ADVANCING CITY CLIMATE ACTION IN MADHYA PRADESH

Transforming **UJJAIN** into a low-carbon and climate-resilient tourist and pilgrimage capital

Ujjain City Climate Action Plan
© State Knowledge Management Centre on Climate Change (SKMCCC), EPCO,
Department of Environment, Government of Madhya Pradesh, 2023

DISCLAIMER

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

Cover image: Ujjain Smart City Development Corporation Ltd.

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)

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 impeding 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 Climate Action Plans (CAPs) have been developed by State Knowledge 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

(Lokendra Thakkar)

Coordinator,
State Knowledge Management
Centre on Climate Change, EPCO

ADVANCING CITY CLIMATE ACTION IN MADHYA PRADESH

Transforming **UJJAIN** into a low-carbon and climate-resilient tourist and pilgrimage capital

Table of Contents

List of Figures & Tables

| Figures

| Tables

Abbreviations

ABD	Area Based Development
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AQI	Air Quality Index
BEE	Bureau of Energy Efficiency
BRTS	Bus Rapid Transit System
C&D	Construction and Demolition
CAAQMS	Continuous Ambient Air Quality Monitoring System
CBD	Central Business District
CH_4	Methane
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPWD	Central Public Works Department
CPCB	Central Pollution Control Board
CSCAF	Climate Smart Cities Assessment Framework
DEP	District Environmental Plan
DEWATS	Decentralized Waste-Water Treatment System
DISCOM	Distribution Company
ECBC	Energy Conservation Building Code
EESL	Energy Efficiency Services Limited
EPCO	Environmental Planning and Coordination Organization
ESCO	Energy Service Company
EV	Electric Vehicle
FAME	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles
GHG	Greenhouse Gas
GI	Green Infrastructure
GoMP	Government of Madhya Pradesh
GPS	Geographic Positioning System
GRIHA	Green Rating for Integrated Habitat Assessment
HFAPoA	Housing for All Plan of Action
ICT	Information and Communications Technology
IGBC	Indian Green Building Council
IoT	Internet of Things
IPT	Intermediate Public Transport

IT	Information Technology
ITS	Intelligent Transport Services
JV	Joint Venture
KL	Kilo Liter
kWh	Kilo Watt Hour
KWp	Kilo Watt Power
LCB	Low Carbon Buildings
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LPCD	Liters Per Capita per Day
LPG	Liquefied Petroleum Gas
MLD	Million Liters per Day
MNRE	Ministry of New and Renewable Energy
MoHUA	Ministry of Housing & Urban Affairs
MP	Madhya Pradesh
MPPCB	Madhya Pradesh Pollution Control Board
MPPHED	Madhya Pradesh Public Health Engineering Department
MPPWD	Madhya Pradesh Public Works Department
MPUVN	Madhya Pradesh Urja Vikas Nigam
MPWRD	Madhya Pradesh Water Resources Department
MRIDA	Mahakaal Rudrasagar Integrated Development Approach
MRV	Monitoring Reporting and Verification
MSW	Municipal Solid Waste
Mt	Metric Tonnes
mt	Million Tonnes
MVA	Mega Volt Ampere
NAAQS	National Ambient Air Quality Standards
N_2O	Nitrous Oxide
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NMT	Non-Motorized Transport
NMV	Non-Motorized Vehicle
NRW	Non-Revenue Water
PBS	Public Bicycle Sharing
PMAY	Pradhan Mantri Awas Yojana
PNG	Piped Natural Gas
PPP	Public Private Partnership

PSP	Private Sector Participation
PT	Public Transport
PWD	Public Works Department
RCP	Representative Concentration Pathways
RE	Renewable Energy
RFID	Radio Frequency Identification
RTO	Regional transport Office
RTSPs	Roof Top Solar Panels
RWA	Resident Welfare Association
RWH	Rainwater harvesting
SAPCC	State Action Plan on Climate Change
SCP	Smart City Plan
SCM	Standard Cubic Meter
SHG	Self Help Group
SKMCCC	State Knowledge Management Centre on Climate Change
SPA	School of Planning and Architecture
SPV	Special Purpose Vehicle
STP	Sewage Treatment Plant
SWH	Solar Water Heater
SWM	Solid Waste Management
T&D	Transmission and Distribution
TOD	Transit Oriented Development
TPD	Tonnes Per Day
UDA	Ujjain Development Authority
ULB	Urban Local Bodies
UMC	Ujjain Municipal Corporation
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
URDPFI	Urban and Regional Development Plans Formulation and Implementation Guidelines
USCL	Ujjain Smart City Limited
WPR	Workforce Participation Rate
WTP	Waste Treatment Plant
ZCB	Zero Carbon Buildings

EXECUTIVE SUMMARY
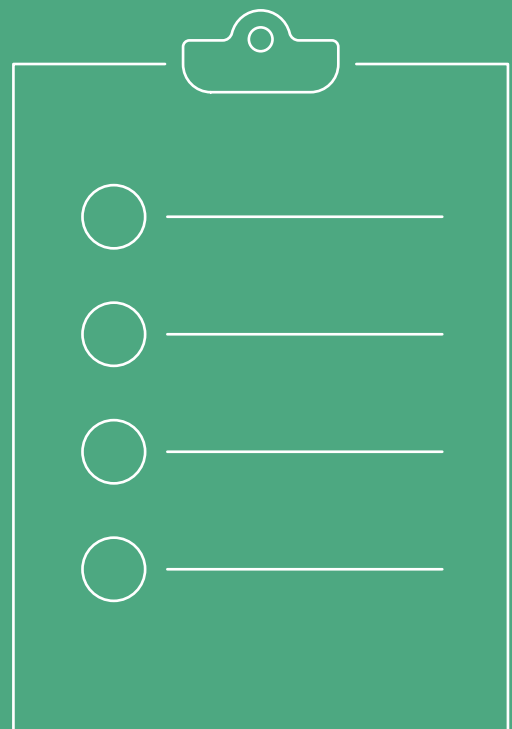
Ujjain and its Vulnerability to Climate Change

Known as the state's religious capital, Ujjain is a culturally rich ancient city located on the banks of River Kshipra in western Madhya Pradesh. Situated in the Malwa Plateau, Ujjain is a religious tourism hub known for the Kumbh Mela, hosted once in 12 years.

Ujjain is an emerging city based on its socioeconomic growth. The city will see an increase in income growth in future. However, by 2030, the population growth in the city will outpace the income growth. This will create a need to provide essential services with the available limited resources for the rising population. Vulnerability assessment analysis done by Environmental Planning and Coordination Organization (EPCO) shows that Ujjain is very highly vulnerable in the water sector with a very high risk of decreasing availability of water, increasing crop water stresses and increase in frequency of extreme weather events such as floods and droughts.

Given the challenges that Ujjain city faces and against the backdrop of the Smart Cities Mission, the Ministry of Housing and Urban Affairs 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 city-level development

actions and policies. It is made up of 28 indicators across five sectors namely, energy & green buildings, urban planning, green cover & biodiversity, mobility & air quality, water resource management and waste management. By taking appropriate measures in these sectors, cities can make a significant contribution to mitigating climate change and becoming resilient to its impacts.

In this context, WRI India is technically supporting EPCO, Department of Environment, and Department of Urban Development and Housing of the Government of Madhya Pradesh, besides the Ujjain administration, in planning adaptation and mitigation strategies and building a city climate action plan (CAP). The climate action plan is based on the GHG emissions profile and vulnerability assessment of the city. It identifies sectoral gaps and proposes key entry points in terms of actions to achieve the sectoral priorities of cities through an inclusive, low-carbon and climate-resilient pathway. The sectoral actions are aligned with inputs received during city-level stakeholders' consultations with participation of officials from district and city authorities, academia, and civil society. The plan prioritizes the actions based on their urgency, importance and convergence with ongoing schemes, programs, and missions of national and state government.

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 Feb 2020, with participation from state and city officials, academicians, and civil society organizations. The idea of the workshop was to apprise the participants and cities about the importance and relevance of developing these city level plans, to brainstorm and identify prominent development challenges and key climate risks in the urban areas of Madhya Pradesh (MP) as well as understand the 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 envisaged by Ujjain city. A thorough review of submissions made by Ujjain as a part of CSCAF 2.0, 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 Ujjain city has been developed which includes 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 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 plan.

- As the next step, to narrow the number of sectoral actions and detailing goals and outcomes, a stakeholder consultation workshop was organized in Ujjain 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 Ujjain to adopt a low-carbon and climate-resilient development pathway.

- The final CAP provides prioritized sectoral actions along with an implementation plan and governance mechanism for effective coordination and monitoring of the CAP's implementation.

ES Figure 1: CAP development process *(Source: CSCAF 2.0 data from city)*

INTENDED OUTCOME OF THE STEP

ENGAGEMENT OVERVIEW

1

City Profile

To establish the local context and parameters for climate solutions

City climate context workshop

Stakeholder consultations to identify:
- Priorities and brainstorm main challenge areas for emissions reduction across sectors
- Climate risks for resilience priorities
- On-going initiatives

2

Key Issues & Needs Assessment

To identify targeted solutions based on needs within the city

Desk review and CSCAF performance analysis

Review of secondary literature to:
- Understand current performance levels
- Understand status of on-going initiatives
- Develop bucket list of solutions
- Draft report on city climate action for stakeholder consultation

3

Prioritisation

To narrow the number of key solutions and detailing goals and outcomes

Stakeholder engagement

Stakeholder consultations to:
- Assess societal, equity and spatial inclusion in the proposed solutions
- Align with current and future priorities
- Identify synergies with state and national level solutions

4

Implementation Plan

To provide high-level reference materials for cities to take forward themselves

Dissemination workshop

Finalized city climate action plan:
- Climate vision and strategy for cities
- Inclusive solutions
- Prioritized actions across the sectors
- Implementation plan

Baseline Assessment

As highlighted in step 2 of the CAP planning process, a climate profile for the city was developed using CSCAF 2.0 analysis along with an emissions inventory and vulnerability assessment of key urban climate risks.

| Climate Smart Cities Assessment Framework Analysis for Ujjain

Ujjain needs to prioritize interventions in increasing shared vehicles that use clean fuel and increasing public transport access and availability. Ujjain also needs to prioritize

areas such as percentage of renewable energy in the grid (0.07% currently). The city also needs to improve its performance in the green cover and water resources sector. Some of the ongoing measures and sector-wise areas of improvement are given below.

| Greenhouse Gas Emissions Inventory

In 2019, Ujjain's GHG emissions were 1.376 $mtCO_2e$ with a per capita emission of 2.3 tCO_2e (Including Manufacturing and Industrial emissions from electricity

ES Table 1: CSCAF analysis *(Source: CSCAF 2.0 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	375	126	143	100	573
Current measures being undertaken in the city	• 0.07 % of total electricity generation is through renewables. • Less than 10% of the buildings are energy efficient or green buildings. • 40% of streetlights are LED lights.	• 6.87% of the municipal area was under green cover in 2020. • Plantation of 12 lakh trees along Rudrasagar lake is underway. • Ankur program has been launched in the state and Pradhan Mantri Awaz Yojana (PMAY) has been linked to it. The program rewards citizens for tree plantation. • Action plan developed to increase green cover in Ujjain. • Established city level biodiversity management committee	• 0.08 buses available per 1,000 population. • 1888 auto-rickshaws run on clean fuels including 113 electric rickshaws. • The city regularly monitors major parameters and city's air quality does comply with NAAQ standards. • Clear Air Action Plan of the city is already in place.	• In 2018, 52% of the municipal households had in-house water supply connections and 10% of the households below poverty line had in-house water supply connections. • As per the data submitted for CSCAF 2.0, 54 MLD of wastewater is treated and is reused for gardening and agriculture purposes. • Energy audit conducted for water supply pumping stations and water treatment plants. • 41% non- revenue water.	• 100% door-to-door collection exists as per the District Environmental Plan. • City has proposed construction of a sanitary landfill. • Implemented a bio-methanation plant with a capacity of 5 tonnes per day to treat vegetable waste. • Bioremediation of legacy waste has been completed. • The city has installed a 600 kg capacity organic waste converter plant in the Mahakal temple campus

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
Areas of improvement	· Increasing green building adoption. · Increasing power generation from RE sources. · Increasing percentage of energy efficient streetlighting. · Promoting rooftop solar in residential and commercial buildings. · Promoting green buildings in at least 85% of ABD area.	· Need to integrate the strategy for rejuvenation and conservation of water bodies and open spaces within the City Development Plan/Master Plan · Identifying measures to increase urban biodiversity and allocate resources. · Need to prepare a disaster management plan with ward level risk assessment and early warning systems.	· Increasing the number of clean fuels run vehicles especially buses and taxis. · Augmenting the public transport fleet. · Increasing the coverage of roads with footpaths and cycle tracks (currently only 1.34%). · Improving last mile connectivity. · Monitoring and revising the clean air action plan	· Increasing the tap water connections to more than 90% households. · Introducing metering policy from immediate effect. · Increasing wastewater reuse. · Carrying out flood/water stagnation risk assessment of the city.	· Reducing waste going to the landfill. · Increasing adequate waste transport infra-structure. · Monitoring the amount of methane collected from STPs and generating clean energy. · Reducing greenhouse gas emissions from waste transport by shifting to alternate fuels.

consumption). Transport constituted 22% and stationary energy constituted 71% while waste accounted for 7% of total city GHG emissions as presented in ES Figure 2.

Majority of these emissions come from manufacturing and construction (49%), followed by residential buildings (36%) and commercial and institutional buildings (15%).

The business-as-usual projected emissions for Ujjain are presented in ES Figure 3. The emissions are projected to increase by 10% by 2025 and 18% by the end of the decade till 2030, compared to the baseline emissions of 2019. This creates an urgent need for the city to implement measures presented in the report for achieving its vision of low carbon and climate resilient development.

| Emissions Scenario Modeling for Ujjain

An emissions scenario analysis was developed using the Climate Action for Urban Sustainability (CURB) tool, an interactive spreadsheet-based tool designed by World Bank in partnership with C40 Cities Climate Leadership Group, Global Covenant of Mayors, and AECOM

ES Figure 2: GHG Emissions Profile of Ujjain, 2019 *(Source: WRI India analysis using primary data)*

- Stationary Energy
- Transport
- Waste

22%
7%
71%
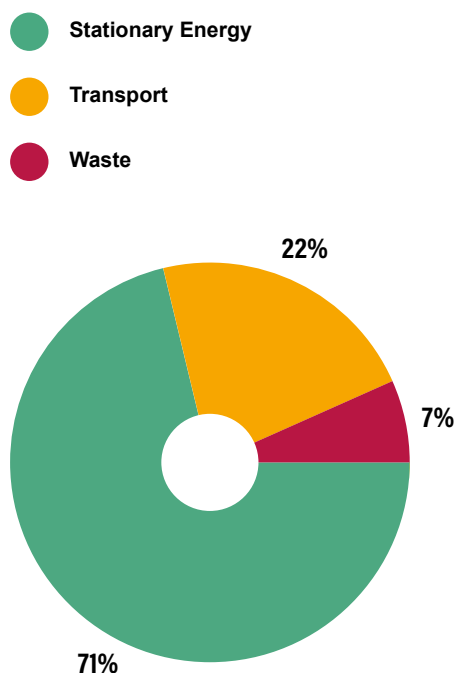
ES Figure 3: Projected emissions for Ujjain *(Source: WRI India analysis using primary data)*
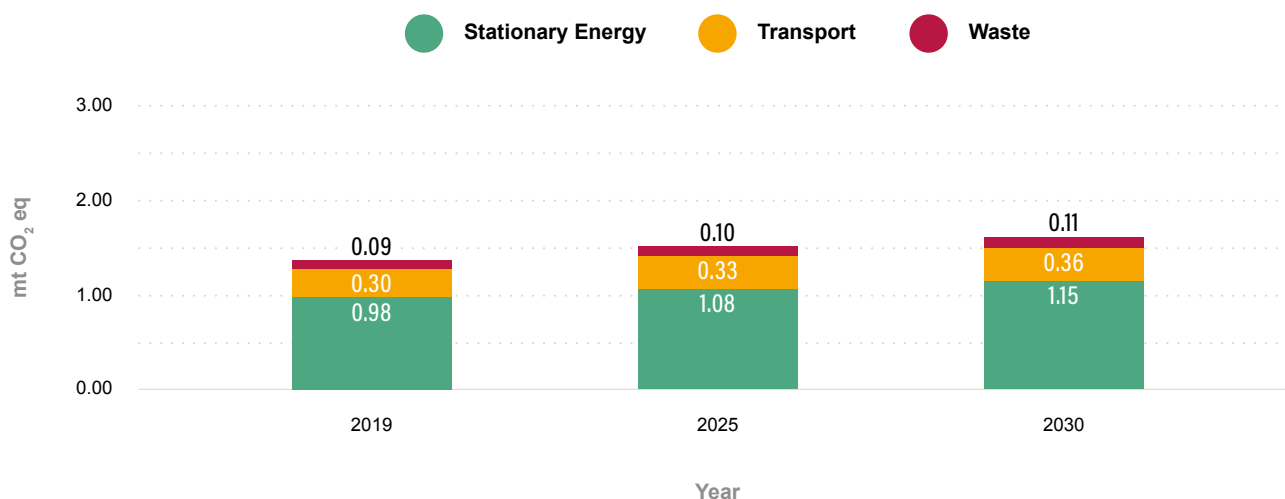
Consulting. It helps cities develop emissions reduction target for key sectors, assess investments required and prioritize low-carbon interventions based on cost, payback period, feasibility and impact on energy consumption and emissions reduction[1].

This tool was used to develop three main scenarios:

- **Business-as-usual scenario:** Predicts the emission reduction if no action is taken for GHG emission mitigation. As per this scenario, emissions are expected to rise 1.5 times from 2019 to 2050 if no action is taken for greenhouse gas mitigation.

- **Existing and planned scenario:** This scenario uses existing or planned city, regional and national actions, policies, and programs to demonstrate the emissions reduction trajectory for the city until 2050. It considers current and planned development strategies that would have an indirect co-benefit of emissions reduction. Examples include actions to subsidize photovoltaic solar and solar rooftop installations, electric vehicle policy, etc. The policies studied for Ujjain include Ujjain Development Plan, Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh for Ujjain prepared by SPA Bhopal, MP EV policy 2019 and the Smart city proposal. As per this scenario, the city has the potential to achieve 10.6% reduction in emissions by 2050 with respect to the BAU scenario.

- **Ambitious scenario:** In most cases including in Ujjain, the existing and planned policies leave a significant gap to the 1.5°C Paris Agreement and Deadline 2020 trajectory. This scenario analyzes the emissions reduction due to actions that are ambitious yet achievable. Taking guidance from proposed projects,

state-level targets, etc., the city's targets were vetted through stakeholder consultations with city-level experts. As per this scenario, the city has the potential to achieve 55% emissions reduction by 2050, mainly attributed to proliferation of rooftop solar, energy efficient heating and cooling solutions in buildings and decarbonization of the electricity grid.

Vulnerability Analysis for Ujjain

The climate of Ujjain is subject to large year-to-year variability, particularly for rainfall. Thus, even in the absence of anthropogenic climate change, the city needs to be resilient to this natural variability. By the 2050s, the city may see its total rainfall increase by 11%, with heavy rainfall days increasing by an average of four days annually.

Observed records for the Ujjain region show emerging trends in temperature over the last few decades – in particular, a clear trend towards higher temperatures and more frequent high temperature extremes. Mean temperature is set to increase by 2.1°C on an average by the 2050s. The city can see an increase of up to 21 hot days.

If global warming can be constrained to 2°C or less with respect to preindustrial conditions, the impacts of climate change would be substantially reduced for Ujjain, particularly in the second half of the century.

[1]CURB tool: Climate Action for Urban Sustainability (Vol.2): User guide, *World Bank, 2017*

ES Table 2: *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 increase in mortality, especially if air quality also decreases. • Negative impacts and constraints on labor productivity, particularly on outdoor workers. • Potential increased demand for air conditioning – which would increase energy demand. • High likelihood of decreasing water availability and increasing crop stresses. • Extremely high risk of decrease in biological richness, accelerated forest cover changes based on the disturbance index, changes in canopy cover along with shift in slope and vegetation.
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. • Very high risk of decrease in average annual rainfall, increase in intensity of precipitation and rise in heat index

Goals and Sectoral Strategies

The table below summarizes the goals and actions which the city may adopt to become low carbon and climate resilient while also addressing concerns of inequality and ensuring inclusivity in development.

