authority, Builder Associations, Industrial Associations, DISCOMs.

- **Timeframe:** Medium term (3-5 years).

- **Mainstreaming with policies, schemes, and programs:** Policy for Implementation of Solar Power-based projects in Madhya Pradesh (2012), Madhya Pradesh Policy for Decentralized Renewable Energy Systems, 2016; Madhya Pradesh Renewable Energy Policy, 2022.

- **Indicators:** Reduced energy use and tariffs for buildings, increased share of renewables, reduced municipal energy costs.

- **Alignment with CSCAF indicators:** Indicator 2 (total electrical energy in the city derived from renewable sources) under energy and green buildings.

Action 2: Mandate to install solar water heaters in new buildings in the municipal area

- **Challenges addressed at the city level:** Only 0.8% of the city's electricity consumption is from renewable sources as per data from CSCAF 2.0. Stakeholder consultations revealed that sensitization programs have been organized by IMC and few private players and NGOs before, but there is lack of uptake and market penetration of solar water heaters.

[132] Melbourne Renewable Energy Project, *City of Melbourne*

[133] Roadmap Inclusive Planning: Policy Recommendations, *C40 Cities, 2018*

- **Description:** Cities such as Thane and Rajkot have issued a mandate for all new commercial buildings to have in-built solar water heaters[134]. BESCOM in Bengaluru is also an example of successful implementation of such a plan through a bylaw that requires developers to install solar water heaters in dwellings with a floor space of 600 sq ft or more, if they are built on parcels of land measuring at least 1,200 sq ft. This mandatory solar thermal capacity is linked to room size, and increases based on the interior space[135].

- **Inclusivity analysis:** Energy efficient retrofit programs may lead to higher rental costs for the building upgrades particularly for low income areas. Informal communities may not have incentives to install solar water heaters due to lack of affordable finance, awareness and high cost. Indore should try and retrofit informal housing without raising rent or provide solar water heaters for free or at subsidized rates[136].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Development Authority, builder associations, citizens' forums, residents' welfare associations, MP Urja Vikas Nigam.

- **Timeframe:** Short term (1-2 years).

- **Mainstreaming with policies, schemes, and programs:** Policy for Implementation of Solar Power-based projects in Madhya Pradesh (2012), Madhya Pradesh Policy for Decentralized Renewable Energy Systems (2016), National Mission for Enhanced Energy Efficiency, Sustainable Habitat Mission.

- **Indicators:** Reduce energy use and tariffs for buildings, increased share of solar, improved indoor air quality.

- **Alignment with CSCAF indicators:** Indicator 2 (total electrical energy in the city derived from renewable sources) under energy and green buildings.

Action 3: Increase clean energy use in slum developments

- **Challenges addressed at the city level:** Indore's slums have grossly inadequate basic amenities[137] and are highly dependent on fossil fuels for domestic use.

- **Description:** Indore Municipal Corporation can provide subsidies for solar cookers, solar water heaters, solar PV, biomass cookstoves, etc. for slum households. They can also implement pro-poor payment schemes such as tax breaks on bill repayments, low-interest loans, vouchers for the substantial upfront cost of clean cookstoves and heating appliances, and installation kits[138]. They can also collaborate with local NGOs working with informal sectors.

- **Inclusivity analysis:** Often low-income communities are excluded from participating in distributed renewable projects due to the potentially high upfront cost of installation and maintenance. This action will ensure more equitable access to cleaner fuel, reduce emissions and improve air quality in low income areas, particularly benefiting women who spend maximum time indoors for cooking[139].

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Development Authority, financial institutions, private sector, NGOs.

- **Timeframe:** Short term (1-2 years), continuous implementation across medium term

- **Mainstreaming with policies, schemes, and programs:** Policy for Implementation of Solar Power-based projects in Madhya Pradesh 2012, Madhya Pradesh Policy for Decentralized Renewable Energy Systems 2016.

- **Indicators:** Reduced energy costs and improved access for slum dwellers, improved air quality, and reduced negative health effects.

- **Alignment with CSCAF indicators:** Indicator 2 (total electrical energy in the city derived from renewable sources) under energy and green buildings.

Action 4: Conversion of municipal buildings into net zero buildings

- **Challenges addressed at the city level:** According to data from IGBC, less than 1% of the municipal buildings are zero carbon ready.

[134] Pune, Rajkot and Thane in the run for WWF's Earth Hour City Challenge 2015, *ICLEI South Asia*

[135] Successful solar energy bylaw in Bengaluru, *Solar Thermal World, 2018*

[136, 138, 139] Roadmap Inclusive Planning: Policy Recommendations, *C40 Cities, 2018*

[137] Slum Networking of Indore City, Indore

- **Description:** Indore has an IGBC city chapter with data on green buildings. According to IGBC data, less than 1% of Indore's municipal buildings are eligible for green building or net zero building rating. Indore Municipal Corporation can work towards converting all municipal buildings into net zero carbon buildings. Net zero carbon buildings have less carbon emissions associated with their annual energy demand[140]. This is achieved through high levels of energy efficiency and renewable energy generated either on-site, for example through rooftop solar panels, or off-site from a wind farm or other source. This means replacing gas for heating and cooking with electricity[141]. Thane is a successful example, as it has implemented a net zero municipal school[142]. The Thane Municipal Corporation's Urban Low Emissions Development Strategy (Urban LEDS) also aims to convert municipal buildings into net zero buildings. WRI India is already working with cities including Indore to establish the scope, definition, and boundaries for zero carbon buildings[143].

- **Inclusivity analysis:** Indore can create tiered building standards, with buildings in richer market areas having to implement more stringent standards. Incentives can also be given for hospitals, schools, etc with the municipality bearing maximum cost.

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Development Authority, private sector.

- **Timeframe:** Long term (>5 years).

- **Mainstreaming with policies, schemes, and programs:** ECBC 2017, India Cooling Action Plan 2018, UJALA Scheme 2015, Policy for Implementation of Solar Power-based projects in Madhya Pradesh 2012, Madhya Pradesh Policy for Decentralized Renewable Energy Systems 2016, Smart Cities Mission, Madhya Pradesh Renewable Energy Policy 2022, National Mission for Enhanced Energy Efficiency.

- **Indicators:** Reduce energy use and tariffs for buildings, increased share of RE in buildings, improved indoor air quality.

- **Alignment with CSCAF indicators:** Indicator 5 (promotion of green buildings) under energy and green buildings.

Action 5: Retrofit buildings under the Pradhan Mantri Awas Yojana (PMAY) scheme with climate-sensitive components

- **Challenges addressed at the city level:** High GHG emissions from residential buildings.

- **Description:** Based on data from IGBC Indore chapter, green buildings in Indore were growing at a rate of 15% each year as of 2019. 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 ensure that low-cost housing is retrofitted with components leading to increased energy efficiency, optimized water consumption, reduced heating effects, and efficient waste management. A study by Shakti Foundation[144] done in 2018, highlights the embodied energy and energy demand of housing under this scheme and includes some recommendations to mainstream energy efficiency within affordable housing. Indore can use this as a guidance document while implementing this action.

- **Inclusivity analysis:** Often low-income communities are excluded from participating in energy efficiency projects due to the potentially high upfront cost of installation and maintenance. 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 cost of living.

- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Development Authority, builder associations, RWAs.

- **Timeframe:** Long term (> 5 years).

- **Mainstreaming with policies, schemes, and programs:** ECBC 2017, Policy for Implementation of Solar Power-based projects in Madhya Pradesh 2012, Madhya Pradesh Policy for Decentralized Renewable Energy Systems 2016, National Mission for Enhanced Energy Efficiency.

- **Indicators:** Reduced energy costs and improved access for slum dwellers, improved air quality and reduced negative health effects.

[140] What Is a Net Zero Carbon Building?, *Net Zero Carbon Guide UK*

[141] Net Zero Carbon Buildings, *Rockwool, 2019*

[142] Implementing Low Carbon Measures in Municipal School, Thane: Case Study, *ICLEI and NIUA, 2020*

[143] A First Step Down the Road to Zero-Carbon Buildings in India, *WRI India, 2018*

[144] Mainstreaming thermal comfort for all and resource efficiency in affordable housing, *Shakti Foundation, 2018*

- **Alignment with CSCAF indicators:** Indicator 5 (promotion of green buildings) under energy and green buildings.