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

Goals	Actions	Outcomes
Goal 1 Make Ujjain a green pilgrimage and tourist capital	• Improve energy efficiency in temples • Minimize plastic and installing dry waste recovery booths and compost units at major temples • Pedestrianize Ramghat and other dense areas in the historic core • Towards zero-carbon building projects in the phase I and phase II of MRIDA • Develop Ujjain's upcoming 2028 Simhastha Kumbh into a Harit or green Kumbh • Promote local tourism through home-stay establishments during tourist season	• Reduction in emissions from energy and tourism sectors • Improvement in air quality • Improvement in health & hygiene, and reduction in water/waste borne diseases • Greater awareness among citizens and floating population • Increased energy savings from low carbon infrastructure
Goal 2 Towards low-carbon and people-friendly transport in Ujjain	• Augment the bus fleet in Ujjain • Implement a special Non- Motorized Transport cell within Ujjain Municipal Corporation • Promote electric mobility in Ujjain • NMT focused urban street design guidelines for Ujjain • Implement and upscale the proposed city-wide public bike sharing system	• Increase in NMT infrastructure • Decrease in air pollution due to transport • Increase in availability and accessibility of public transport • Access to NMT options • Access to low-carbon shared mobility options

Goals	Actions	Outcomes
Goal 3 Powering Ujjain through renewable energy	• Mandate installation of solar roof-top panels in all public educational institutions • Promote of green and cool roofs in residential projects/colonies/apartments to reduce cooling demand • Incentivize installation of rooftop solar panels and solar water heaters in all new residential constructions • Mandate installation of solar water heaters on rooftops of hotels in Ujjain • Explore common solar PV projects for community low-income housing	• Reduced per capita electricity consumption • Better market for RE technologies • Creation of new job opportunities • PPP engagement for efficient infrastructural distribution • Reduction in emissions from the consumption of grid supplied electricity from renewables • Improved access to energy
Goal 4 Greener, inclusive spaces for all in Ujjain	• Promote green terraces or kitchen gardens in buildings • Engage citizens in urban green cover conservation • Initiatives to restore, maintain and enhance the city's biodiversity	• Increase in urban green cover • Improved flood resilience • Improved carbon sequestration • Physical health benefits • Improved biodiversity
Goal 5 Sustainable waste management for a clean Ujjain	• Explore decentralized composting at the zone level • Public-private partnership models for managing construction and demolition waste • Upgrade collection and transportation infrastructure to electric vehicles	• Reduction in GHG emissions due to improved processing and treatment facilities • Creation of new jobs through expanded waste management infrastructure • Amount of organic waste processed • Reduction in emissions from waste • Reduced operational costs for waste transportation
Goal 6 Water for everyone in Ujjain	• Strengthen the implementation of the NRW action plan • Disaster risk reduction by developing and implementing an integrated flood and storm water management plan incorporating nature-based solutions • Implement a demand management plan for optimal usage of water resources • Develop inclusive business models for wastewater treatment and reuse	• Increased access to potable water • Reduced NRW losses • Increased flood resistance • Better sewage management • Reduced water costs and improved equitable access

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 emission profile of the city included in the plan may be used as a guiding analysis to prioritize 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 regularly with the latest emissions profile of the city. Instituting a climate change cell at the city level with representation from ULB departments concerned, Smart city, citizen forums, academic institutions and civil society becomes 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.

INTRODUCTION
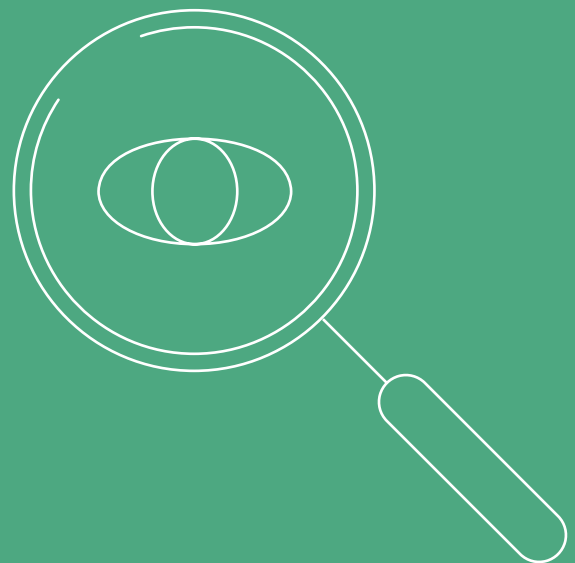
Cities are significant contributors to climate change and are also vulnerable to its consequences. By taking appropriate measures, cities can contribute to mitigating climate change and becoming resilient to its impacts. State action plan on climate change (SAPCC) has served as the primary policy document guiding climate actions at the sub-national level. Thus, any city-level climate actions must be in synergy with the SAPCC. The actions that cities take would not only help India meet its international NDC commitments but also support in achieving the SDGs.

In this context, World Resources Institute India has partnered with State Knowledge Management Centre on Climate Change, EPCO, Department of Environment, Government of Madhya Pradesh, for supporting Department of Urban Development and Housing, Government of MP and seven Smart Cities in MP to build their capacities in planning adaptation and mitigation strategies and to build a city climate action plan in line with the Climate Smart Cities Assessment Framework launched by the Ministry of Housing & Urban Affairs, Government of India.

Vision of Ujjain Climate Action Plan

The Ujjain Climate Action Plan envisions a smart heritage city of the future – revitalized in a climate-smart manner to sustain its cultural integrity and economic prosperity; a city that promotes a climate-resilient economy while retaining its essence as a pilgrimage center; a city that ensures livability and sustainability for all its citizens, manifesting a behavioral change towards the environment and striving towards a low-carbon, climate-resilient and energy-efficient religious pilgrimage capital. The Ujjain City Climate Action Plan is not only about reducing

negative effects on the environment, but it is also about making holistic improvements to Ujjain's rich heritage and enhancing the city's sustainability.

Taking cues from the risks that climate change presents to future generations living in the city, the CAP recognizes that mitigation and adaptation actions must be taken on priority to provide community wide benefits across the following areas:

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

Green Piligrimage & Tourist Destination

CAP focusses on more renewables to not only reduce emissions and negative environmental impacts due to tourism and related activities but also make the city grow its economy in a green and sustainable manner

Climate-smart Heritage Conservation

Retroffiting with energy-efficient systems, conserving heritage and culturally significant structures, and promoting knowledge of the city's rich culture to make the city more socially interactive

Community-driven Change to Improve Quality of Life

Driving change in a holistic and inclusive manner to reduce GHG emissions by putting citizens first, sensitizing them and also improving their participation in making Ujjain climate-smart and resilient

Self-reliant City

Creating self reliance in energy for residential demand as well as Kumbh activities, awareness on cutting-edge yet convenient technologies to reduce GHG emissions, increase jobs and time-saving opportunities

More Equitable & Inclusive City

To include the views of residents and businesses to ensure equal access to opportunities through low-cost transportation and diverse housing options and to maximize use of public spaces and enhanced community engagement

Climate Action Planning Process

WRI India adopted a 4-pronged approach in the entire process of preparing the Climate Action Plan (CAP) as illustrated in the figure below.

- 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 of the workshop was to apprise the participants about 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 also to understand the ongoing initiatives in order to establish the 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 envisaged by Ujjain city. A thorough review of submissions made by Ujjain as a part of CSCAF 2.0, sectoral plans and government reports and other documents was done to identify key issues and gaps in achieving the sectoral priorities. A detailed climate profile which includes temperature and rainfall projections, baseline and projected GHG inventory, has been developed for Ujjain city. 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 reduction of GHG emissions in the short and long term.

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

INTENDED OUTCOME OF THE STEP

ENGAGEMENT OVERVIEW

1

City Profile

To establish the local context and parameters for climate solutions

City climate context workshop

Stakeholder consultations to identify:
- Priorities and brainstorm main challenge areas for emissions reduction across sectors
- Climate risks for resilience priorities
- On-going initiatives

2

Key Issues & Needs Assessment

To identify targeted solutions based on needs within the city

Desk review and CSCAF performance analysis

Review of secondary literature to:
- Understand current performance levels
- Understand status of on-going initiatives
- Develop bucket list of solutions
- Draft report on city climate action for stakeholder consultation

3

Prioritisation

To narrow the number of key solutions and detailing goals and outcomes

Stakeholder engagement

Stakeholder consultations to:
- Assess societal, equity and spatial inclusion in the proposed solutions
- Align with current and future priorities
- Identify synergies with state and national level solutions

4

Implementation Plan

To provide high-level reference materials for cities to take forward themselves

Dissemination workshop

Finalized city climate action plan:
- Climate vision and strategy for cities
- Inclusive solutions
- Prioritized actions across the sectors
- Implementation plan

This review and analysis helped in drawing up a list of sectoral goals and actions which are outlined in the climate action plan.

- As the next step, in order to narrow the number of sectoral actions and detailing goals and outcomes, a stakeholder consultation workshop was organized in Ujjain in September 2021, with participation from city officials, sectoral experts and civil society representatives. The preliminary findings were presented during the workshop and inputs were sought on the goals and proposed actions for a low-carbon and climate-resilient development pathway for Ujjain. These consultations also provided inputs for bringing inclusion principles into the proposed actions, aligning the actions with current and future priorities of Ujjain city as well as with state and national programs.

- The final CAP provides prioritized sectoral actions along with an implementation plan and governance mechanism for effective coordination and monitoring of the CAP's implementation.

CITY
PROFILE
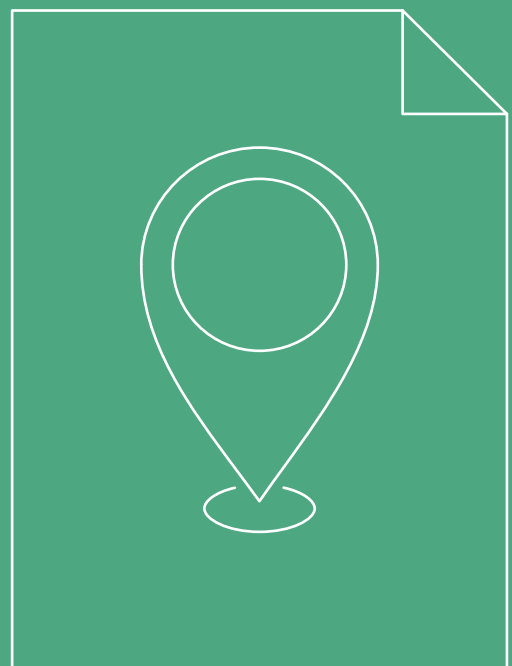
Ujjain is an ancient, culturally rich, and religiously significant city located on the banks of River Kshipra in western Madhya Pradesh, a state in central India. Known as the state's religious capital, it is at a distance of about 200 km from Bhopal, the state capital, and 60 km from Indore, the state's commercial capital.

Another unique feature about Ujjain which makes it significant is that it is located exactly at the median of Tropic of Cancer, which also represents the 'Mean Time' of India for Panchanga – India's traditional calendar. Due to its heritage and religious confluence, the city remains a top tourist destination during the Kumbh Mela, and hence is well connected by road, rail, and air routes.

Due to the prevailing job opportunities, there has been rapid urbanization over the past years attracting migrants, who reside mostly in the southern part of the city. The slums/low-income communities comprise 23% of the city's population[2] and are more vulnerable to the impacts of climate change.

The city is geographically located (approx.75°46' E, 23°10' N) on the southern part of Malwa Plateau with an average elevation of 494 m above mean sea level on the banks of River Kshipra which flows into River Chambal. Demographically, Ujjain is a tier III city and the fifth largest city in the state with a population density of 6,488 persons/sq.km spread across its administrative area of 151.83 sq.km. According to the 2011 Census, the city's entire population is 515,215 persons, with 120,141 of them

living in slums. There is also a large floating population of 10,000-60,000 persons/day during festive seasons. However, the city now has a stagnant decadal growth rate witnessing only a 1.41% growth over the decade 2001-2011. The workforce participation rate (WPR) for Ujjain city is 35.99%, which is less than the national average of 39.1% and the city's literacy rate is 74.76%.

Looking from an infrastructural perspective, Ujjain Smart City Limited won an award for the best bio-methanation system in the waste management sector in 2019. The city has a 5TPD bio-methanation plant which consumes biodegradable waste from the nearby vegetable markets and the adjacent residential communities and converts them into biogas. This biogas runs through gas generators and has led to an estimated electricity generation of 300 units/day and a compost of 1.5TPD. In the water management sector, the city faces a challenge in piped water supply, despite sufficient natural ground water availability in the city[3].

As Ujjain shelters many low-income and marginalized communities, the climate impacts must be embedded in an inclusive manner within the urban development policies while designing climate actions. Municipal services such as public transport, water, waste, electricity, education, health, etc. must meet the needs of vulnerable communities while also serving co-benefits of reducing city-level climate impacts. Thus, it is important to advance and prioritize a set of inclusive climate actions towards making the city low carbon and climate smart.

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

MADHYA PRADESH   UJJAIN DISTRICT   UJJAIN CITY
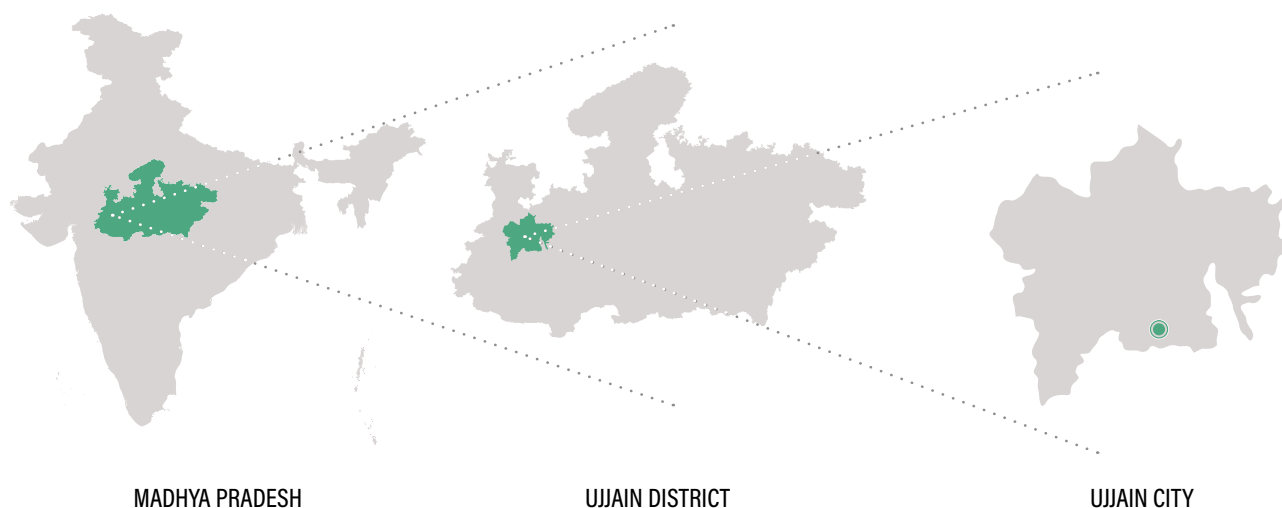
[2] Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh Ujjain, *School of Planning and Architecture, 2019*
[3] Ujjain Smart city website

Demography

The population of Ujjain city was 601,371 in 2020[4] in a municipal area of 92.68 sq.km, making it a densely populated city with 6,488 people residing per sq.km.

The demographic indicators, based on the last two census rounds, are presented in the table below:

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

Particulars	2001[5]			2011[6]		
	Total	Males	Females	Total	Males	Females
Population	431,162	224,475	206,687	515,215	264,871	250,344
Literates	308,191	173,858	134,333	385,193	210,075	175,118
SC Population	76,136	39,505	36,631	104,898	53,742	51,156
ST Population	8,373	4,480	3,893	9,673	4,945	4,728
Total Workers	133,305	108,992	24,313	185,447	143,385	42,062
Number of Households	77,212			102,401		
Slum Households	102,450 (23.8% of total population)			113,352 (22% of total population)		

Climate Profile

Ujjain city has a tropical climate with temperatures ranging from 25°C to 45°C as mean maximum temperature, while the lowest temperatures range from 3°C to 12°C. The average annual rainfall is 890 mm. Located in the Malwa Plateau, Ujjain has a unique feature of pleasant summer nights, also known as Shab-e-Malwa, which is a name for the cool breeze that blows through the plateau.

Temperature

The observations as well as simulations show an increase in mean annual temperature. Under a high emissions scenario (RCP 8.5), this trend is projected to continue till the end of the century, with an average rise of 4.3°C from 1981-2010 to 2071-2100. If emissions decrease rapidly in low emission scenario (RCP 2.6), the average rise is limited to about 1.1°C[7]. The observations 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). Under a high emissions scenario, the number of warm days, shown in Fig 5 is projected to increase by about 45 days on an average from 1981-2010 to 2071-2100, and the number of heat wave days to increase by around 165 days on an average. If emissions decrease rapidly, the increase in warm days will be limited to 10 days on an average and the increase in heat wave days to about 30 days on an average[8].

Rainfall

The simulations show a general tendency towards increasing total annual rainfall, although variability is large. Under a high emissions scenario, total annual rainfall is projected to increase by about 15% (about 145mm) on an average from 1981-2010 to 2071-2100. If emissions decrease rapidly, this increase is limited to about 70mm.

---

[4] CSCAF 2.0 2020

[5] District Census Handbook, Ujjain District, *Government of Madhya Pradesh*

[6] Census of India, Ujjain District, *Government of India*

[7, 8] Making Madhya Pradesh's Smart Cities Climate Resilient, *CEEW, 2020*

Figure 4: *Increase in mean temperature for Ujjain (Source: CEEW)*

Tmean (°C)
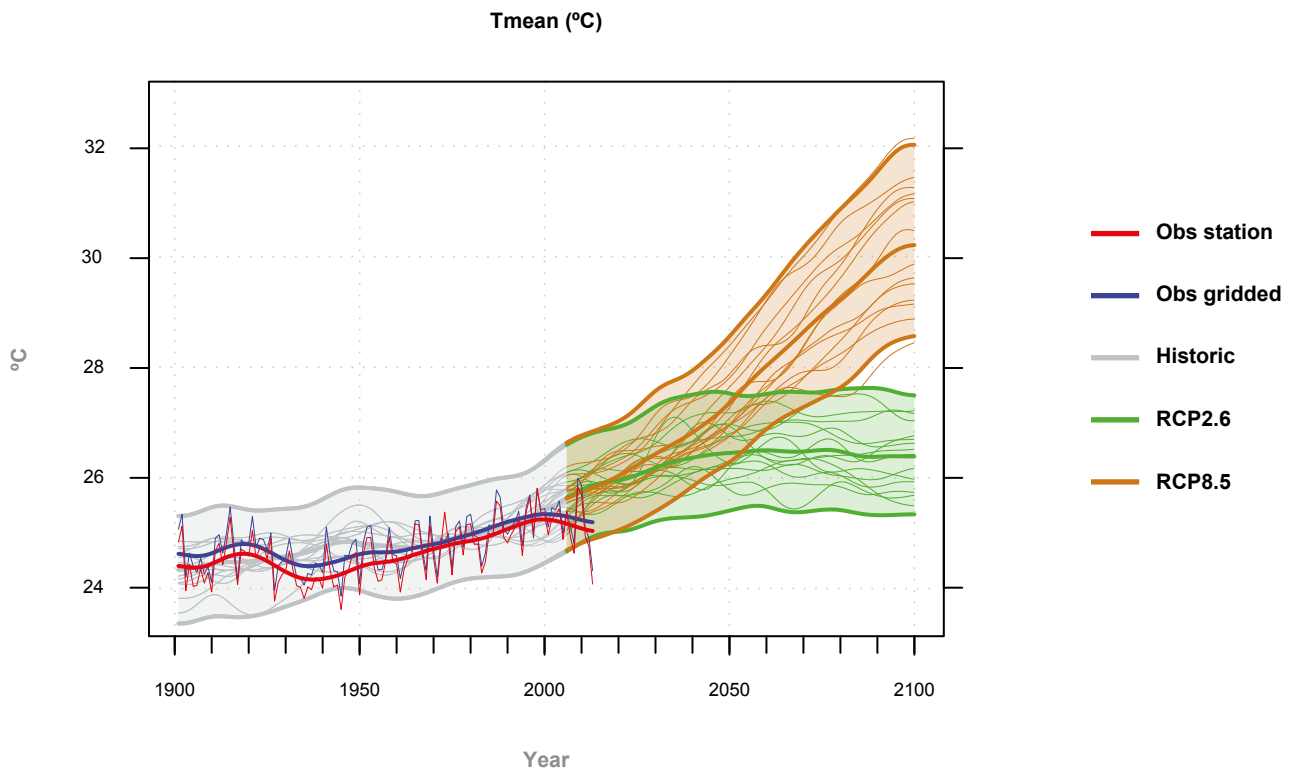
Figure 5: *Increases in temperature extremes for Ujjain (Source: CEEW)*

TX90p (% of days)
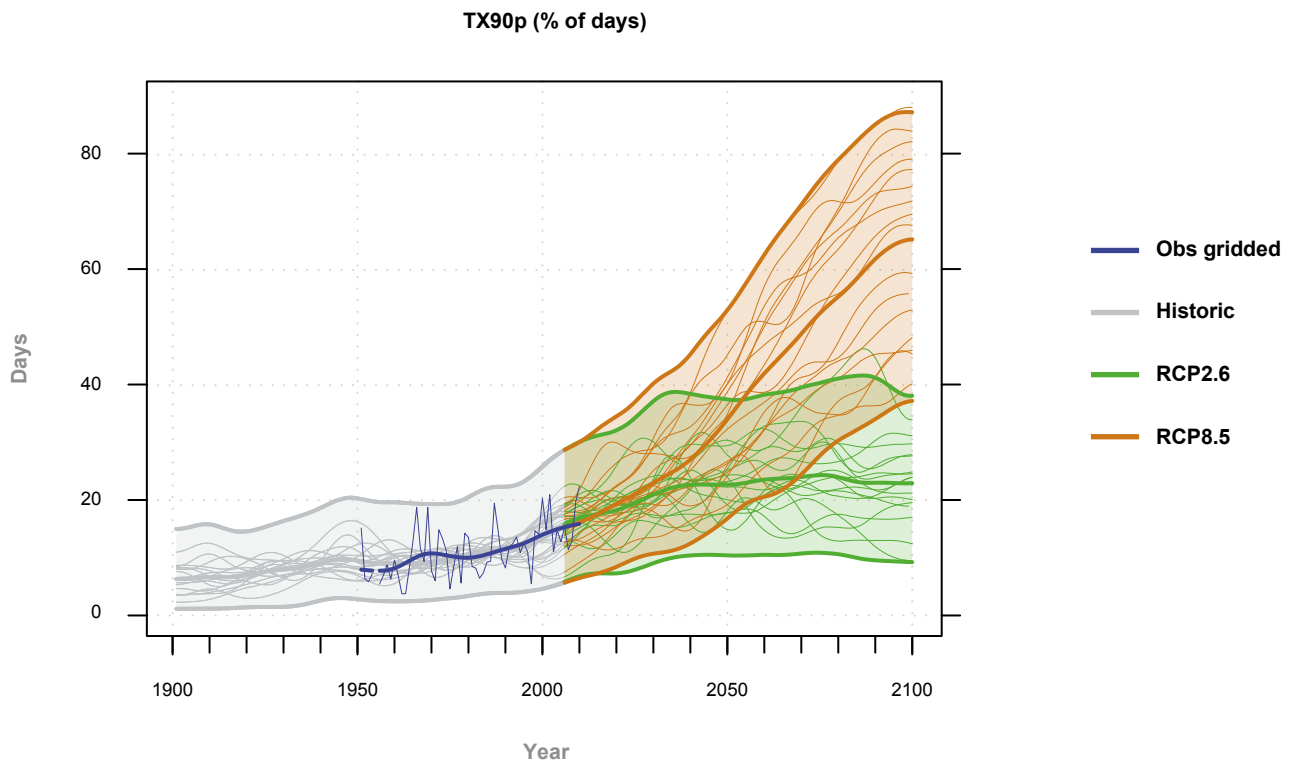
The observation of heavy rainfall events is dominated by decade-to-decade and year-to-year variability. The projections indicate more frequent heavy rainfall events. Under a high emissions scenario, the number of days per year with a rainfall of more than 20mm, as shown in Figure 7, is projected to increase by about seven days on an average from 1981-2010 to 2071-2100.

Figure 6: Increases for mean precipitation for Ujjain *(Source: CEEW)*

Ptotal (mm)
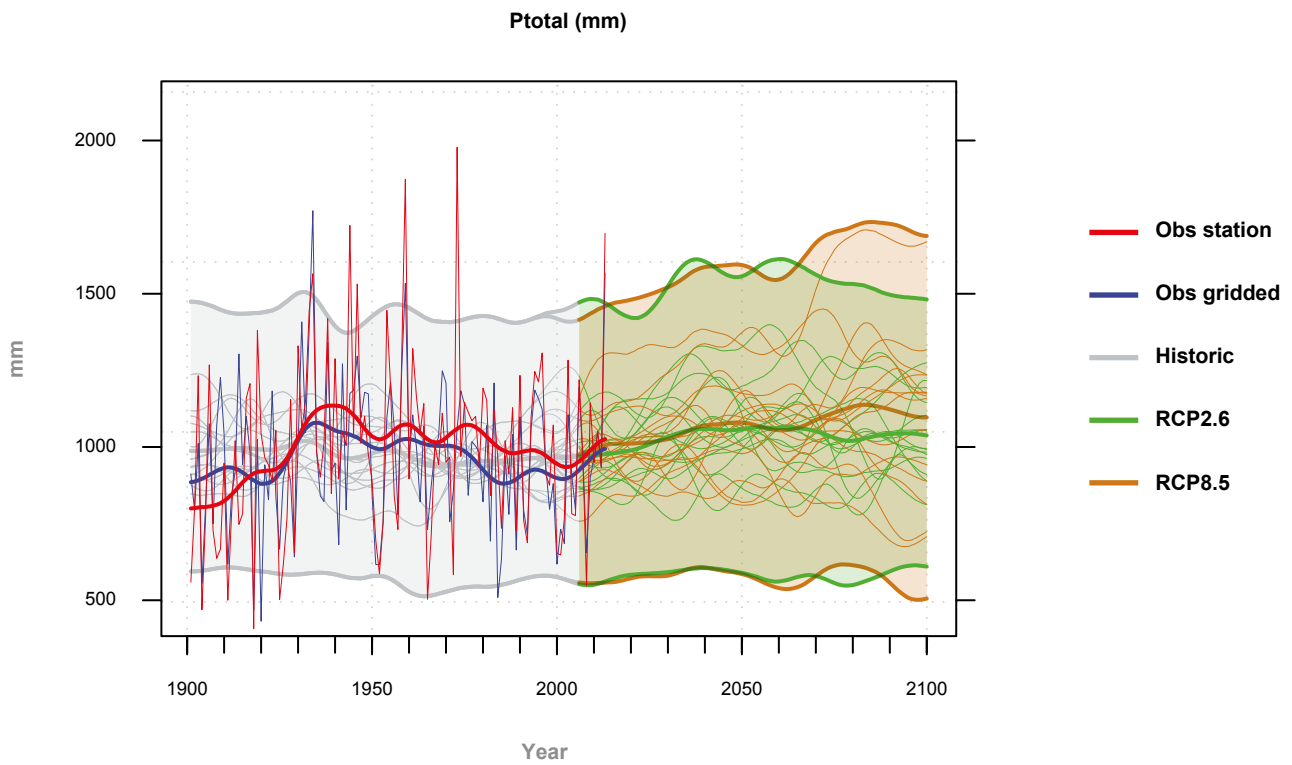
Figure 7: Number of heavy-rainfall days for Ujjain *(Source: CEEW)*

R20mm (days)
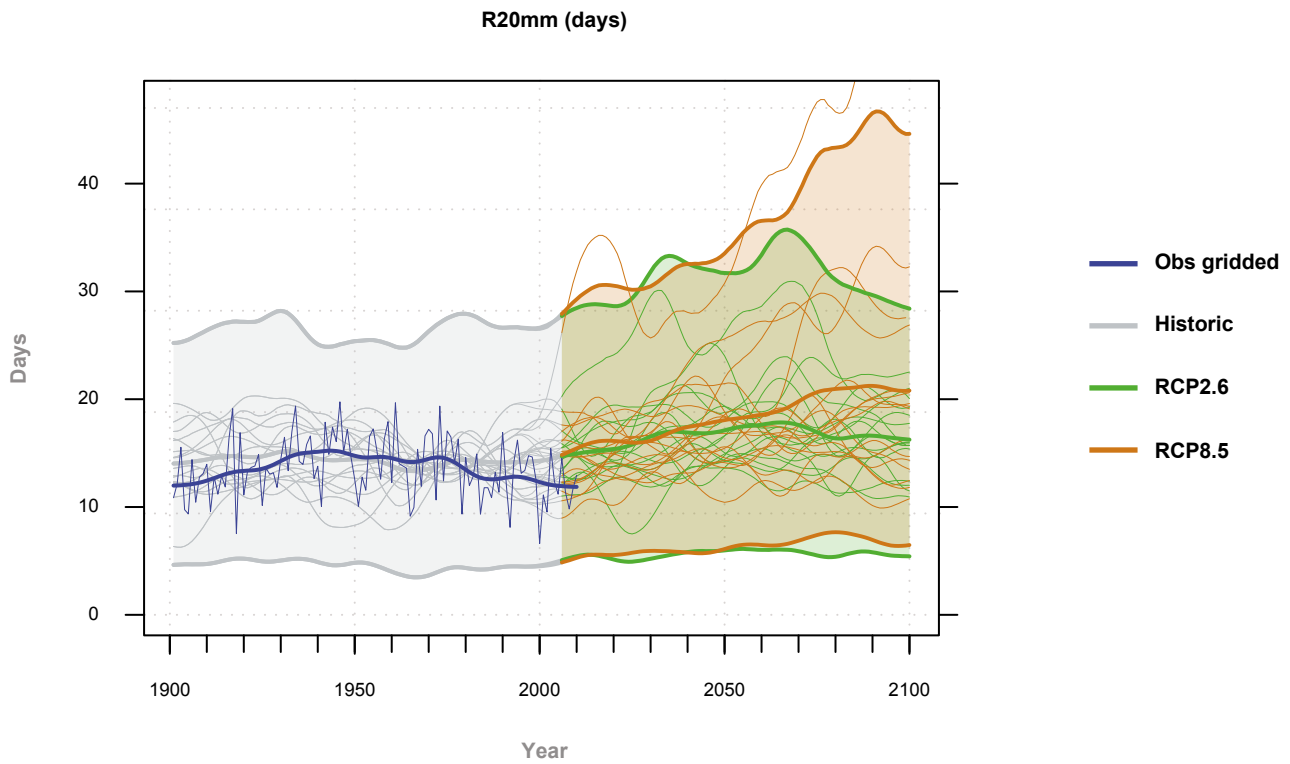
The next table shows the projected changes in temperature and rainfall in 30-year average, with respect to a present-day baseline of 1981-2010, for the '2030s' (2021-2050), the '2050s' (2035-2064) and the '2080s' (2071-2100).

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

	Observed 1981-2010	2030s RCP8.5	2050s RCP8.5	2080s RCP8.5	2080s RCP2.6
Temperature					
Mean Temperature	25.4°C	+1.3 (0.9 to 1.7) °C	+2.1 (1.5 to 2.7) °C	+4.3 (3.0 to 5.4) °C	+1.1 (0.5 to 1.8) °C
Warm Days	13 days	+12 (7 to 19) days	+21 (10 to 32) days	+46 (28 to 64) days	+10 (3 to 20) days
Warm Nights	13 days	+21 (13 to 28) days	+33 (21 to 44) days	+63 (50 to 75) days	+16 (6 to 26) days
Rainfall					
Total Rainfall	860 mm	+8 (-4 to +22) %	+11 (-5 to +22) %	+15 (-13 to +39) %	+7 (-6 to +21) %
Heavy Rainfall Days	13 days	+3 (0 to +9) days	+4 (0 to +13) days	+7 (0 to +22) days	+3 (-1 to +8) days
Consecutive Dry Days	107 days	+3 (-14 to +23) days	+4 (-18 to +25) days	+5 (-16 to +36) days	0 (-16 to +15) days

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 negative, with larger positive changes at the upper end of the range. This indicates greater uncertainty in the direction and magnitude of rainfall change than for temperature.

Key inferences that can be drawn from the above observations and projections for temperature and rainfall are presented below[9]:

- The climate of Ujjain, especially rainfall, shows large year-to-year variability. Hence the city needs to be resilient to this natural variability even in the absence of anthropogenic climate change.

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

- Climate projections show higher greenhouse emissions, and a somewhat higher total rainfall and more intense and frequent rainfall extremes.

- If global warming can be limited to 2°C or less with respect to preindustrial conditions, the climate impact would be substantially reduced for Ujjain, 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 increase in mortality, especially if air quality also decreases. • Negative impacts and constraints on labor productivity, particularly on outdoor workers. • Potential increased demand for air conditioning – which would increase energy demand. • High likelihood of decreasing water availability and increasing crop stresses. • Extremely high risk of decrease in biological richness, accelerated forest cover changes based on the disturbance index, changes in canopy cover along with shift in slope and vegetation.
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. • Very high risk of decrease in average annual rainfall, increase in intensity of precipitation and rise in heat index

---

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

Socio-Economic Profile of Ujjain

The sex ratio of Ujjain city stands at 945 females per 1,000 males as per Census 2011, which is better than the state average of 931 and the national average of 940 per 1,000 males. The average literacy rate of Ujjain city was 74.76% in 2019 which was higher than the national average of 74%. From a gender perspective, male and female literacy were 54% and 45% respectively[10].

Ujjain provides good overall quality of life and moderate cost of living (which is 25-30% lower compared to the other metros), which has ensured availability of senior professionals and skilled workforce at competitive rates.

The economy of Ujjain to some extent is dependent on agriculture. The chief agricultural products grown in Ujjain district are wheat, jowar, maize, etc. The adoption of new agricultural technologies by Ujjain's farmers helps to increase the production of various agricultural crops.

Another unique feature about Ujjain is that it is located exactly at the median of Tropic of Cancer, which also represents the 'Mean Time' of India for Panchanga - India's traditional calendar. Due to such religious significance, in addition to its heritage, the city remains a top tourist destination during Kumbh Mela, and hence is well connected by road, rail and air routes. Due to the prevailing job opportunities, there has been rapid urbanization over the past years, attracting migrants who reside mostly in the southern part of the city. Ujjain also had 168 slums comprising of 23% of the city's population in 2019[11].

Ujjain has scarce industrialization. Some of its principal industries are Vikas Industries (brass and copper products manufacturing), S&S industries (plastic resin manufacturing) and Hira Industries (food manufacturer). A good revenue from these industries helps Ujjain's economy reach a remarkable level. In the year 2016-17, GDP of Ujjain was more than Rs 20 lakh at current price. Ujjain is also an abode of several reputed educational institutions. Some of its recognized educational institutions are Vikram University, Maharshi Panini Sanskrit University, Mahakal Institute of Technology, Ujjain Polytechnic College, Ujjain Engineering College.

City Typology

To ensure that the CAP identifies relevant actions for vulnerable groups, a socioeconomic profile of the city has been developed. The methodology is adapted from the World Resources Report "Towards a More Equal City"[12] and contextualized for cities in MP. The method uses the 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 8.

Figure 8: City socio-economic classification *(Source: Adapted from World Resources Institute)*

Emerging Cities
- Low Income Today
- High Income Growth Relative to Population

Thriving Cities
- High Income Today
- High Income Growth Relative to Population

Aspiring Cities
- Low Income Today
- Low Income Growth Relative to Population

Stabilizing Cities
- High Income Today
- Low Income Growth Relative to Population

x-Axis:
Income Today

y-Axis:
Income Growth Relative to Population

Growth base year: 2021-30

[10, 11] Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh Ujjain, *School of Planning and Architecture, 2019*
[12] Towards a More Equal City: Framing the Challenges and Opportunities, *Beard, V.A., A. Mahendra, and M.I. Westphal, 2016*

- **Aspiring Cities** have a low GDP per capita today, and a low ratio of projected income growth to projected population growth during 2021-2030 compared to other cities. We classify these as aspiring 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 population growth, indicating increases 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. The figure below shows the socioeconomic transition of Ujjain city from the decade 2011-2020 to 2021-2030. On the x-axis we have per capita GDP and on the y-axis ratio of GDP growth to population growth. We have used logarithmic scale to respond to skewness towards the larger values. The point where both the axes cross is India's value.

Ujjain stays in the emerging city category in both the decades i.e., 2011-2020 and 2021-2030. The city will see an increase in income growth in the decade 2021-2030 compared to the previous decade. However, by 2030, the population growth will outpace the income growth of the city. This will create a need to provide essential services with the available limited resources for the rising population. The city needs to improve efficiency in service delivery and also engage with citizens and other stakeholders for optimal consumption of resources. The city also needs to explore avenues to increase its GDP by promoting energy efficient pilgrimage tourism, and by creating service hubs, given its proximity to Indore and Dewas clusters.

Figure 9: Socio-economic typology of Ujjain *(Source: WRI India)*
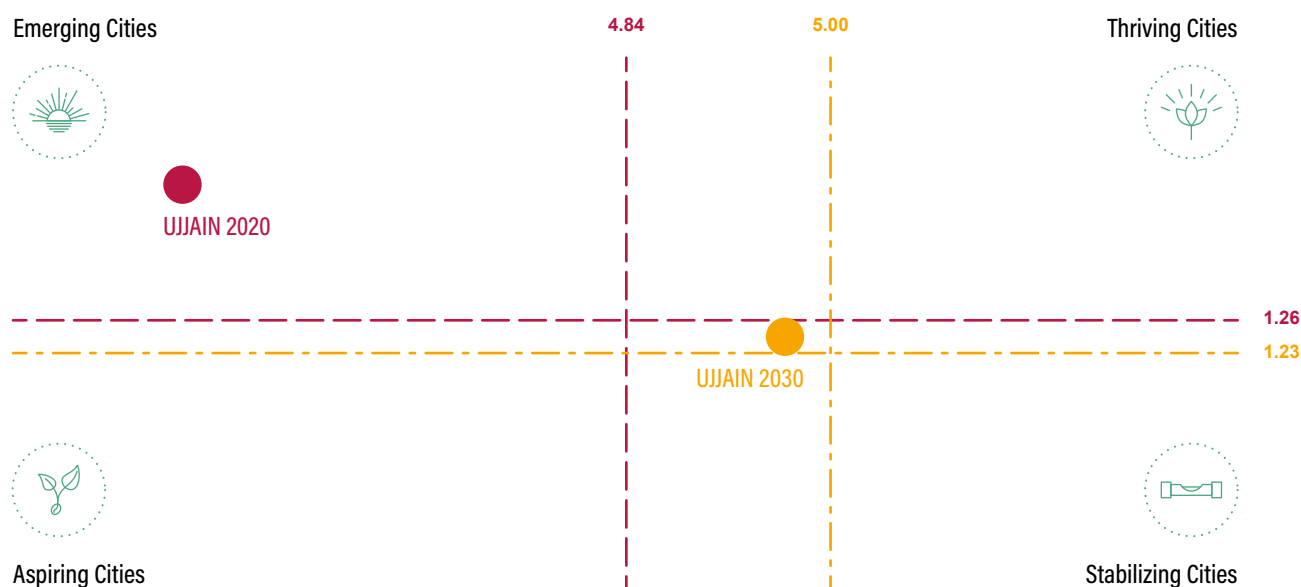
BASELINE ASSESSMENT

CSCAF 2.0 Analysis

Ujjain has performed well in the first two rounds under CSCAF. The city has been doing exceedingly well under the waste management sector and the same is also reflected in its Swachh Survekshan rankings. The city also has demonstrable example of public bus rapid transit system which caters to more than 80,000 people every day. However, the city must focus on improving its score and performance for indicators under other sectors. Some of the current initiatives and possible areas of improvement have been highlighted in the table below.