Action 6: Institutional measures to promote green buildings

- **Challenges addressed at the city level:** 43% of buildings have secured third party verification for green building upto minimum level[145]. The city can increase the total built up area of green buildings.

- **Description:**
  - The ECBC 2017 codes have been mandated in commercial buildings, however, it lacks compliance. Indore should ensure strict compliance through monitoring permit requirements, calculation methods, regular inspections, monitoring energy bill reductions, etc.[146]
  - The city needs to have promotional or penalty schemes for code compliance, pre-certification, and certification of green buildings.

- **Inclusivity analysis:** The cost of achieving green building code specifications may be passed on by developers to consumers, making it unaffordable for low-income renters, homeowners, or small-scale businesses. Developers would have less incentive to invest in new building projects if communities were unable to afford higher housing prices. Thus, there may be fewer new, efficient buildings constructed for low-income groups, pushing more households into informal accommodation. The city could set targets for new public housing and affordable housing with efficiency measures and practices[147].

- **Implementing stakeholders:** Indore Municipal Corporation, Indore Smart City, MPUVN, PWD, UADD, Town Planning Department.

- **Timeframe:** Short term (1-2 years).

- **Mainstreaming with policies, schemes, and programs:** MP Policy for Decentralized Renewable Energy Systems, 2016; Energy Conservation Building Code.

- **Indicators:** Higher percentage of energy derived from renewable sources, reduced residential power costs, energy savings, number of certified and pre-certified green buildings in the city, numbers of ECBC/ ENS compliant buildings, total built-up area of green buildings.

- **Alignment with CSCAF indicators:** Indicator 5: Promotion of green buildings

[145] CSCAF 2.0 Report Indore

[146] Madhya Pradesh Energy Conservation Building Code 2021, M.P. Urja Vikas Nigam Ltd.

[147] Roadmap Inclusive Planning: Policy Recommendations, *C40 Cities, 2018*

Goal 6: Sustainable Waste Management for a Clean Indore

Indore remains on the forefront of sustainable waste management, earning the title of cleanest city in India for five consecutive years in a row. It presents some successful examples of landfill management and waste-to-energy initiatives. However, it still needs to improve its wastewater management and sewage treatment capacities. Thus, the following actions focus on enabling Indore to reach even greater heights in terms of solid waste management and improve the energy efficiency of its wastewater treatment plants.

Identified Actions

Action 1: Power generation from wastewater

- **Challenges addressed at the city level:** 89% of waste sector emissions come from wastewater treatment in Indore.
- **Description:** Indore has a sludge hygenization plant in Kabit Khedi where dry sludge is converted to bio-fertilizer by exposing it to Cobalt-60 gamma irradiation[148]. Alternatively, instead of converting sludge to fertilizer directly, the city can also explore a model to convert sludge to energy. The methane rich sludge should undergo thermal hydrolysis and anaerobic digestion to generate biogas, which can be used onsite to power the sewage treatment plant or further purified and sold as natural gas. Furthermore, the solid digestate left in this process can be used as a fertilizer. This can be done in existing wastewater treatment plants, thereby avoiding the need for new infrastructure[149]. For example, 7 STPs in Chennai are generating biogas[150]. Bangalore also generates 1MW power from its 60 MLD plant[151]. Ahmedabad generates biogas from sewage, earning 2.75 crore each year. Plan was to supply gas to private agency who would supply it for use in industrial plants. However, the plant's efficiency has lowered significantly due to mixing of industrial wastewater with domestic wastewater which corrodes the domes of the biodigesters[152], something Indore must ensure is avoided.
- **Inclusivity analysis:** The electricity generated can also be used to power nearby low-income areas. The manure can also be given free of cost to farmers as compost.
- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Smart City, IDA, water utilities, private agencies managing the sewage treatment plants, DISCOMs
- **Timeframe:** Medium term (3-5 years)
- **Mainstreaming with policies, schemes, and programs:** Madhya Pradesh Policy for Decentralized Renewable Energy Systems, 2016, Madhya Pradesh Urban Services Improvement Project (ADB), SBM 2.0.
- **Indicator:** Reduced energy costs for sewage treatment, increased municipal revenue from wastewater.
- **Alignment with CSCAF Indicators:** Indicator 6: (Energy-efficient wastewater management system) within water management; Indicator 2: (total electrical energy from renewable sources) under energy and green buildings.