Table 4: CSCAF analysis for Ujjain *(Source: CSCAF 2.0 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	375	126	143	100	573
Current measures being undertaken in the city	• 0.07 % of total electricity generation is through renewables. • Less than 10% of the buildings are energy efficient or green buildings. • 40% of streetlights are LED lights.	• 6.87% of the municipal area was under green cover in 2020. • Plantation of 12 lakh trees along Rudrasagar lake is underway. • Ankur program has been launched in the state and Pradhan Mantri Awaz Yojana (PMAY) has been linked to it. The program rewards citizens for tree plantation. • Action plan developed to increase green cover in Ujjain. • Established city level biodiversity management committee	• 0.08 buses available per 1,000 population. • 1888 auto-rickshaws run on clean fuels including 113 electric rickshaws. • The city regularly monitors major parameters and city's air quality does comply with NAAQ standards. • Clear Air Action Plan of the city is already in place.	• In 2018, 52% of the municipal households had in-house water supply connections and 10% of the households below poverty line had in-house water supply connections[13]. • As per the data submitted for CSCAF 2.0, 54 MLD of wastewater is treated and is reused for gardening and agriculture purposes. • Energy audit conducted for water supply pumping stations and water treatment plants. • 41% non- revenue water.	• 100% door-to-door collection exists as per the District Environmental Plan[14]. • City has proposed construction of a sanitary landfill. • Implemented a bio-methanation plant with a capacity of 5 tonnes per day to treat vegetable waste. • Bioremediation of legacy waste has been completed[15]. • The city has installed a 600 kg capacity organic waste converter plant in the Mahakal temple campus[16].

[13] Status of water flows in Ujjain, *Heinrich Böll Foundation-India & Development Alternatives, 2018*
[14, 15] District Environmental Plan for Ujjain, *MPPCB, Madhya Pradesh, 2021*
[16] Mahakal temple in Ujjain goes the organic way, *The Times of India, 2022*

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
Areas of improvement	• Increasing green building adoption. • Increasing power generation from RE sources. • Increasing percentage of energy efficient streetlighting. • Promoting rooftop solar in residential and commercial buildings. • Promoting green buildings in at least 85% of ABD area.	• Need to integrate the strategy for rejuvenation and conservation of water bodies and open spaces within the City Development Plan/Master Plan • Identifying measures to increase urban biodiversity and allocate resources. • Need to prepare a disaster management plan with ward level risk assessment and early warning systems.	• Increasing the number of clean fuels run vehicles especially buses and taxis. • Augmenting the public transport fleet. • Increasing the coverage of roads with footpaths and cycle tracks (currently only 1.34%). • Improving last mile connectivity. • Monitoring and revising the clean air action plan	• Increasing the tap water connections to more than 90% households. • Introducing metering policy from immediate effect. • Increasing wastewater reuse. • Carrying out flood/ water stagnation risk assessment of the city.	• Reducing waste going to the landfill. • Increasing adequate waste transport infra-structure. • Monitoring the amount of methane collected from STPs and generating clean energy. • Reducing greenhouse gas emissions from waste transport by shifting to alternate fuels.

Greenhouse Gas Emissions Profile

A citywide GHG emissions inventory forms a critical piece of any climate action plan. The greenhouse gas emissions inventory for Ujjain includes an analysis of all the sectors/ sources that emit GHGs into the atmosphere and include transport, waste, and energy sectors. Establishing the sources and activities that contribute to emissions allows the city to develop mitigation policies and strategies.

Critical Sources

In 2019, Ujjain's GHG emissions were 1.375 mtCO$_2$e which was 2.3 tCO$_2$e per person (Including Manufacturing and Industrial emissions from electricity consumption). The emissions inventory was compiled as per the Global Protocol for Communities (GPC) BASIC standards using C40's City Inventory Reporting and Information System (CIRIS) tool. Majority of the emissions comes from energy and electricity consumption in industrial sector followed by residential buildings. The contribution of the three sectors to total emissions in the city is given in the figure below.

Figure 10: Percentage distribution of emissions by sector *(Source: WRI India analysis using primary city data)*

- ● Stationary Energy
- ● Transport
- ● Waste
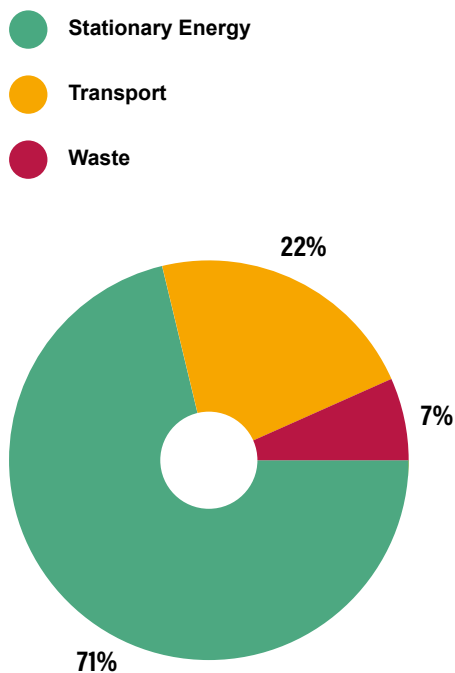
Stationary energy contributes 71% to the city's total emissions, followed by transportation that contributes 22%. Waste sector contributes 7% to Ujjain's total emissions. This is because the city's electricity is generated predominantly from high-emitting fossil fuels. The inventory includes scope 1 emissions which are emissions due to activities in the city (for all sectors), scope 2 emissions which are emissions from electricity consumption in the city (for all sectors) and scope 3 emissions from waste, which are emissions outside the city due to activities originating within the city (example, if waste generated inside the city is treated elsewhere outside municipal limits).

As per emissions projected for Ujjain, the emissions are projected to increase by 10% by 2025 and 18% by the end of the decade till 2030, compared to the baseline emissions of 2019. This creates 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 11: Emissions contribution by sector *(Source: WRI India analysis using primary data)*
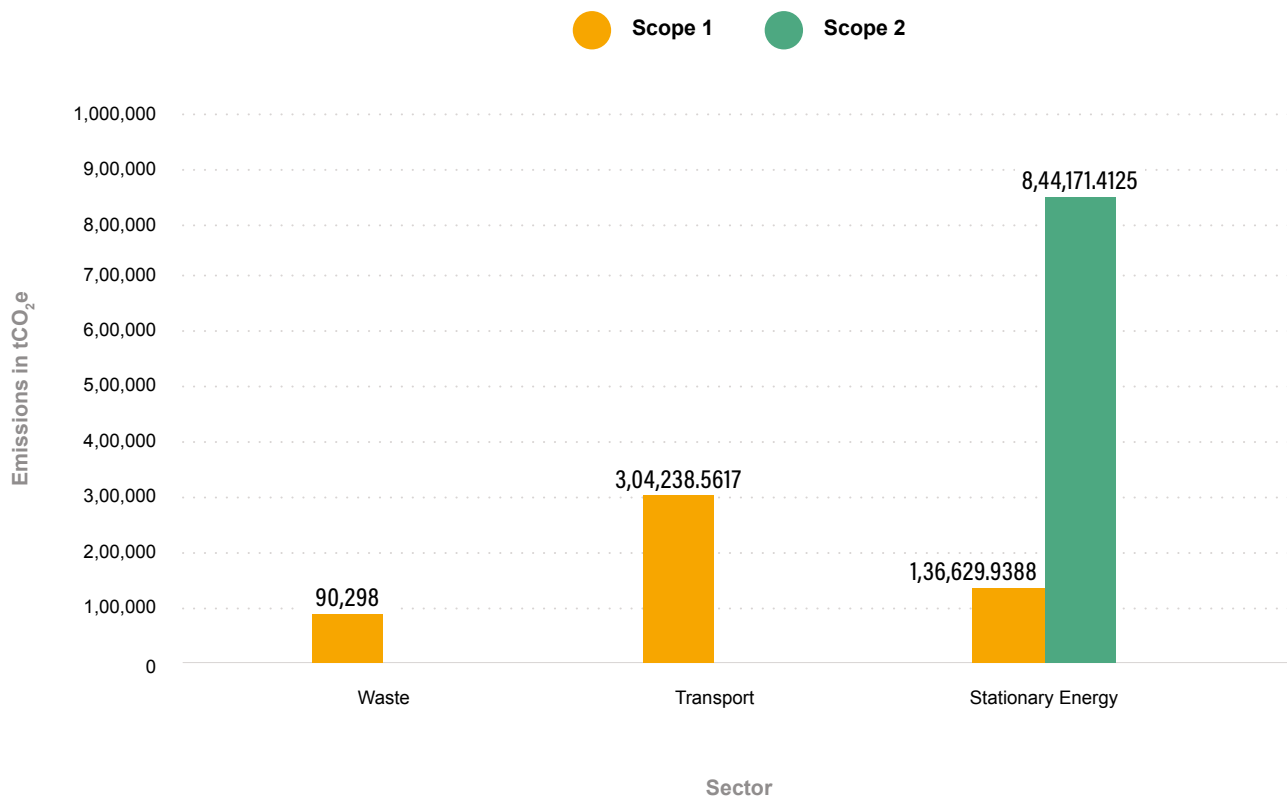
Figure 12: Projected emissions for Ujjain *(Source: WRI India analysis using primary data)*

Legend: ● Stationary Energy ● Transport ● Waste

Y-axis: mt CO_2 eq

2019: 0.98, 0.30, 0.09
2025: 1.08, 0.33, 0.10
2030: 1.15, 0.36, 0.11

X-axis: Year
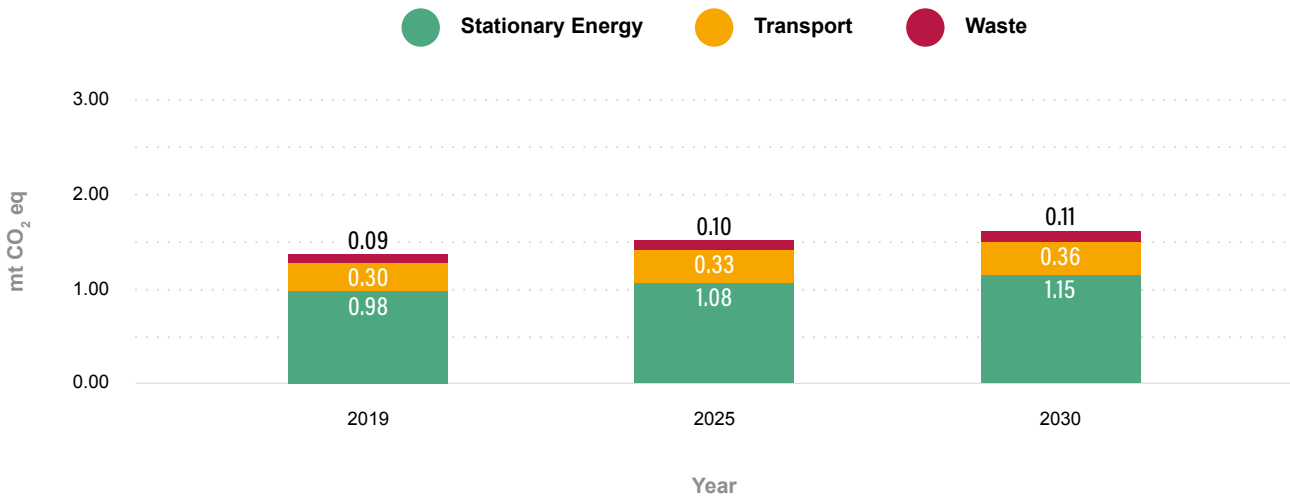
Energy Sector Emissions

Stationary energy sector comprises of emissions from electricity consumption and fuel consumption from (i) residential buildings (ii) commercial and institutional buildings and (iii) manufacturing industries and construction and (iv) urban agriculture. As per city level electricity consumption data obtained from the state distribution company (DISCOM), the total electricity consumption in Ujjain city is 1,036,078 MWh in 2019, out of which industrial consumption is the highest with 583,829 MWh, followed by domestic consumption of 281,001 MWh (Fig 13).

LPG fuel consumption totals 41,201.03 metric tonnes (Mt). PNG consumption is 19,101,577 (SCM) and CNG consumption is 703.74 metric tonnes (Mt). There is no data available on kerosene and coal consumption within the city.

This sector accounts for 980,801 tCO_2e of Scope 1 and Scope 2 emissions of the city's total emissions. These include emissions from electricity consumption and fuel consumption including PNG, LPG and CNG. Figure 16 presents the distribution of stationary energy emissions of Scope 1 and 2.

Figure 13: Electricity consumption by sub-sectors *(Source: DISCOM data)*

Legend:
● Industrial
● Residential
● Commercial
● Public Water Works
● Streetlights
● Agriculture Irrigation

27%
11%
3%
2%
1%
56%
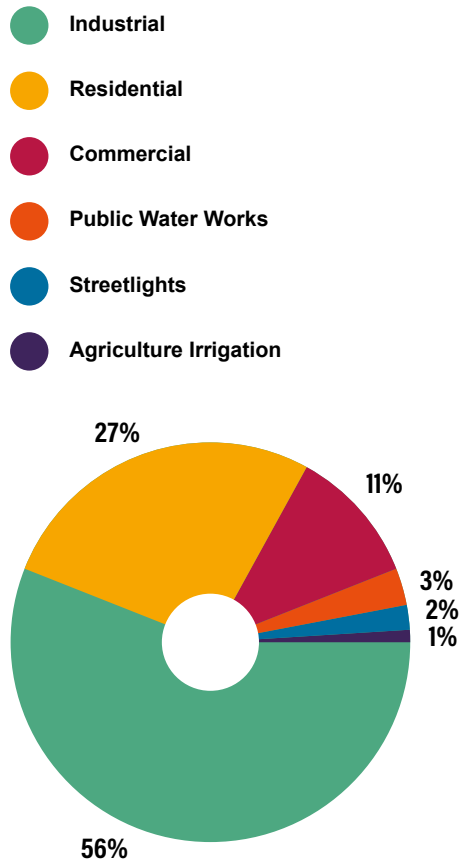
Figure 14: Liquified petroleum gas (LPG) consumption *(Source: WRI India primary data)*

● Domestic/Residential LPG (Mt)

● Commercial Industrial LPG (Mt)

9%

91%
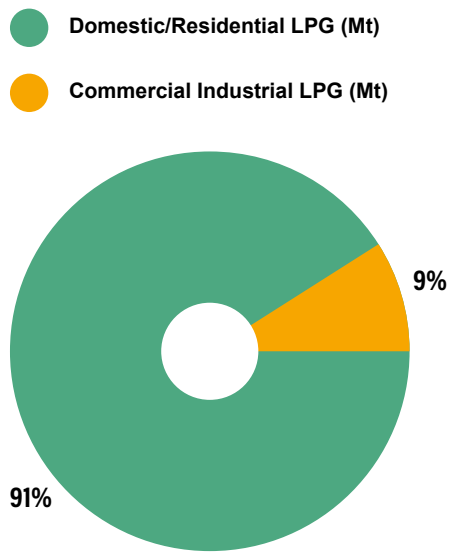
Figure 15: Piped natural gas (PNG) consumption *(Source: WRI India primary data)*

● Industrial PNG (SCM)

● Domestic/Residential PNG (SCM)

● Commercial PNG (SCM)

28%

7%

65%
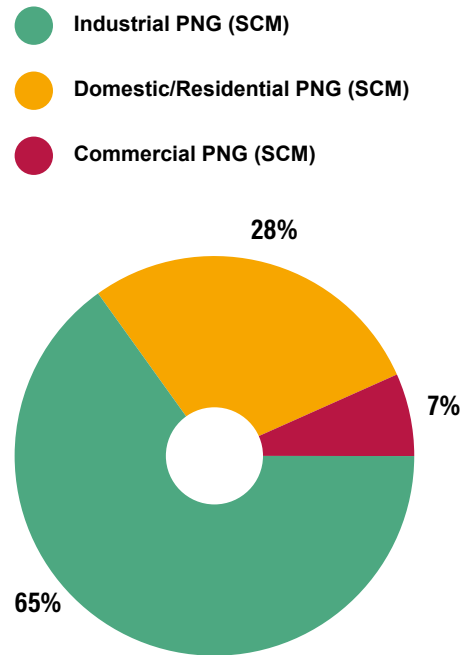
Figure 16: Stationary energy emissions by sub-sector *(Source: WRI India primary data)*

● Scope 1   ● Scope 2   ● Total

Emissions in tCO$_2$e

12,00,000

8,00,000

4,00,000

0

Manufacturing Industries & Construction

Commercial & Institutional Buildings & Facilities

Residential Buildings

Sub-sectors
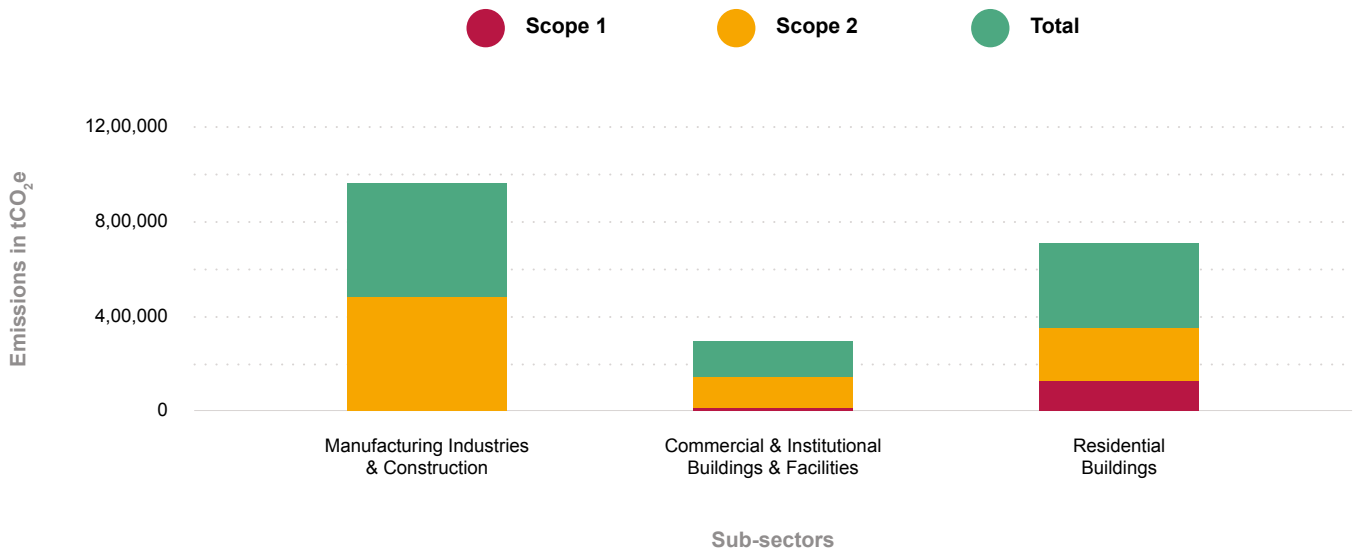
Transportation Sector Emissions

The transport sector accounts for 304,239 tCO$_2$e emissions, coming from the consumption of petrol and diesel in on-road transport. Data was obtained from fuel agencies such as Indian Oil Corporation Limited, Bharat Petroleum Corporation Limited, and Hindustan Petroleum Corporation Limited.