Action 2: Community compost pits in each zone based on land availability

- **Challenges addressed at the city level:** 93% of wet waste is processed through mechanical compost plant. The city needs 50 trolleys and 160 mini trucks more efficient waste collection. This can be minimized[153].
- **Description:** Community compost pits can be explored in each zone which generates compost from all the wards and sell it to farmers, local vendors, residents, gardens, parks, and horticultural department. For example, Mysore has a 5TPD decentralized biodegradable waste management unit in each zone, handling biodegradable waste from 5 wards. Only segregated wet waste comes to these units. It

[148] India's Second Municipal Sewage Hygienization facility gets final operational and safety clearance, *International Irradiation Association, 2022*

[149] From Waste to Watts: How Sewage Could Help Fix India's Water, Energy and Sanitation Woes, *WRI India, 2017*

[150] How India is turning sewage into energy, CNBC, 2016

[151] This sewage treatment plant in Banglaore generates power!, *India Today, 2016*

[152] Compendium of recycle and reuse of wastewater in 54 million plus cities, *MOHUA, 2021*

[153] District Environmental Plan for Indore District, *MPPCB, 2021*

is managed by NGO, SHG or Stree Shakti Sangha. Vehicles are provided by the corporation along with support of 95,000 per month. It generates a revenue of about 30,000 per month. Land attached to MRFs, open land, near railway station or parks can be used.

- **Inclusivity analysis:** Jobs for low-income groups and women can be created in these composting centers at each ward. In low garbage collection areas, programs like exchanging compost for city-issued goods/services such as bus tickets, schoolbooks, or other needs can also be explored.
- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Smart City, IDA, waste department, NGOs, SHGs.
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** SBM 2.0.
- **Indicators:** Reduced fuel use and costs for waste transport, increase in % organic waste processed, revenue generation from waste.
- **Alignment with CSCAF indicators:** Indicator 1: Waste minimization initiatives undertaken by the city; Indicator 4:Extent of wet waste processed.

Action 3: Introduce incentive-based take back programs for dry waste

- **Challenges addressed at the city level:** There are 2 MRF facilities of 300 TPD and 200 TPD capacity in working by IMC and 92% dry waste is recycled. Citizen involvement can further be improved through such local collection programs.
- **Description:**
  - Buy back schemes in each zone/ward: Plastic and paper collection centres where citizens can get money/ coupons/ etc. Shops can also allow consumers to bring back waste that was through items brought there. IMC can incentivize shops to take back their waste through property tax rebates, increasing Floor Area Ratio, etc.
  - PET bottle reverse vending machines: Already implemented in many cities. In Delhi , users get coupons for hotels or other shops. Easy to use digital vending machines. In Mumbai for example the machines were provided by Wockhardt Foundation, an NGO. Ludhiana has also installed 10 machines in busy commercial areas. IMC can install these in parks, railway stations, tourist areas, etc.
- **Inclusivity analysis:** Jobs for low-income groups and women can be created in these centers. Informal workers can be brought into the formal system to manage and monitor these vending machines and engage in recycling the waste to generate revenue. They can be given daily wages, ID cards, health insurance and other benefits.
- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Smart City, IDA, waste department, NGOs, SHGs.
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** SBM 2.0.
- **Indicators:** Increase in plastic waste recycled, % of new jobs created.
- **Alignment with CSCAF indicators:** Indicator 1: Waste minimization initiatives undertaken by the city; Indicator 2: Extent of dry waste recovered & recycled.

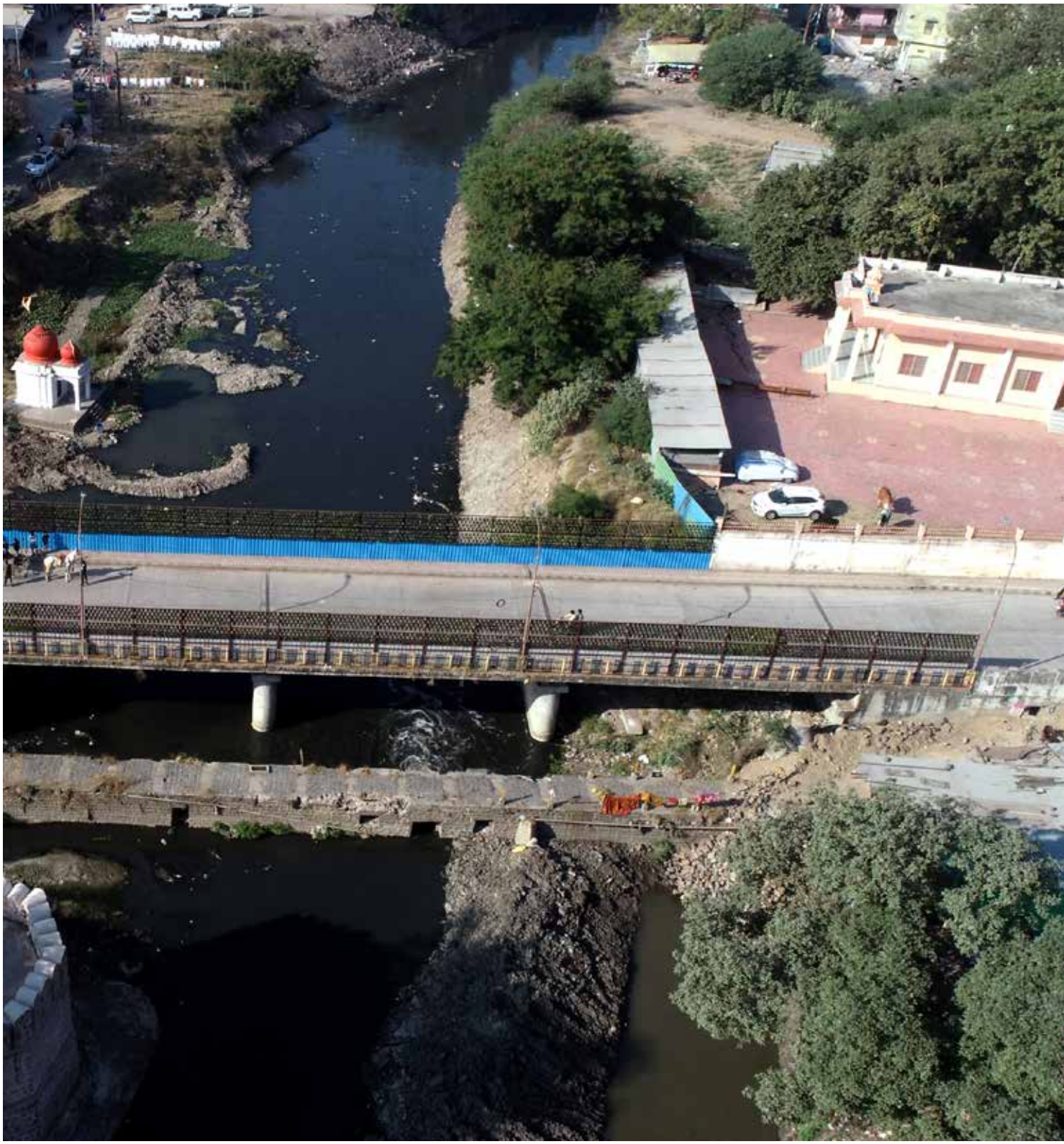
Action 4: Eco-bricks from plastic waste

- **Challenges addressed at the city level:** There are 2 MRF facilities of 300 TPD and 200 TPD capacity in working by IMC and 92% dry waste is recycled. Citizen involvement can further be improved through such initiatives.
- **Description:** Eco bricks from plastic, paper and inert waste which can be used in construction: Children in Jamshedpur are made to fill plastic waste in bottles as part of school activity which are later used as bricks for walls[154]. IMC can pilot something similar to reuse plastic in new constructions and mandate the same in the long term. This helps promote behavioural change among children as they learn to turn waste into something of value.
- **Inclusivity analysis:** Involving children in the waste management process and spreading awareness.
- **Implementing stakeholders:** Indore Municipal Corporation (lead), Indore Smart City, IDA, waste department, NGOs, SHGs, educational institutions.
- **Timeframe:** Medium term (3-5 years).
- **Mainstreaming with policies, schemes, and programs:** SBM 2.0