Waste Sector Emissions

Figure 17: Distribution of waste sector GHG emissions by sub-sectors *(Source: WRI India primary data)*

- ● Wastewater
- ● Biological Waste
- ● Solid Waste
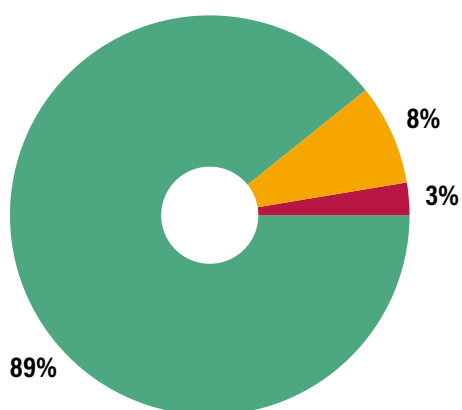
Waste accounts for 90,298 tCO$_2$e emissions, coming mainly from emissions of the city's wastewater (89%). About 8% of emissions comes due to composting of biological waste while the remaining 3% can be attributed to landfilled solid waste. The inventory should also cover emissions due to incineration of waste, but the city could not provide any data on the same and hence this has not been included. Moreover, the inventory's accuracy can be increased with data on waste composition, which was not provided by the city.

Emissions Scenario Modeling for Ujjain

An emissions scenario modelling analysis was done for Ujjain using the Climate Action for Urban Sustainability (CURB) tool. The Climate Action for Urban Sustainability tool is an interactive spreadsheet-based tool designed by 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 investments required, and prioritize low-carbon interventions based on cost, payback period, feasibility and impact on energy consumption and emissions reduction[17]. This tool was used to develop three main scenarios.

- **Business-as-usual scenario:** Predicts the emissions reductions if no action is taken for GHG emissions mitigation.

- **Existing and planned scenario:** This scenario uses existing or planned city, regional and national actions, policies, and programs to demonstrate the emissions

reduction 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 to the 1.5°C Paris Agreement and Deadline 2020 trajectory. This scenario analyzes the emissions reduction 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 the targets are feasible.

Business-As-Usual (BAU) Scenario for Ujjain

This scenario was developed based on the existing pace of economic growth and urban development of the city,

---

[17] CURB tool: Climate Action for Urban Sustainability (Vol.2): User guide, *World Bank, 2017*

assuming there is no planned actions or targets for mitigating emissions in the coming decades. As mentioned earlier, Ujjain falls under emerging cities category, with a low-income today but high-income growth in relation to population growth in the next decade. Based on the 2019 emissions inventory for the city (Fig 10), the total emissions for the city amount to 1.37 $mtCO_2e$ in 2019, with 2.3 tCO_2e per capita.

Taking 2019 as the base year, if the city does not or will not take any action to reduce emissions by the next couple of decades, the following Fig 18 which states the emissions forecast by horizon decade of 2030, 2040 and 2050, estimates that emissions can increase 1.5 times from 2019 to 2050 reaching 2.1 $mtCO_2e$. As stated previously, majority emissions come from the manufacturing and construction industries' energy consumption followed by residential and commercial sectors' energy consumption and then the transportation sector.

Existing and Planned Scenario for Ujjain

The E&P scenario uses data from existing and planned city, regional and national actions, policies, and programs to demonstrate the emissions reduction trajectory for the city under the current ambition level. It considers current and planned development strategies that would have an indirect co-benefit of emissions reduction. Examples include actions to subsidize photovoltaic solar installations, solar rooftop, electric vehicle policy, etc. The policies studied for Ujjain include Ujjain Development Plan, Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh prepared by School of Planning and Architecture Bhopal for Ujjain, MP Electric Vehicle policy 2019 and the smart city proposal. Under this scenario, emissions are expected to reduce by 10.6% by 2050, a slight reduction from the BAU scenario. However, it is still not aligned with the 1.5°C Paris Agreement and Deadline 2020 emission trajectories.

Figure 18: BAU emissions projections for Ujjain *(Source: WRI India primary data)*
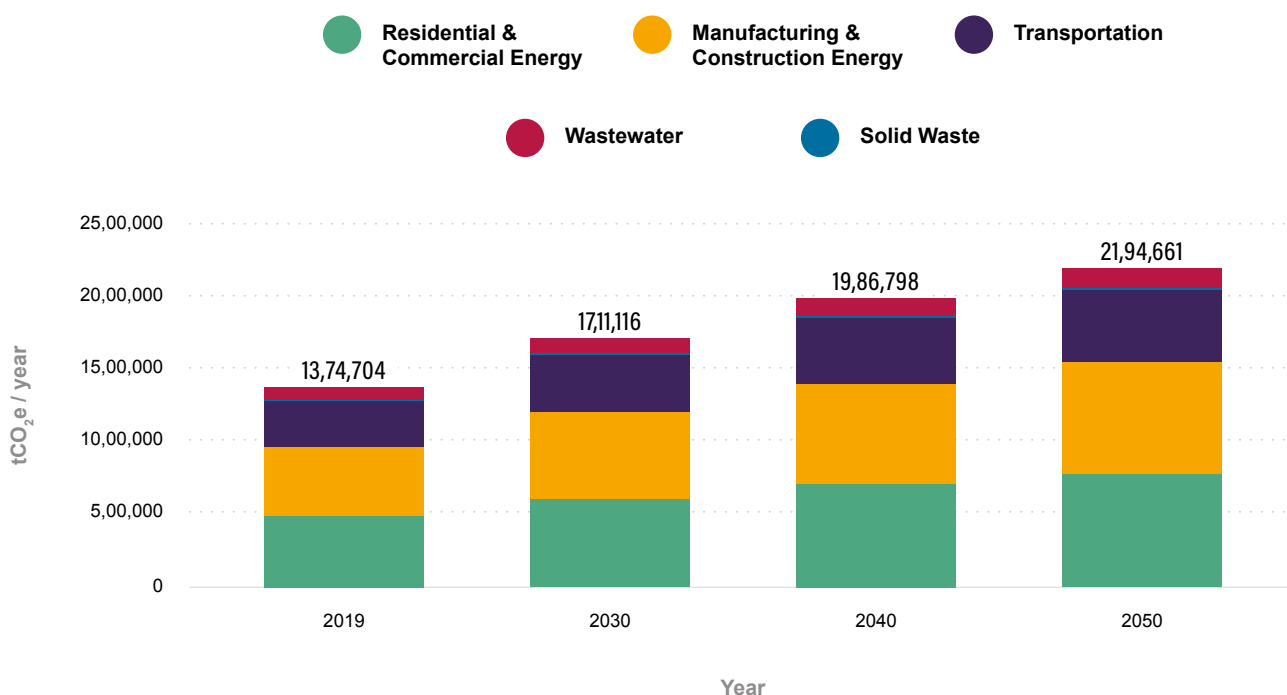
Figure 19: Emissions reduction potential for Ujjain under the E&P scenario *(Source: WRI India analysis using primary data and consultations)*
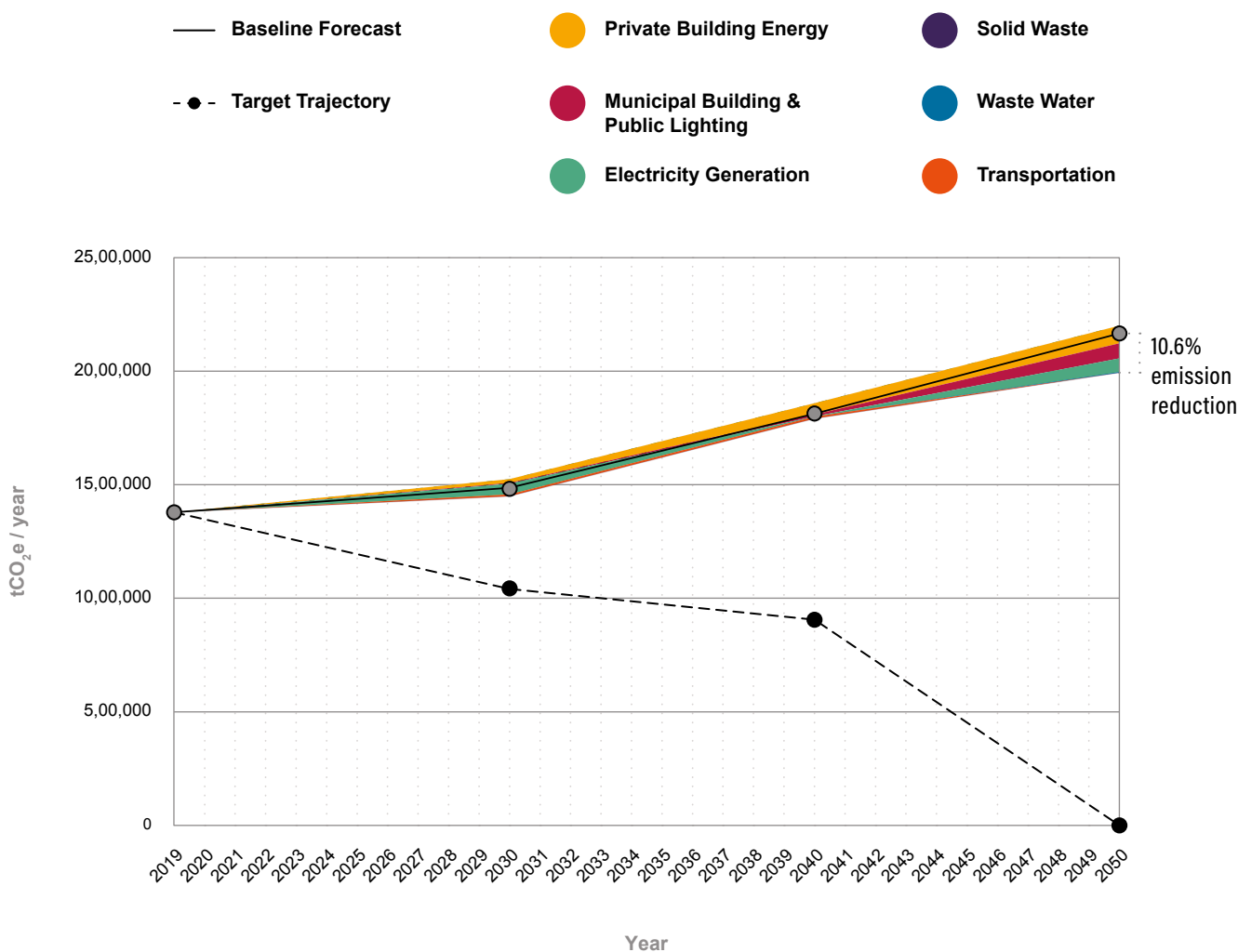
Ambitious Scenario for Ujjain

This scenario was modelled to bridge the gap between the current trajectory and the 1.5°C Paris Agreement goals. In this scenario, some ambitious yet achievable targets were set, aligning them with India's commitment at the 26th session of the Conference of Parties (COP26) at Glasgow, where the country set a target to source 50% of its energy demand from renewables by 2030. Fig 20 represents emissions potential for the ambitious scenario, which was developed in consultation with sectoral experts.

Due to the ambitious scenario actions and strategies, the city would be able to achieve an emissions reduction of 14% by 2030, 21% by 2040, and 55% by 2050. This implies that the city will have a residual emission amounting to a 45% gap in meeting the 2050 target of 100% emissions reduction. This can be attributed to methane emissions from wastewater treatment, which

remains ineffective due to lack of a robust sewage network. Moreover, the city has limited scope and direction to move towards electric vehicles, owing to a largely informally driven public transport system, besides limited institutional and financial capacities. Further research would be required to gauge the reduction of all long-term residual emissions. The assumptions for the sectors are provided below.

- **Energy and Buildings:** Ujjain city do not have any plans for RE as power generation and RE mix are managed by the Department of Energy, Government of MP with no city-specific target for RE. Madhya Pradesh aims to achieve 20% of its energy demand from renewables by the financial year 2024, 30% by 2027 and 50% by 2030[18]. Ujjain city and DISCOM aim to contribute to the state target. During the consultation, stakeholders agreed that Ujjain had the potential to achieve 52% RE in its power generation

[18] REC inks three strategic MoUs in backdrop of Madhya Pradesh Global Investors Summit 2023, *Press Information Bureau, 2023*

mix by 2050 supported by rooftop solar in private and public buildings.

- **Transport:** Due to limited population and area, the city lacks an efficient public transport infrastructure and supporting policies on the ground. The city has only 48 diesel buses and no plans for any CNG or EV buses in the near future. Only 1.54% of Ujjain city area is covered by NMT network. However, a household survey in 2018 highlighted that 37% of slum population and 17% of the non-slum population choose non-motorized systems for making their daily trips, calling for better NMT infrastructure[19]. The city validated that market-driven development and city administration's support can achieve a fleet composition of 50% EV on road in terms of public, private and urban freight transport by 2050. Ujjain has 1888 autos based on

clean fuel out of which 113 were e-rickshaws as per CSCAF 2.0 data. Only 48 buses are available for 597,649 people, which means 0.08 availability of public transport for a population of 1,000. The city has implemented a vehicle-free zone, parking lots and shaded pedestrian areas in the Mahakal area under CITIIS 1.0 (City Investments to Innovate, Integrate and Sustain) project[20].

- **Solid Waste:** The Ujjain Municipal Corporation generates 205.3 tonnes of waste per day[21], which includes waste generated by the floating population that visits the city every day. The waste collection system is inadequate, and the city is planning for 8 more mini trucks and 8 collection trolleys[22]. 20 TPD of C&D waste and 8.67 TPD of plastic waste is generated. Bioremediation of legacy waste has been

Figure 20: Ambitious scenario emissions reduction potential for Ujjain *(Source: WRI India analysis using primary data and consultations)*
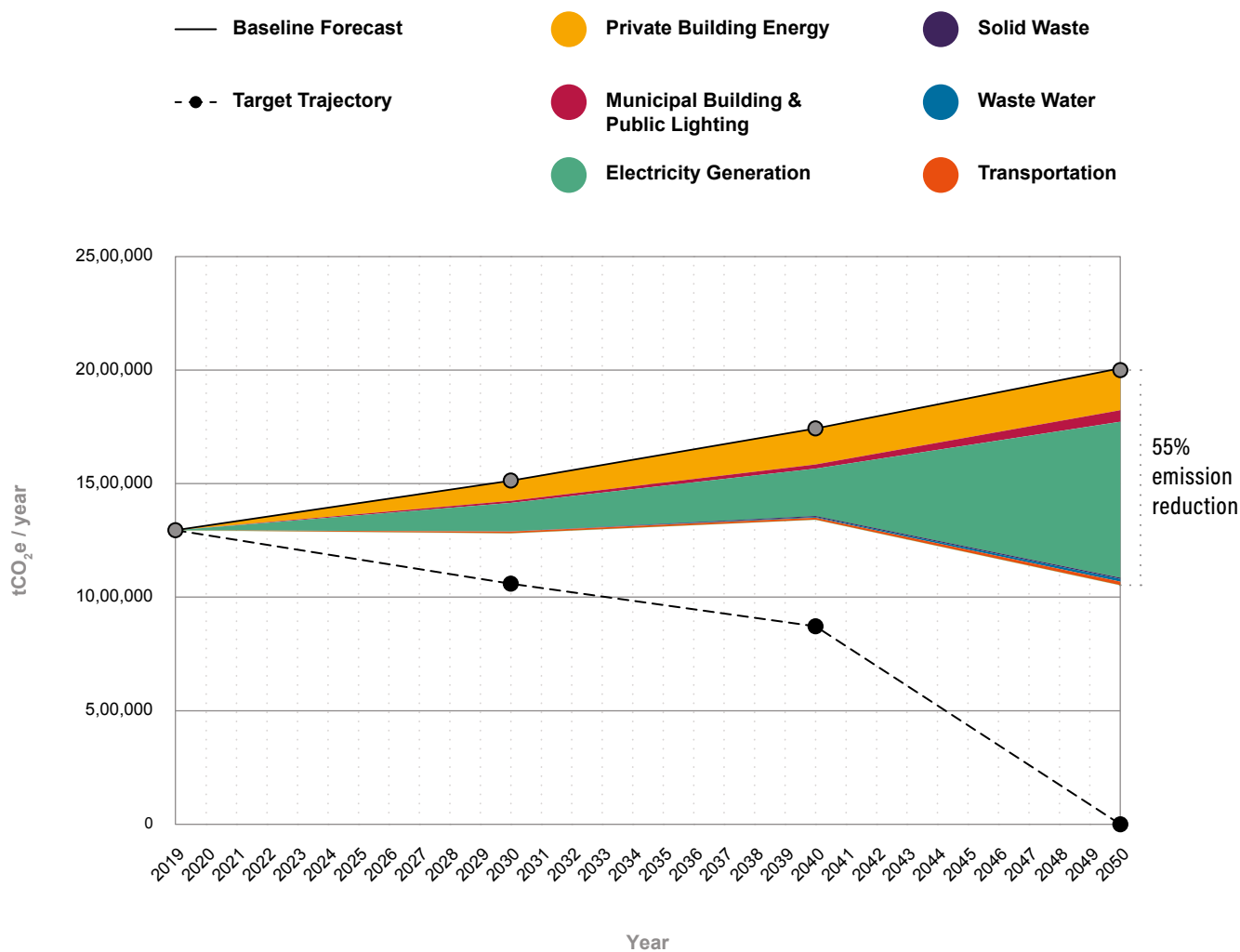
[19] Mobility Planning for an Indian Pilgrimage City - A Case of Ujjain City, Madhya Pradesh, India, *Dr. Kakoli Saha, 2018*

[20] Mahakal Rudra Sagar Integrated Development Approach, Phase II, *CITIIS*

[21, 22] District Environmental Plan for Ujjain, *MPPCB, Madhya Pradesh, 2021*

completed and there is a proposal to construct a sanitary landfill[23]. There is no information on methane collection.

- **Waste and Wastewater:** 52% of the municipal households have in-house water supply connection and 10% of the households below poverty line have in-house water supply connection[24]. Total water put into the system is 110 MLD while only 65 MLD is sold, amounting to 41% of non-revenue water[25].

The city aims to achieve 24x7 water supply with reuse of recycled wastewater[26]. Ujjain aims to have 100% rainwater harvesting in the ABD area. The stakeholder consultations also highlighted that since the city does not have 100% underground sewage network and the existing Sequential Batch Reactor (SBR) based treatment plant is not functional.

The sectoral targets for this scenario are provided in the following table:

Table 5: Ambitious scenario targets for Ujjain *(Source: WRI India analysis using data from local consultations and secondary literature)*

Target	2030	2040	2050
Energy and Buildings			
Share of renewables in the total electricity from the grid (%)	13	18	52
Share of total residential high-income buildings with solar PV installed (%)	20	25	35
LED lighting in existing commercial and residential buildings (%)	40	80	100
Solar PV in municipal buildings (%)	20	50	90
Share of municipal buildings with LED (%)	40	50	90
Transport			
Mode share for public transport (%)	12	26	39
Electrification of passenger automobiles (%)	25	55	80
Electrification of light duty freight (%)	20	40	70
Electrification of buses (%)	10	30	50
Waste			
Share of organic waste composted (%)	70	90	100
Share of CNG transport vehicles (%)	20	40	80
Wastewater and Water			
Share of NRW (%)	20	40	80
Share of pumps with improved efficiency (%)	60	90	100
Treatment with gas capture (%)	10	40	100

---

[23] District Environmental Plan for Ujjain, *MPPCB, Madhya Pradesh, 2021*

[24] Status of water flows in Ujjain, *Heinrich Böll Foundation-India & Development Alternatives, 2018*

[25] CSCAF 2.0, *2020*

[26] Ujjain Smart City Limited website

Vulnerability Assessment

EPCO has carried out climate change impacts and vulnerability assessment of water, forest, agriculture, and health sectors for all the 52 districts in the state of Madhya Pradesh. The analysis was carried out for projected climate in the state over the periods 2021-2050 (mid-century, MC) and 2071-2100 (end-century, EC) using a multi model ensemble from the Coordinated Regional Climate Downscaling Experiment (CORDEX) for RCP 4.5 and RCP 8.5 scenarios. A glimpse of the vulnerability assessments of different sectors is given below.

According to this analysis, Ujjain has a low composite vulnerability, determined by social indicators, economic indicators, water indicators, agriculture indicators and forest indicators. In terms of water resources, Ujjain falls under very high vulnerability with a very high risk of decreasing availability of water, increasing crop water stresses and increasing frequency of extreme events like floods and droughts in the RCP 4.5 mid-century, reducing to a high-level vulnerability in the end-century scenario.