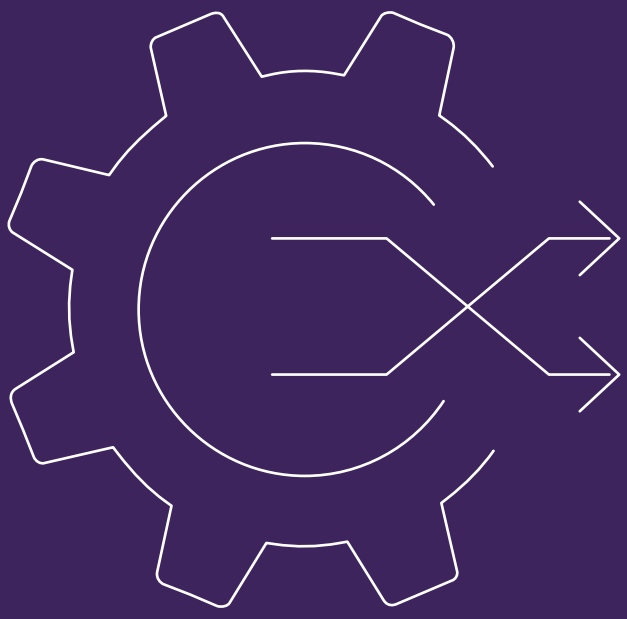
[154] Waste Wise Cities, *NITI Aayog, 2021*

- **Indicators:** Increase in plastic waste recycled, reduction in C&D waste and emissions from construction

- **Alignment with CSCAF indicators:** Indicator 1: Waste minimization initiatives undertaken by the city; Indicator 2: Extent of dry waste recovered & recycled



IMPLEMENTATION AND GOVERNANCE OF INDORE CLIMATE ACTION PLAN



Creation of Indore Climate Change Cell

Indore Municipal Corporation is responsible for infrastructure development and citizen service, and Indore Smart City is responsible for implementing projects as per the Smart City proposal. However, there is no dedicated cell or staffing capacity to address climate change concerns as part of development planning. Effective implementation of the plan requires mainstreaming climate actions within the scope of existing departmental priorities, project plans and future proposals by creating a dedicated cadre/working cell.

Priority 1

Creating Indore climate change cell

- **Description:** To align with the State Action Plan on Climate Change and implement the Indore City Climate Action Plan, there should be a dedicated climate cell with representatives or nodal officers from the line departments concerned. Many cities, including Coimbatore, Mumbai, and Aurangabad, have developed such a cell, which is tasked with the implementation and monitoring of the plans. The climate cell should coordinate with the State Knowledge Management Centre on Climate Change, EPCO, Department of Environment, GoMP, which is the state nodal agency for climate change, to implement and report the progress of the actions proposed in the plan.

  The role of the climate cell includes:
  - Facilitating coordination between EPCO and the city on climate change-related issues and projects
  - Supporting and advising on key amendments to statutory policy regulations, and liaising with parastatal agencies for data collection and information
  - Building internal capacity for climate knowledge and science
  - Engaging and coordinating across departments within the city corporation, to mainstream climate resilience thinking in existing and proposed projects
  - Facilitating implementation of the actions proposed in the plan
  - Reporting the implementation and monitoring status of the plan to the state nodal agency
  - Working with sectoral experts and scientists to periodically update the plan, including city GHG inventory for monitoring the GHG emissions, and the respective causes and challenges

- **Tentative staffing and stakeholders:**
  - Municipal Commissioner, Indore Municipal Corporation (Chairman)
  - Officer nominated by Forest Department (Member)
  - Officer nominated by MP Pollution Control Board Regional Office (Member)
  - Chief City Planner (Member)
  - Environment Engineer (Member)
  - Officer from Transport Section (Member)
  - Officer from Water Supply Section (Member)
  - Officer from Swachh Bharat Mission Cell (Member)
  - Officer from Energy/Electricity Section (Member)
  - Officer from Buildings Section (Member)
  - Officer from Gardens Section (Member)
  - Climate Scientist nominated by Chairman (Member)
  - Representatives from citizen forums (Member)
  - Chief Executive Officer, Indore Smart City, or nominated official (Member Secretary)

- **Implementation time:** Short term (1-2 years).