Figure 21: Climate change vulnerability assessment *(Source: Madhya Pradesh Climate Change Knowledge Portal)*

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

Forest Vulnerability

District Forest Vulnerability - Madhya Pradesh
Vulnerability: Current (1981-2010)

Very High

District Forest Vulnerability - Madhya Pradesh
Projected Vulnerability: Mid-Century (RCP4.5 , 2021-2050)

Moderate

District Forest Vulnerability - Madhya Pradesh
Projected Vulnerability: End-Century (RCP4.5 , 2071-2100)

Moderate

Climate Vulnerability

District Climate Vulnerability - Madhya Pradesh
Vulnerability: Current (1981-2010)

Low

District Climate Vulnerability - Madhya Pradesh
Projected Vulnerability: Mid-Century (RCP4.5 , 2021-2050)

Moderate

District Climate Vulnerability - Madhya Pradesh
Projected Vulnerability: End-Century (RCP4.5 , 2071-2100)

Moderate

The city faces a moderate forest vulnerability in the RCP 4.5 mid-century and end-century scenarios with an extremely high risk of decrease in biological richness, accelerated forest cover changes based on the disturbance index, changes in canopy cover along with shift in slope and vegetation. In terms of climate, the city faces a moderate vulnerability in the RCP 4.5 mid-century and end-century risk projections, with a very high risk of decrease in average annual rainfall, increase in intensity of precipitation and rise in heat index.

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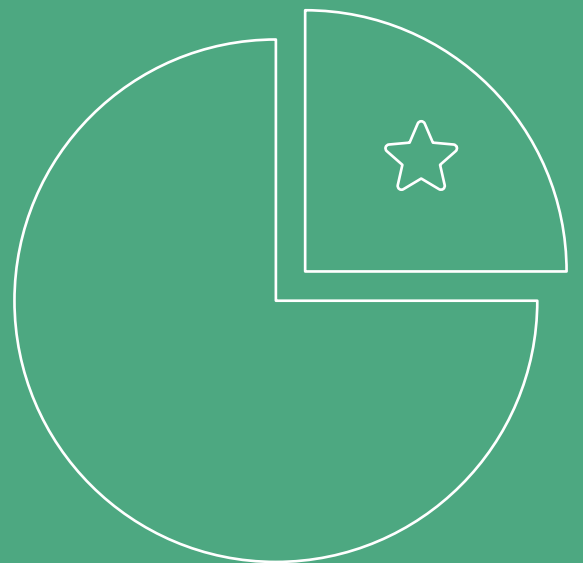
This section provides a detailed description of the current performance of Ujjain city on different indicators under CSCAF, based on which the sectoral goals have been identified to address the gaps and challenges towards making Ujjain a low-carbon and climate-resilient city.

Sectoral Assessment

| Energy and Green Buildings

As per the primary data obtained from the state distribution company, the total electricity consumption was 1,036,078 MWh in FY 2019-20. The city has a very negligible renewable energy contribution of 243.308 MWh (0.07%)[27]. In terms of consumption of fossil fuel, the breakup for FY 2019-20 is shown in the table below.

As per the CSCAF 2.0 data, 40% of streetlights in the city are energy efficient as of 2020[28], however the city has issued a work order for the same. Ujjain is currently working on installing solar rooftop in public buildings and has completed a smart pole project[29].

Sustainable tourism can be promoted through adaptive reuse of buildings and space, heritage streets and improvements in facade. As per the ABD plan, the city has a goal to implement green buildings in at least 85% of the ABD area, incorporating passive solar design. As per Ujjain's ABD plan, the city aims to utilize 65% of rooftops in the redevelopment area for solar power generation of 42,800 units per day, constituting 30% of total power consumed in the ABD area[30].

| Urban Planning, Green Cover and Biodiversity

Conservation of water bodies and open areas is a priority for Ujjain. They have mapped water bodies and open areas in the city. The city has also allocated financial resources towards such conservation. In 2019, the total per capita green space was 7-8 m^2 which is less than the average suggested by Urban and Regional Development Plans Formulation and Implementation Guidelines (URDPFI) in 2019. The total sequestration from all the five parks in the city was 553.38 kg/year and the total estimated carbon sequestered by all the trees in Ujjain was 12,306,772 tonnes per year in 2019[31]. Planting of 12 lakh trees along Rudrasagar lake is underway in addition to development of botanical gardens and parks in the ABD area with multi-use open space, cycling and jogging tracks, Japanese garden, bird sanctuary, children's play area, open air theatre, etc., particularly in the Vrindavan region and Mannat Garden. A tender has been issued for the same[32]. Under the Mayur Van project, Ujjain has issued a work order to implement living green walls and rooftop gardens in buildings[33]. The city aims to link ecology with the built environment, protect the existing green areas and increase the number of green open spaces for public

Table 6: Break-up of fossil fuel consumption in Ujjain (Source: Primary data from fuel agencies)

Type of Fuel	Consumption
Diesel	67,207 kl
Petrol	43,425 kl
CNG	704 Tonnes
Auto LPG	0.339 Tonnes
Domestic LPG	37,687 Mt
Commercial/Industrial LPG	3,514 Mt
Residential PNG	53,90,494 SCM
Commercial PNG	12,77,827 SCM
Industrial PNG	1,24,33,256 SCM

[27, 28] CSCAF 2.0, *2020*

[29] Ujjain Smart City Limited, project list

[30, 32, 33] The Smart City Challenge under Smart City Mission, Phase II, *Ujjain Smart City Proposal*

[31] Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh Ujjain, *School of Planning and Architecture, 2019*

interaction and activities while restricting the urban fabric. Native species of trees are being planned in the Mahakaal Rudrasagar Integrated Development Approach (MRIDA) corridor.

The city has prioritized urban biodiversity management. The city has an established city-level biodiversity management committee and has conducted a baseline assessment for urban biodiversity management.

| Mobility and Air Quality

The mode share of Ujjain was as follows in 2018: 2-wheeler (42%), car (4%), bus (8%), autorickshaw (12%), MAGIC (12%), cycle (7%) and walk (15%)[34] as seen in Fig 22.

Figure 22: Mode share of Ujjain *(Source: Kakoli Saha, 2018)*

- 2-Wheeler
- Pedestrian
- Autorickshaw
- Magic Tempo
- Bus
- Cycle
- 4-Wheeler
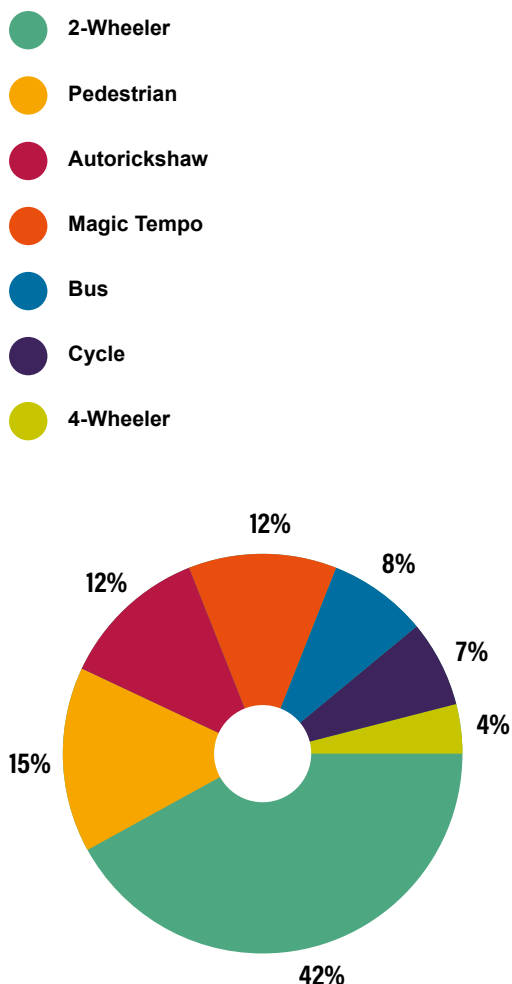
The city has no commercial CNG/electric 4-wheelers or 2-wheelers. However, a tender has been issued for a public e-bike or e-scooter system on a rental basis along with electric charging stations[35]. Ujjain has 1888 autos based on clean fuel out of which 113 were e-rickshaws as per CSCAF 2.0 data[36]. Only 48 buses are available for 597,649 people, which means 0.08 availability of public transport for a population of 1,000[37]. Buses also covered only 36% of the municipal area with low frequency in 2018[38]. Ujjain has issued a work order for developing smart mobility shelters on a PPP basis[39]. As per the vehicle fleet data from the regional transport office, the city had negligible EVs as of 2019 with 91% of the fleet running on petrol (Fig 23).

Figure 23: Distribution of vehicles by fuel type registered in 2019 *(Source: RTO data)*

- Petrol
- Diesel
- CNG
- EV
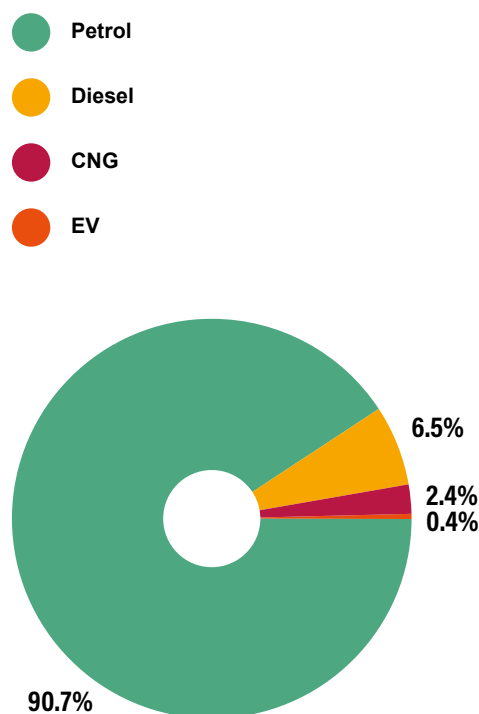
Within the ABD area, the city aims to develop an integrated multimodal transport hub in the area near the railway station by integrating it with the bus stand[40]. The city has completed a project for battery operated e-rickshaws with booking mobile app for citizens, to help them locate nearby e-rickshaws and find the estimated distance of the vehicle from the actual or chosen location[41]. The city is in the work order stage for development of basement parking and a hawkers' zone

---

[34, 38] Mobility Planning for an Indian Pilgrimage City - A Case of Ujjain City, Madhya Pradesh, India, *Dr. Kakoli Saha, 2018*

[35, 39, 41] Ujjain Smart City Limited, project list

[36, 37] CSCAF 2.0, *2020*

[40] The Smart City Challenge under Smart City Mission, Phase II, *Ujjain Smart City Proposal*

at Maharajwada II and Urdu school premises[42]. As per CSCAF 2.0, only 1.54% of road length is covered with footpaths and cycling tracks. A tender has been issued to construct a pedestrian bridge across Rudrasagar lake and development of a square front Shanti Palace[43].

Ujjain does monitor PM_{10}, $PM_{2.5}$, NO_x, and SO_x as per CPCB guidelines and CO, NH_3, Pb and O_3 as per NAAQS, and makes it available in the public domain. The city has been demonstrating a reduction trend in air pollution and improvement in air quality. The city's air quality does comply with the NAAQ standards. However, currently the AQI ranges from poor to unhealthy, with the $PM_{2.5}$ values being 42 times higher than the levels recommended by the World Health Organization[44]. The city has an action plan for control of air pollution[45]. Ujjain also plans to use smart technological solutions to monitor air and water pollution.

Waste Management

As per the district environment plan of 2021, Ujjain Nagar Palika has achieved 100% coverage of households for door-to-door collection and source segregation[46]. The Ujjain Municipal Corporation generates 205.3 tonnes of waste per day, which includes the waste generated by the floating population that visits the city every day. 20 TPD of C&D waste is generated. 8.67 TPD of plastic waste is generated. The wet waste is completely composted. Bioremediation of legacy waste in the Pandyakhedi site was completed in 2021. However, there is no information on methane collection. A work order has been issued for the development of a transfer station for handling cleaning waste[47].

There is a focus on ICT-driven monitoring and control of waste management including collection, transportation, and treatment. The city has plans to complement this with optimization of routes, timing, and fuel consumption to reduce cost of service delivery[48]. The city has implemented a bio-methanation plant with a capacity of 5 tonnes/day to treat all the vegetable waste from the city's markets. The project has resulted in a GHG emissions reduction of 12,176 kg/month[49]. The city has also implemented a composting plant in the Mahakal temple to convert floral waste to incense sticks[50].

Water Management

Total water produced is 110 MLD and 65 MLD is sold amounting to 41% NRW[51]. The city has completed the project on 24x7 Water Supply in ABD Area by retrofitting of existing water supply pipelines and allied infrastructure. Ujjain aims to have 100% rainwater harvesting in the ABD area[52].

Rejuvenation and construction of pedestrian bridge along the Rudrasagar Lake and lakefront development at Chhota Rudrasagar are in a tender stage[53]. Cleaning and desilting of the water bodies and subsidiary streams to rejuvenate its carbon sequestration capacity is also underway[54]. The city aims to create separate ponds for *visarjan* (immersion of idols).

The city plans to implement online water monitoring and computerized billing systems for consumer demand management. The city is in the work order stage for laying of underground power supply cables and allied electrical infrastructure, drainage, water supply pipelines including smart, meters SCADA. The city is in the work order stage for installing a Water Treatment Plant of 2 MLD capacity pumping station and pipeline for conveying of water from Narsinghghat, Kshipra River to Rudrasagar. The city also installed three WTPs that can accommodate a total capacity of at least a 1.29 MW system: Undasa plant can accommodate 100 kW, Gaughat plant 550 kW, and Ambodia water treatment plant can have 640 kW. The city has completed Installation of 1.29 MW Power Solar Photovoltaic Plant at 3 water pumping stations. As per the CSCAF 2.0 data, 54 MLD of wastewater is generated, out of which is 61.3% is treated and reused. The city reuses its wastewater for gardening and agricultural purposes. Construction of sewerage network in ABD area of Ujjain is also in the work order stage[55].

The city has not carried out any flood/ water stagnation risk assessment[56]. Ujjain has conducted an energy audit for water supply pumping stations and treatment plants. It has also conducted an energy audit for raw and clear water. However, no audit has been conducted for wastewater pumping stations.

Ujjain's 3-pronged Smart city development goals include the following:

[42, 43, 47, 53, 54, 55] Ujjain Smart City Limited, project list

[44] AQI Dashboard, *10 March 2023*

[45, 51, 56] CSCAF 2.0, *2020*

[46] District Environmental Plan for Ujjain, Madhya Pradesh, *MPPCB, 2021*

[48, 52] The Smart City Challenge under Smart City Mission, Phase II, *Ujjain Smart City Proposal*

[49] Best Practices Compendium, *NIUA, 2019*

[50] Mahakal temple in Ujjain goes the organic way, *The Times of India, 2022*

1. Enhancement of religious and socio-cultural identity:
• Conservation and restoration of all the heritage buildings and public spaces.
• Creation of additional avenues for tourists, linked to heritage, spirituality, yoga and wellness, and knowledge-driven activities, to achieve a multifold increase in foreign tourists and increase in domestic tourists.
• Increasing the average duration of stay in Ujjain.

2. Socioeconomic development:
• Tourism and knowledge-driven initiatives should create new jobs in the area of hospitality, transportation, trade, and commerce, IT, and other associated services.
• Incubation of budding entrepreneurs for knowledge and tourism based economic activities.
• Skill development of workforce in tourism and allied activities.

3. Quality living environment for citizens and quality experience for tourists:
• 24x7 water supply through recycling and Smart grids.
• Implementing efficient air quality, water quality and weather monitoring systems.

Sectoral Goals

The sectoral goals identified for Ujjain city are aligned with the priorities of existing sectoral departments to ensure efficient implementation of the Ujjain CAP. However, there is considerable scope to establish convergence and dove-tailing across sectors, establish collaborations across departments and reap the co-benefits of holistic solutions. The six goals identified are as follows:

Figure 24: Sectoral goals for Ujjain *(Source: WRI India)*

UJJAIN

Goal 1
Make Ujjain a Green Pilgrimage and Tourist Capital

Goal 2
Towards Low-carbon and People-friendly Transport in Ujjain

Goal 3
Powering Ujjain through Renewable Energy

Goal 4
Greener, Inclusive Spaces for All in Ujjain

Goal 5
Sustainable Waste Management for a Clean Ujjain

Goal 6
Water for Everyone in Ujjain
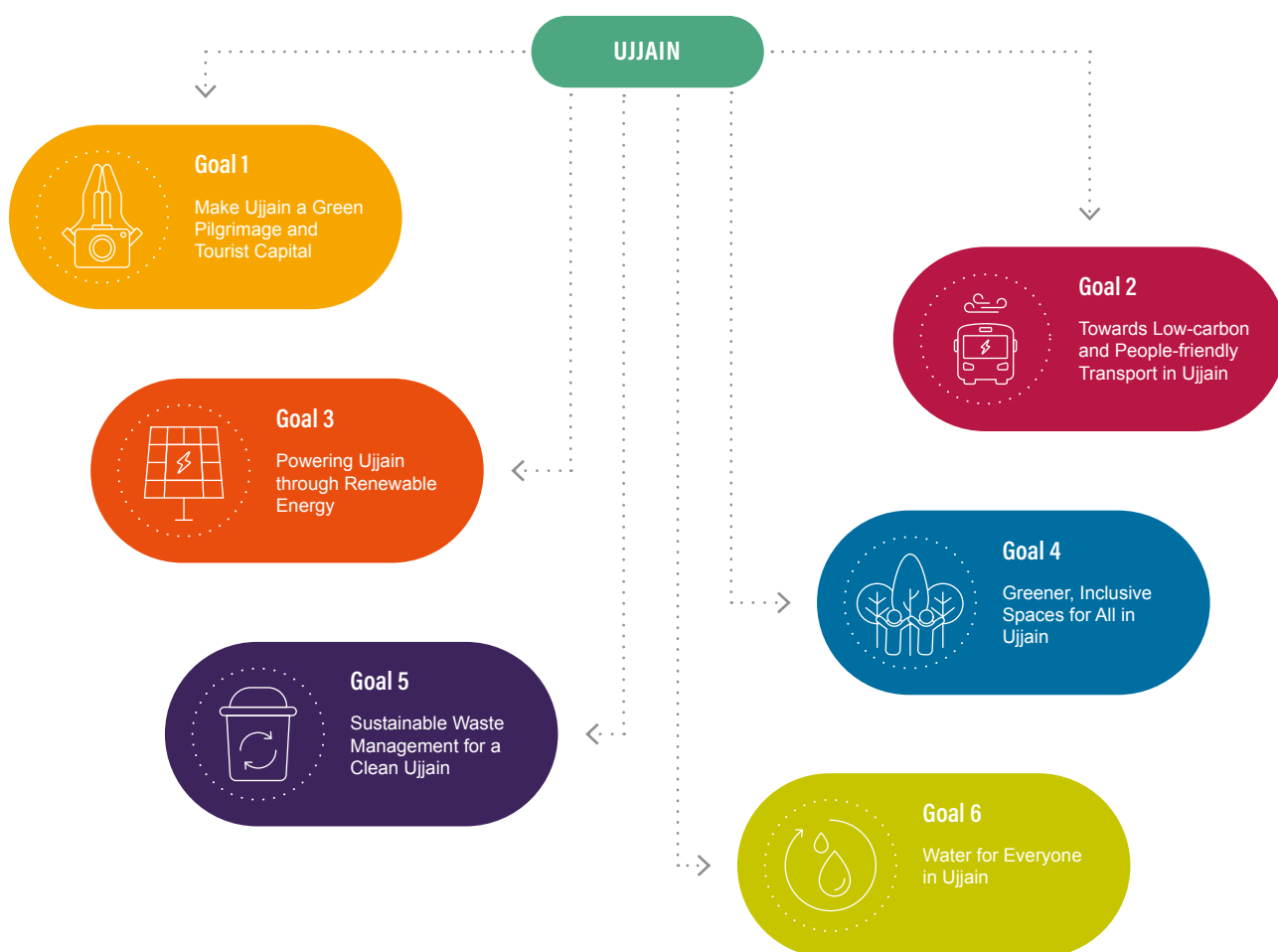
Mainstreaming Inclusivity in the Ujjain Climate Action Plan

Ujjain's CAP 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 adapted 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[57]. As a first step towards mainstreaming inclusivity, cities must ensure that inclusivity is embedded in processes, policies, and impacts (Fig 25). 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 the elderly, children, disabled, religious minorities, informal communities, temporary workers, etc.

Figure 25: Inclusive climate action planning *(Source: C40 Cities & WRI India)*

Inclusivity of Process	Inclusivity of Policy	Inclusivity of Impact
Processes that engage with impacted stakeholder groups	Policies that are designed to keep people at the centre of decision making	Mechanisms that direct and distribute the outcomes equitably across citizen groups

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

SECTORAL CLIMATE ACTIONS
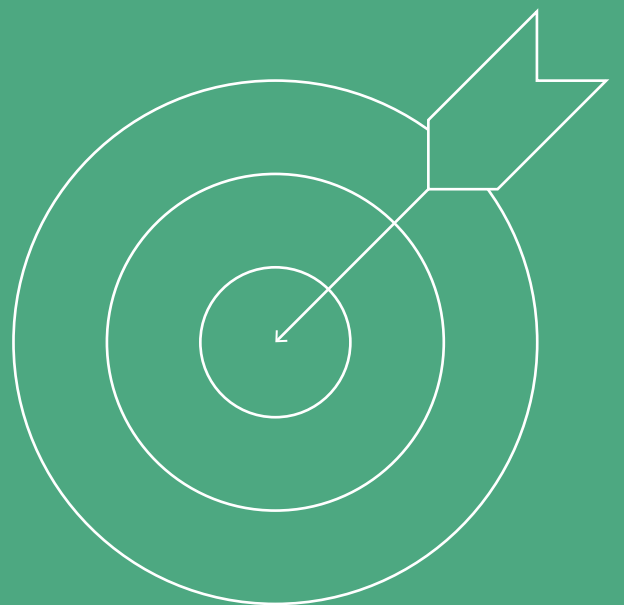
Goal 1: Make Ujjain a Green Pilgrimage and Tourist Capital

Ujjain can be developed into a green pilgrimage destination. It has a floating population, with lakhs of tourists on festive seasons, particularly on Kumbh Mela held every 12 years. The city gets 7-8 crore visitors during Kumbh Mela and 30,000 - 75,000 during other festivals. Ujjain's Smart city proposal also recognizes the importance of developing the city into a religious and cultural hub by improving NMT, waste management practices, optimal consumption of electricity and minimal use of fossil fuels.

| Identified Actions

Action 1: Improve energy efficiency in temples

- **Challenges addressed at the city level:** High electricity consumption from commercial buildings and institutions.

- **Description:** The city can initiate retrofitting and restoration of the ancient cultural and heritage temple structures with energy efficient equipment such as lights, fans, air conditioners and so on. For this, the city should conduct an energy audit to investigate the energy consumption pattern in the temples of Ujjain and the feasibility for energy efficient measures like replacing all types of bulbs and fans with LED bulbs and energy-efficient fans, installing solar powered LED streetlights, and replacing the electrical geysers with solar water heaters. Andhra Pradesh State Energy Conservation Mission (APSECM), and Andhra Pradesh State Energy Efficiency Development Corporation Limited (APSEEDCO) along with the Bureau of Energy Efficiency (BEE) has planned to make seven temples in the city along with the famous Tirumala Tirupati Devasthanam (TTD)[58] as energy efficient buildings. UMC and USCL can work along with Bureau of Energy Efficiency (BEE) in a similar manner and push towards retrofitting the existing ancient temples with energy efficient systems. Initiatives that can be taken include replacing the ordinary conventional 75-watt capacity fans with super-efficient 35-watt BLDC (Brushless Direct Current) fans and replacement of old high-capacity pump sets with BEE star rated energy efficient pump sets. The city can also mandate the temple associations to install roof top solar panels at their premises.

- **Inclusivity analysis:**
  - Cost savings incurred by the municipality through energy savings can be utilized for promoting energy efficiency, increased energy access and renewable energy in low-income areas.
  - Low-income groups can be involved in operation and maintenance of the appliances.

- **Implementing stakeholders:** Ujjain Municipal Corporation, Ujjain Smart City Limited, temple associations/trusts, BEE, private technology manufacturers and suppliers, pilgrims, and citizens.

- **Timeframe:** Medium term (3-5 years), Requires long-term monitoring (<5 years).

- **Possible alignment with schemes:** Energy Conservation Building Code, MP Renewable Energy Policy 2022, Policy for Implementation of Solar Power-based projects in Madhya Pradesh 2012, Madhya Pradesh Policy for Decentralized Renewable Energy Systems 2016.

- **Monitoring indicators:** Energy/ cost savings, reduction in emissions due to reduced usage of electricity, % new jobs created, % of temples with energy efficiency retrofits.

- **Alignment with CSCAF indicators:** Indicator 6, green building adoption. Indicator 2, energy from renewable sources. Indicator 3, fossil fuel consumption in the city under the Energy & Green buildings sector.

Action 2: Minimize plastic and install dry waste recovery booths and compost units at major temples

- **Challenges addressed at the city level:** Improper waste management is an issue in the tourist hotspots of Ujjain. Unhygienic and improper waste management posed a health risk to devotees as they bathed in the highly polluted Kshipra River during the Kumbh Mela in 2016[59].

- **Description:** The Mahakal temple in Ujjain aims to be a zero-waste premises. Compost is to be made from rotten flowers and garlands offered to God and the gas produced will be used for cooking food. A waste recycling plant is also proposed to be set up in

---

[58] Case of Tirumala Tirupati Devasthanams (TTD) as an energy-efficient building, *Deccan Chronicle, 2023*

[59] MP Govt fails as Garbage piles up causing diseases to devotees, *India.com, 2016*

the parking lot to recycle dry waste. Dry waste will be sent to a recycling unit after being processed here[60]. USCL can set up similar organic waste composting centers and PET bottle reverse vending machines in other temples such as Kalbhairava temple, Harisiddhi Temple and Ram Ghat. PET bottle reverse vending machines have already been implemented in many cities like Delhi[61], where users get coupons for hotels or other shops. Hanuman temple on Palace Road and the Sampangi Rama temple on Cunningham Road in Bangalore have installed two composting units[62] for managing its daily waste generation and produce compost, which is then used as manure for the trees located on-site.

The city can also promote sustainable temple practices by using puja thali's (plates for temple offering) made from recycled waste and incense sticks made from floral temple waste. The prashads (devotional offering) in temple can be distributed in boxes or small bowls or plates made of dry leaves[63]. Jute and cotton shopping bags can be distributed by the shops within the premises of these temples to promote ecotourism and encourage sustainable waste management practices in tourist and temple sites. Ujjain could also support the temple associations to manage their waste efficiently by providing special rebates/subsidies for installing indoor-compost/bio-digestor plants within the temple premises.

- **Inclusivity analysis:** The waste sector provides livelihoods for recyclers and informal waste collectors who collect recyclable waste from the streets, waste dumps or landfills. In case of Ujjain, the floating population generates a huge amount of waste at major tourist spots and these spots could become important sites for these informal waste pickers. Their livelihoods may be at risk when waste recovery/ recycling booths are put in place. These informal waste collectors can be roped in as paid service providers. For example, running the waste recovery/ recycling booths would enable inclusion in the waste sector. Business models like making incense sticks out of recycled floral waste, would generate livelihood opportunities for women like in Mahakal temple[64].

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, temple associations/trusts, MPPWD, MP Tourism Board, Self Help Groups

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

- **Possible alignment with schemes:** SBM-Urban 2.0

- **Monitoring indicators:** Increase in % organic waste processed, % new jobs created.

- **Alignment with CSCAF indicators:** Indicator 6, waste minimization initiatives undertaken by the city. Indicator 3, extent of wet waste processed. Indicator 2, extent of dry waste processed under the waste management sector.

Action 3: Pedestrianize Ramghat and other dense areas in the historic core

- **Challenges addressed at the city level:** Currently Ujjain's air quality index ranges from poor to unhealthy, with the $PM_{2.5}$ values being 42 times higher than the levels recommended by the World Health Organization[65]. Transport accounts for 22% of total GHG emissions in the city.

- **Description:** Ujjain can develop its congested tourist, market, and shopping areas into pedestrian friendly zones. These can be heritage streets approaching ghats, and other city market areas. The area between Mahakal and Harsiddhi temple is a no-vehicle zone. In 2017, Ujjain Municipal Corporation had declared Ramghat a 'no-vehicle zone', however it remains a crowded area[66]. Ujjain can consider pedestrianizing this area. Chennai's Pondy bazaar had nearly 5000 pedestrians daily but the 1.4km stretch had broken footpaths, encroachments, intruding greenery, narrow walkways, vehicles parked haphazardly and no public convenience.

The following are some measures the city can take to pedestrianize commercial areas:
- Widening footpaths and including ramps for wheelchairs. In Pondy bazaar it was widened from 2 feet to 10 feet
- Providing colourful street furniture for sitting
- Child friendly play equipment
- Decorative LED lighting
- Native tree plantations
- Smart ducting boxes for underground utilities
- Wall art and murals
- Public bicycle sharing

[60] Mahakal temple in MP's Ujjain to become a zero-waste premises, *ETV Bharat, 2023*

[61] I Discovered a Reverse Vending Machine to Deposit a Plastic Bottle for Recycling in Delhi, Here's How It Works, *NDTV, 2018*

[62] Bengaluru Temple: Waste Management Model, *NDTV SwachIndia, 2017*

[63] Amritsar's Golden Temple Takes a Step to Go Plastic Free, *NDTV SwachIndia, 2018*

[64] Trash To Treasure!, *Logical Indian: Start-up stories*

[65] AQI Dashboard, *10 March 2023*

[66] Ram earns 'No vehicle zone', *Free Press Journal, 2019*

- Battery operated feeder vehicles for elderly, disabled or those in need
- Restrooms and lounges. In Chennai, the Rotary Club of Madras had collaborated with the municipal corporation to set them up

In Chennai, within the first few months of implementing this project, retailers saw a 15-20% increase in sales[67].

- **Inclusivity analysis:** City should ensure inclusive access to all through street furniture, ramps, feeder services, etc.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, MPPWD, MP Tourism Board, RWAs.

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

- **Possible alignment with schemes:** AMRUT – projects supporting non-motorized transport.

- **Monitoring indicators:** Proportion of NMT infrastructure out of the total road network length, no. of pedestrianization pilots.

- **Alignment with CSCAF indicators:** Indicator 3, percentage of coverage of NMT network in the city under Mobility & Air quality sector. Indicator 4, level of air pollution under Mobility & Air quality sector.

Action 4: Towards zero-carbon building projects in the phase I and phase II of MRIDA

- **Challenges addressed at the city level:** High emissions from buildings sector, low uptake of green buildings.

- **Description:** The phase 1 of the Mahakal Lok Project was inaugurated by the Honorable Prime Minister of India in October 2022. A work order has been issued for the conservation & restoration of Mahakal Dwar and Revitalization of pedestrian link near Mahakaleshwar Temple Precinct under MRIDA Phase II project. This project along with the proposed visitor's plaza in the Shri Mahakal Lok corridor, which is envisioned to cater a capacity of 20,000 pilgrims at a time under the Phase I of the project proposal can be piloted as zero- carbon buildings[68]. A (net) zero carbon building (ZCB) can be defined as an energy efficient building that supplies most (but not all) of its annual energy use through on- or near-site renewable energy sources.

Key components of such buildings can include:
- Energy efficiency: Ensuring energy efficiency through compliance with local codes and standards through energy efficient equipment use
- Renewable energy: Achieving further reductions in building emissions through renewable energy sources through on-site RE generation, off-site RE generation or purchase.
- Carbon offsets: Carbon offsets can be used to balance out residual emissions. The emissions reduction benefits must be claimed through a credible mechanism such as carbon credits or a local carbon credit fund.

The city could also retrofit the buildings in Maharaj-wada with energy efficient equipment's and construct the Shikhar darshan, meditation room, the heritage Dharamshala and the Kumbh museum as zero-carbon cultural centers, as planned under the phase II work of the Shri Mahakal Lok Corridor. Best practice examples which can be adapted include the Delhi's Indira Paryavaran Bhawan. It is compliant with local codes and standards, has natural lighting in the daytime, shading, landscaping and uses 70% lesser energy than a conventional building and is India's highest green rated building[69]. Most of the Infosys campuses in the country are LEED platinum buildings and have PV panels, RE electricity and off-site RE plants[70].

- **Inclusivity analysis:** The net-zero transition in such large-scale government projects could open value pools around green building materials and promote business for small start-ups manufacturing green/ alterative building materials and those in their supply chain.

This would also encourage more youth entrepreneurs to explore avenues for green/low-carbon alterative material manufacturing in the city.

- **Implementing stakeholders:** Ujjain Smart City Limited (lead), Ujjain Municipal Corporation, MP Tourism Board, MPUVN, private technology manufacturers and suppliers, private residential owners, JVs, and citizens.

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

- **Possible alignment with schemes:** Energy Conservation Building Code, MP Renewable Energy Policy 2022, Policy for Implementation of Solar Power-based projects in Madhya Pradesh 2012, Madhya

[67] Chennai's Pondy bazaar pedestrian plaza, *C40 Cities, 2019*
[68] PM to inaugurate 1st phase of Mahakal corridor project in Ujjain, *The New Indian Express, 2022*
[69] Green buildings for composite climatic zone, *NIUA*
[70] Accelerating Building Decarbonization: Eight Attainable Policy Pathways to Net Zero Carbon Buildings for All, *World Resources Institute, 2019*

Pradesh Policy for Decentralized Renewable Energy Systems 2016.

- **Monitoring indicators:** Energy savings for municipal buildings, proportion of energy consumed from renewable sources, % reduction in GHG emissions from energy and buildings.

- **Alignment with CSCAF indicators:** Indicator 2, total electricity derived from renewable sources under the energy & green buildings sector. Indicator 6, green building adoption under the energy & green buildings sector.

Action 5: Develop Ujjain's upcoming 2028 Simhastha Kumbh into a Harit or green Kumbh

- **Challenges addressed at the city level:** High tourist footfall for the Kumbh leading to high solid waste generation, high electricity consumption and wastewater generation.

- **Description:**
  - Waste management - The city had already banned all kinds of plastic in the last April 2016 Kumbh mela[71]. The city must continue the practice of banning all single-use plastic in the upcoming 2028 Kumbh. The city can also start preparing for the green Simhastha Kumbh in advance and initiate activities such as cleaning of the Kshipra River, removal of waste from the river, creating a waste management plan/ infrastructure, setting up STPs, and so on. These activities can become a practice to promote green festivals in the city and help Ujjain promote itself as a sustainable, eco-friendly pilgrimage destination. Nashik's Kumbh Mela in 2015 became the first environment-friendly, Harit Kumbh. The Maharashtra government cleaned up the Godavari, removed waste from the river, planted one lakh saplings to increase green cover, discouraged the use of plastic by distributing 6.25 lakh cloth bags in place of 1.6 tonne plastic ones[72], constructed a few thousand toilets, placed garbage bins near food and tea stalls to prevent littering and set up STPs to prevent untreated waste from being released into the river[73]. Allahabad's Kumbh Mela was also planned with eco-friendly initiatives like giving tree saplings as prasad, constructing bio-digester toilets, volunteer driven trash cleanups and public awareness programs[74].

- Power supply demand - The government can prepare to set up on-grid RE power generation facilities for ensuring a clean energy mix. Ujjain can also ensure that all lights are LEDs preferably run at-least partially on renewable energy.

- **Inclusivity analysis:**
  - The Simhastha Kumbh attract tourists, devotees, and pilgrims of all income groups from across the country. The city can ensure to design the pedestrian spaces considering all groups - women, children, people with disability and the elderly to ensure an inclusive access for all vulnerable groups.
  - The activities undertaken to develop the Kumbh festival into a green festival like waste management, must integrate some of the informal and low-income communities into the festival ecosystem as paid workers/ service providers.
  - Eco-friendly puja thalis (devotee plates for temple offering) made of recycled waste or eco-friendly woven handloom can be promoted. The city can encourage the marginalized/ low-income workers to form self-help groups and conduct capacity building of these workers to create such eco-friendly materials for temple use.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, MP Tourism Board, MPUVN, SHGs.

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

- **Possible alignment with schemes:** Projects under Smart City Proposal, SBM-U 2.0, MP Renewable Energy Policy 2022

- **Monitoring indicators:** Increase in footfall of tourists/ floating population, reduction in energy demand from the grid, improved waste segregation/collection, improved water quality.

- **Alignment with CSCAF indicators:** Indicator 6, green building adoption under the Energy & Green buildings sector. Indicator 2, total percentage of electricity derived from renewable sources. Indicator 3, waste minimization initiatives undertaken by the city under the waste management sector

---

[71] As Ujjain gets ready for the Kumbh, it discreetly adds technology to the festivity, *Economic Times, 2016*

[72] A 'successful Green Kumbh': 6.25 lakh cloth bags distributed in place of 1.6 tonne plastic ones, *Indian Express, 2015*

[73] Why Nashik Kumbh Mela will be of epic proportions this time, *Dailyo, 2015*

[74] Eco Friendly Green initiative Kumbh Mela, *Ganga Action Parivar*

Action 6: Promote local tourism through home-stay establishments during tourist season

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

- **Description:** MP tourism board[75] promotes local economy through home stay establishment schemes namely: Homestay establishment (Registration and Regulation) Scheme 2010 (revised 2018), and the Bed and Breakfast establishment (Registration and Regulation) Scheme 2019. These schemes give an opportunity for the residential owners to utilize their additional accommodation area available in their homes for tourists to stay. The MP Tourism Board also provides one-time financial assistance for the owners to help them in marketing and outreach of their hospitality services and provides annual incentives. Indore has marketed this widely during the 17th edition of Pravasi Bharatiya Divas in January 2023 where 200 NRI guests stayed with local residents. An app was also created to match hosts with guests in Indore[76]. UMC can also sensitize the local citizens on these schemes and promote local tourist economy in the city. The city can provide additional incentives like tax rebates, reduction in utility bills, certificates, etc. for the homeowners to retrofit their homes into energy efficient tourist stays by installing solar water heaters and other energy efficient equipment. This is also in line with Mission LiFE which encourages citizens to take measures to incorporate sustainability in their day to day lives.

- **Inclusivity analysis:** UMC should ensure adequate economic incentives to ensure that residential owners do not absorb transaction costs or short-term increases in energy costs due to implementation of rooftop solar heaters and panels.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), EPCO, Ujjain Smart City Limited, MP Tourism Board, Citizens, MPUVN, RWA, DISCOM.

- **Timeframe:** Initial implementation in the short term (1-2 years) but extending it to the long term.

- **Possible alignment with schemes:** MP Homestay establishment (Registration and Regulation) Scheme 2010 (revised 2018), MP Bed and Breakfast establishment (Registration and Regulation) Scheme 2019, MP Renewable Energy Policy 2022.

- **Monitoring indicators:** % of registered homestays, % of new jobs created, reduced GHG emissions from energy and buildings.

- **Alignment with CSCAF indicators:** Indicator 6, green building adoption under the Energy & Green buildings sector. Indicator 2, total percentage of electricity derived from renewable sources.

---

[75] Tourism in Madhya Pradesh, *MP Tourism Board*
[76] App to register 'hosts' & 'guests' for homestay facility, Performance Improvement Planning, *The Times of India, 2022*

Goal 2: Towards Low-Carbon and People- Friendly Transport in Ujjain

The city of Ujjain has very limited public transport infrastructure, where only 48 buses are available for 597,649 people (0.08 availability of public transport for a population of 1,000). Moreover, as per the CSCAF 2.0 analysis, only 1.54% of the road network is covered with footpaths and cycle tracks. Ujjain smart city has completed a 1.7 km long cycle track around the existing sports ground[77]. A household survey in 2018 highlighted that 37% of the slum population and 17% of the non-slum population choose non-motorized systems for their daily trips[78]. The city also faces significant congestion and air pollution due to high modal share of car and 2 wheelers (46%)[79]. Moreover, less than 1% of vehicle fleet in the city is electric as per data from the regional transport office. Thus, this goal envisions helping Ujjain reduce emissions from the transport sector by enabling a shift towards public transport and non-motorized travel modes along with a shift towards alternate fuels.

| Identified Actions

Action 1: Augment the existing bus fleet in Ujjain

- **Challenges addressed at the city level:** Limited availability and accessibility of public transport, congestion due to increasing usage of private cars, increasing emissions from road transport.