Creating an Indore City-level Climate Budget in Municipal Finance

Identifying and creating funding streams for climate action can catalyze climate-responsive development. It is estimated that every $1 spent on flood protection infrastructure[155] in India results in $248 in avoided damages until 2050 and reduces the likelihood of areas being flooded from 4% to 2%. This would also deliver the co-benefits of aligning urbanization in line with Sustainable Development Goals.

As per the Madhya Pradesh State Budget allocation 2021-22[156], the state has allocated INR 1.12 billion for the launch of Mukhya Mantri Swa-Rozgar Yojana to provide low-interest loans to encourage self-employment among youth. This can be leveraged by the city in the actions proposed in this plan, particularly in the stationary energy and waste sectors, for driving more employment opportunities through a green transition. An amount of INR 25.81 billion, allocated under the Atal Grah Jyoti Yojana, has also been aligned to a few actions proposed in the plan. An amount of INR 57.62 billion has been allocated under the Jal Jeevan Mission, which could be effective for pilot implementation of actions proposed in the water sector. It is important to utilize the budgets provided by the state, to tag these to climate-responsive development, and channelize them into the green economy in the city.

It is prudent for Indore to create a city climate budget for the implementation of its climate action plan. The allocation of a municipal-level climate budget will create accountability for implementing climate actions and will help ensure better coordinated outcomes. To achieve this, the city-level climate action plan should be approved by the mayor-in-Council.

Priority 2

Formulating a City Climate Budget (CCB)

- **Description:** A few states in India have already taken steps to incorporate climate budgeting into their public finance management systems. Gujarat's Climate Change Department adopted a budget called the Climate Change Budget Scheme[160], which earmarks funds for specific climate change programs. Odisha has a climate budget framework[161] institutionalized for its cities. Chhattisgarh, Assam, and Maharashtra track the climate change relevance of developmental projects through budget coding[162]. Thus, MP and its cities also need to step up the action, considering their estimated climate risks, vulnerability score and the climate performance of MP's smart cities.

  The climate budget should tag project activities for specific purposes in its budget documents by catalyzing a climate finance framework. The city should prepare a climate budget in alignment with the plan. The status of climate actions and achievements should be tracked quarterly and reported annually.

- **Implementation time:** Short term (1-2 years).

Table 8: State vulnerability score and financial expenditures

State	State Vulnerability Score[157]	Overall Average CSCAF Scores of MP's SMART Cities[158]	SDG Progress[159] (Benchmark Score 66)	Status of Climate Finance/ Climate Budget	Scope of Urbanization and Climate Vulnerability
Madhya Pradesh	Medium Vulnerability	High Vulnerability ★★★	Performer-62	No climate budget framework institutionalized	7 smart cities

* Priority 1 and Priority 2 should be developed in coordination with State Knowledge Management Centre on Climate Change, EPCO, Department of Environment, GoMP, after the launch of the Climate Action Plan.

[155] Adequate Floods Methodology, Technical Note, *WRI India, 2020*

[156] Madhya Pradesh Budget Analysis 2021-22, *PRS Legislative Research, 2021*

[157] Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework, *DST, GoI & SDC, 2019-20*

[158] Climate Centre for Cities, NIUA

[159] SDG India, Index & Dashboard, NITI Aayog, 2020-21

[160] Budget Book, *Gujarat Climate Department, 2019-20*

[161] Climate Budget Framework, *Odissa Finance Department, Govt.of Odissa, 2020-21*

[162] Case of Climate Budget Coding in India, *The Bastion, 2020*

The city authorities can select actions and recommendations provided in this plan to develop a detailed implementation plan for pilot projects that can be rolled out in the short, medium, and long term. The GHG emissions profile of the city included in the plan may be used as a guiding analysis to prioritize the implementation of actions in different sectors. The plan also provides guidance on mainstreaming actions with existing policies, schemes, and programs to establish convergence of implementation.

Lastly, this plan must be treated as a dynamic document, and must be updated periodically with the latest emissions profile of the city. Instituting a climate change cell at the city level, with representation from the ULB departments concerned, Smart City, citizens' forums, academic institutions, and civil society, is necessary to lead and coordinate this process. Organizing periodic stakeholder consultations would help in strengthening the plan as per the evolving requirements of the city.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