- **Description:** Ujjain has only 0.08 buses per 1000 population. A survey in 2018 also identified that buses cover only 36% of municipal area with low frequency[80]. Ujjain should consider augmenting its fleet and improving its frequency and coverage. The first step is to identify the route structure. This can be done by plotting the major activity centres and determining travel patterns. Next, the city can calculate ridership demand. In the absence of a structured public transport operation, this can also be done by surveying the travel demand met through IPT services like the rickshaws and autos. Through this, the main corridors and major bus stops can be identified. The third aspect is to identify the operational plan, which is usually either destination oriented (consisting of direct connections between multiple destinations) or direction oriented (combination of interconnected routes). The city must also regularly conduct period

route and service rationalization exercises at least once in 5-10 years. The regular bus routes can also be accompanied by feeder buses or midi buses like in Chennai and Bangalore, which help increase access in parts of the city that are outside the purview of the public transport route and enable better last mile connectivity.

The new buses should be complemented with adequate infrastructure. Bus stops must be located in main junctions without issues of road safety, sufficient footpath, closed shelters and in proximity to overhead bridges or pedestrian crossings. As per calculations and Indian Roads Congress 1983 standards, bus bays need to be at least 79m in length and 5m in width to provide sufficient bus docking and tapering length[81]. Branding can be done thorough colour coding or numbering and can be route wise. For e.g. front of buses are painted pink in Chennai to denote free fares for women. Bangalore has 4 buses based on fares and route having different colours[82].

- **Inclusivity analysis:**
  - Passenger safety and convenience must be incorporated in all stages of this action. Buses can be fitted with ramps for disability access.
  - Road design plays an important role in ensuring safe use of bus services, with elements such as traffic calming measures, speed control and signages.
  - Bus terminals can also be included with toilets, water and other facilities.
  - Fare rationalization and multimodal fare integration is important to make public transport accessible to low income and minority groups.
  - Poorly designed infrastructure for pedestrians and cyclists may exclude people with disabilities and create safety concern[83].
  - Communication material can also be provided in English and native languages to enable better access.
  - Women's safety is another aspect that must be incorporated in the new buses, perhaps through the training of women drivers, separate seats for men and women, limiting overcrowding in buses or having women only buses in some routes.

---

[77] Ujjain Smart City Limited, project list

[78, 79, 80] Mobility Planning for an Indian Pilgrimage City- A Case of Ujjain City, Madhya Pradesh, India, *Dr. Kakoli Saha, 2018*

[81, 82] Bus Karo 2.0 case studies from India, *WRI Ross Centre 2013*

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

- **Implementing stakeholders:** Ujjain Smart City Limited (lead), Ujjain City Transport Services Pvt. Ltd., UMC, financial agencies, private operators, citizens.

- **Timeframe:** Medium term (3-5 years), maintenance and route rationalization (long term >5 years).

- **Possible alignment with schemes:** AMRUT, FAME phase-2

- **Monitoring indicators:** Increase in the modal share of public transport, availability of safe infrastructure like cycle or walking lanes connecting bus stops, reduction in congestion and travel time, increase in ridership or percentage of income spent on public transport, increase in the number of CNG or electric buses in the fleet, % of mode share disaggregated by gender and income.

- **Alignment with CSCAF indicators:** Indicator 1, clean technologies shared vehicles. Indicator 2, availability of public transport. Indicator 3, percentage of coverage of non-motorized transport network (pedestrian and bicycle) in the city, under mobility and air quality.

Action 2: Implement a special non-motorized transport (NMT) cell within Ujjain Municipal Corporation

- **Challenges addressed at the city level:** Only 1.54% of the city's road network was covered with walking or cycling paths in 2020[84]. However, a household survey in 2018 highlighted that 37% of the slum population and 17% of the non-slum population choose non-motorized systems for their daily trips, calling for better NMT infrastructure[85].

- **Description:** According to MoHUA's guidance document[86] for NMT strategies in cities, the first step is the establishment of a NMT cell to enable policy-level and planning-level interventions, with representatives from various city agencies, local government departments, academic institutions, NGOs, and private sector. It is important to engage political leaders, policy makers and decision makers, in goal setting and vision building for establishing NMT.

  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, tourism development, land use and economic development
  - Public outreach as part of master planning activities and ABD area planning.
  - Identifying technical leadership, preferably from city staff, representatives from NGOs or local advocacy groups dedicated to the planning process
  - Brainstorming on an NMT roadmap with short-term, medium-term, and long-term interventions with a timeline.

  Examples in the Indian context include Chandigarh[87], one of the best practices shared as part of CSCAF.

- **Inclusivity analysis:**
  - This central, multi-stakeholder coordination will enable an inclusive development with increased walking and cycling networks in the city and ensure access to disabled and other vulnerable groups. (e.g., wheelchair access from road to pavement, elderly access like railings, separate cycle tracks with clear signage, separate lane in pavement for disabled access and removal of encroachments).
  - Bike sharing mechanisms, if implemented, must also cover informal settlements.
  - Migrant and vendor management is key as they are especially impacted due to no or fewer rights to public space or resettlement benefits compared to more permanent or formal businesses[88].

- **Implementing stakeholders:** Ujjain City Transport Services Pvt Ltd (lead), Ujjain Development Authority (UDA), USCL, citizens, financial agencies, local government departments, academic institutions, NGOs, and private sector.

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

- **Possible alignment with schemes:** AMRUT - Funding for non-motorized urban transport projects, Smart Cities Mission (Cycles 4 Change and Streets for People challenge).

- **Monitoring indicators:** Creation and active functioning of an urban level NMT cell, increase in safe infrastructure like cycling or walking lanes connecting bus stops, reduction in congestion and travel time, increase in modal share of NMT modes.

[84] CSCAF 2.0, *2020*

[85] Mobility Planning for an Indian Pilgrimage City- A Case of Ujjain City, Madhya Pradesh, India, *Dr. Kakoli Saha, 2018*

[86] NMT Guidance Document, Sustainable Urban Transport Project, *MoHUA, GoI, 2016*

[87] Strategy for pedestrianisation & non-motorized transport (NMT), Chandigarh, *NIUA*

[88] International Journal of Sociology and Social Policy, Informal Street vending: a comparative literature review, *Sara Recchi, 2020*

- **Alignment with CSCAF indicators:** Indicator 3, percentage of coverage of non-motorized transport network (pedestrian and bicycle) in the city, under mobility & air quality sector.

Action 3: Promote electric mobility in Ujjain

- **Challenges addressed at the city level:** As per the 2019 vehicle fleet data, the city has negligible EVs with 91% of the fleet running on petrol. Moreover, Ujjain's air quality remains in the unhealthy category, calling for urgent measures to reduce air pollution[89].

- **Description:**
  - Two wheelers - Currently, Ujjain has <1% EVs. Thus, one way to reduce emissions in this sector is to shift towards low-carbon fuels. The city has already issued a tender for a public e-bike or e-scooter service. This can be done by leveraging private players such as Ola, Bounce and Vogo. Currently the city has limited Ola/ Uber fleets. There is also a need to introduce fast chargers in malls, parking lots, residential areas, auto hubs, etc. Currently all the electric autos only charge with slow chargers at home. The city can consider piloting EV chargers integrated into urban infrastructure like streetlights. Ujjain can also provide subsidies for e-scooters for students or professionals to increase uptake.
  - Four wheelers - Ujjain can implement initiatives like preferential parking access for EVs, mandate to have certain percentage of parking lots EV ready by 2030, discounts on tolls/ registration fees for EVs.
  - Buses - Ujjain can consider piloting electric hop-on-hop-off buses in the Mahakal Lok Corridor that was recently inaugurated in 2022.

- **Inclusivity analysis:**
  - Renting electric scooters can lead to significant cost reductions for people who use them occasionally[90], thus increasing access to low-cost micro mobility solutions.
  - Loans for vehicle purchase can be made more easily available for low-income groups and small businesses to reduce the total cost of ownership.
  - Increased awareness campaigns targeted at low-income groups, particularly the youth, on the environmental and economic advantages of e-scooters compared to ICE.

  - Training for bus drivers could be conducted on how to operate and maintain electric buses.

- **Implementing stakeholders:** Ujjain City Transport Services Pvt Ltd (lead), Ujjain Development Authority (UDA), citizens, financial agencies, private sector, bus drivers' association.

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

- **Possible alignment with schemes:** FAME phase II, MP EV policy.

- **Monitoring indicators:** Number of e-vehicles sold (RTO data), share of EV vehicles in total mix, percentage of use by low-income communities, reduced emissions from the transport sector, increase in % of low carbon buses.

- **Alignment with CSCAF indicators:** Indicator 1, shared vehicles using clean technologies under mobility & air quality sector. Indicator 3, fossil fuel consumption in the city under energy & green buildings sector.

Action 4: NMT-focused urban street design guidelines for Ujjain

- **Challenges addressed at the city level:** Only 1.54% of Ujjain city was covered with NMT network in 2020[91]. However, a household survey in 2018 highlighted that 37% of the slum population and 17% of the non-slum population choose non-motorized systems for their daily trips, calling for better NMT infrastructure[92].

- **Description:** Ujjain 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 to create streets that support both non-motorized and private transport modes. These can include guidelines on road width, segregated cycle tracks, street furniture, street trees, permeable pavements, etc. Cities like Pune, Delhi, Mumbai, and Ahmedabad already have such guidelines in place[93]. These guidelines act as binding documents that mandate all urban professionals involved with street planning and urban renovation to integrate them in the design process. The project on survey, design, widening & construction of existing selected roads is under the Detailed Project Report (DPR) stage. These guidelines can be incorporated into the same.

---

[89] AQI Dashboard, *10 March 2023*

[90] Electric scooter, is it better to rent or buy?, *Varla, 2022*

[91] CSCAF 2.0, *2020*

[92] Mobility Planning for an Indian Pilgrimage City- A Case of Ujjain City, Madhya Pradesh, India, *Dr. Kakoli Saha, 2018*

[93] Street Design Guidelines for Greater Mumbai, *2014* | Urban Street Design Guidelines Pune, *2016*

- **Inclusivity analysis:**
  - The guidelines should have inclusivity aspects such as curb ramps.
  - Strict measures to tackle vendor encroachment along with relocation measures.
  - Incorporation of safe and efficient infrastructure for cycling and walking (adequate pavements, pedestrian crossings and refuge spaces and bicycle parking) to ensure services for groups like low-income and racial, ethnic, and religious minority communities that primarily rely on these modes[94]
  - Designing bicycles such as Copenhagen's Christiana bikes, with provisions to carry small children safely.
  - Many cities in India have painted separations which are often encroached upon by cars. The cycle tracks must be physically segregated from roads and there should be clear signages to ensure safety of cyclists[95].

- **Implementing stakeholders:** Ujjain City Transport Services Pvt Ltd (lead), Ujjain Development Authority (UDA), Ujjain Smart City Limited, citizens and private sector.

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

- **Possible alignment with schemes:** AMRUT - Funding for non-motorized urban transport projects.

- **Monitoring indicators:** Increase in length of cycle and walking paths as a percentage of total road length, reduced emissions from the transport sector, increase in the 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, under mobility & air quality sector.

Action 5: Implement and upscale the proposed city-wide public bike sharing system

- **Challenges addressed at the city level:** The city has re-issued a tender for public e-bike or e-scooter sharing system as per smart city data[96]. The city also has an app called Cykul. Given the high mode share for cycling, the public bike sharing system should be implemented on priority basis.

- **Description:** The city should first conduct a public perception survey to understand the needs for a PBS, the demand, the areas where people frequently cycle, etc. Then the entire network of bicycle rental shops that could be used as stations and repair hubs need to be mapped, and the existing cycle rental establishments can be integrated with the new public bike sharing system. Ujjain should then focus on rebranding and effective marketing of cycle lanes and linking these to green areas, lakes, and other recreational spots. A rental system can be established, ensuring equitable access to cycle lanes across all wards.

- **Inclusivity analysis:** Ujjain needs to ensure that the cycle tracks are inclusive and accessible to low-income groups and are physically segregated from the main road to ensure safety. The bikes should be tracked with GPS to prevent theft. They should be affordable for all income groups. UMC should also ensure accessible modes for usage including digital and non-digital methods to cater to those without cellphone access. The PBS marketing should also be done in local language. Stands should be placed in low-income areas as well.

- **Implementing stakeholders:** Ujjain City Transport Services Pvt Ltd (lead), Ujjain Development Authority (UDA), Ujjain Smart City Limited, public, private sector, business, and residential associations in the area.

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

- **Possible alignment with schemes:** AMRUT - Funding for non-motorized urban transport projects.

- **Monitoring indicators:** Mode share for cycling, length of cycle paths in the city, % of low-income wards with cycle stands.

- **Alignment with CSCAF indicators:** Indicator 3, percentage of coverage of non-motorized transport network (pedestrian and bicycle) in the city, under Mobility & Air quality sector

---

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

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

[96] Ujjain Smart City Limited, project list

Goal 3: Powering Ujjain through Renewable Energy

According to the FY 2019-20 electricity consumption from the distribution company, out of the total electricity consumption, only 0.07% is from on-grid renewable energy sources. Less than 10% of the buildings are energy efficient or green buildings in Ujjain[97]. Given 71% of the city's GHG emissions comes from stationary energy sector, a shift towards renewable energy becomes pertinent in the short term.

Identified Actions

Action 1: Mandate installation of solar roof-top panels in all public educational institutions

- **Challenges addressed at the city level:** As per the CSCAF 2.0 data, 0.07% of city's energy consumption comes from renewables.

- **Description:** The city has installed roof top solar panels of 210 kW on the rooftop of Government Nutan school and a capacity of 20 kW on the rooftop of Ganesh Nagar school[98]. There is also a 100kW capacity solar plant at the USCL office. This needs to be upscaled further to installing rooftop solar panels in all government schools and college premises. The city has issued a work order for installation of solar PV panels on public/government buildings[99]. This can be further expanded to all public educational institutions. Incentives like tax rebates can also be provided. Ujjain can adopt good practices to increase the usage of solar power such as the one adopted by Diu Smart City. Diu, which had 73% dependency on Gujarat for power generation until 2017, became the first city in 2018, to operate on 100% RE throughout the day[100]. The city had installed solar panels on roof tops of all the 79 government buildings, thereby generating 1.3 MW annually. Innovate financing models can include:

  - Revenue sharing - Delhi Municipal Corporation had opened a tender for solar PV in all municipal buildings where revenue is shared between agency and DMC over 25 years minimum[101].
  - Green bonds/ masala bonds: Bonds issued outside India but in INR. Investor bears risk rather than the borrower. Indore plans to issue green masala bonds for funding floating solar project[102].

- **Inclusivity analysis:** Installation of solar panels in government schools would sensitize the students on alternative sources of energy and lesser usage of conventional energy. The teachers can play a role in creating this awareness amongst the students by conducting a site visit to the installed solar rooftop in their campus. Through the knowledge learnt at schools, the students will in turn inform and educate their families (including middle/low-income households) on how to use energy more efficiently.

- **Implementing stakeholders:** MPUVN (lead), Ujjain Municipal Corporation, Ujjain Smart City Limited, private technology manufacturers and suppliers, educational institutions, students, DISCOM.

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

- **Possible alignment with schemes:** MP Policy for Decentralized Renewable Energy Systems, 2016, MP RE Policy 2022.

- **Monitoring indicators:** Percentage of energy coming from a renewable source, reduced electricity bill for municipality.

- **Alignment with CSCAF indicators:** Indicator 2, total electrical energy derived from renewable sources. Indicator 6, green building adoption. Indicator 5, promotion of green buildings.

Action 2: Promote green and cool roofs in residential projects/colonies/apartments to reduce cooling demand

- **Challenges addressed at the city level:** High electricity consumption in residential buildings.

- **Description:**
  - Cool roofs - Promoting measures for evaporative cooling such as placing wet jute gunny sacks, painting white reflective paint, building highly reflective surfaces that stay cool, coatings and treatments such as lime-based whitewash, white tarp, white China mosaic tiles, acrylic resin coating and so on - cools roofs provide access to

---

[97] CSCAF 2.0, *2020*

[98] Ujjain Smart City website

[99] Ujjain Smart City Limited, project list

[100] Diu Smart City becomes first to run on 100% renewable energy during daytime, Ministry of Housing & Urban Poverty Alleviation, *Press Information Bureau*

[101] North Delhi municipal corporation issue tender for supply of solar power plants on revenue sharing model in various municipal buildings, *EQ Mag Pro, 2022*

[102] Indore Municipal Corporation to release Green Bonds for solar power, *The Times of India, 2022*

affordable cooling for those who are most vulnerable to the health effects of extreme heat. This measure was an important part of the 2017 Ahmedabad Heat Action Plan[103] and has also been piloted by the Greater Hyderabad Municipal Corporation[104] as part of their state building energy efficiency program. Similarly, Surat and Indore had also embarked upon the cool-roof project in which over 100 households were coated with low-cost techniques and green cool-proofing materials such as lime concrete, helping to reduce temperatures and the costs of electricity and water.

- Green roofs - These are roofs with a vegetative cover. Ujjain can pilot this action by retrofitting to green roofs in all municipal buildings. This would sensitize the citizens and therefore encourage uptake. In Indian cities like Chennai, Bangalore, Mumbai, and Hyderabad, the concept of green buildings is slowly but steadily becoming the new norm of construction. Some cities are also using treated wastewater to maintain these green roofs which not only reduce ambient temperatures but also improve visual appeal[105].

- **Inclusivity analysis:** Cool roofs - Slum residents are more likely to be exposed to heat, since they live mostly in unventilated conditions, and in homes constructed of heat-trapping materials with tin or tarp roofs, and their tenements lack trees and shade. Retrofitting interventions such as – implementing cool roofs can significantly impact internal temperatures and provide thermal comfort indoors. Since Ujjain has 23% slum households, this action becomes pertinent to enhance their resilience to heat stress. The city can consider the integration and retrofitting of climate components in all its upcoming affordable housing units under PMAY.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), MPUVN, Ujjain Smart City Limited, private technology manufacturers and suppliers, marginalized slum households.

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

- **Possible alignment with schemes:** PMAY affordable housing scheme.

- **Monitoring indicators:** Percentage of houses with cool roofs/green roofs (disaggregated by income), reduction in urban heat island effect, reduced illnesses, or reduced mortality due to heatwaves.

- **Alignment with CSCAF indicators:** Indicator 6, green building adoption. Indicator, promotion of green buildings.

Action 3: Incentivize installation of rooftop solar panels and solar water heaters in all new residential constructions

- **Challenges addressed at the city level:** From the total stationary energy emissions, almost 36% comes from residential buildings.

- **Description:** Residential constructions have a huge potential to reduce emissions through renewable energy sources. A simulation study was carried out to determine the technical performance of a 6.4 KWp grid-connected rooftop solar PV-system for a household to supply electricity in Ujjain. The study concluded that the power generation potential in Ujjain was good, with a scope of increasing average rooftop solar capacity to above 6.4 KWp depending on availability of rooftop area. The performance ratio (ratio of actual power generated to expected power generated) was 75%<, indicating that the grid-connected rooftop PV system in Ujjain is technically viable and with wider implementation, would have considerable benefits on emission reduction and energy saving[106].

This sector should become an immediate priority to avoid the lock-in effect due to inefficient building stock. Incentives or measures to increase uptake of solar panels/solar water heaters include:

- Subsidies - Few cities like the Diu Smart City offers all its residents an installation subsidy of Rs 10,000 -50,000 for installing a 1-5kW capacity roof solar PVs. It is observed that this helped reduce power tariffs by 10-15% each year[107]. Karnataka State Govt provides rebate of 50p per unit up to 50Rs per month for installing SWH[108]. Pune also provides a 5% tax rebate for one energy efficiency initiative out of SWH, composting or RWH, 10% for 2[109].

[103] Ahmedabad Heat Action Plan, *NRDC, 2017*

[104] GHMC to push Energy Code for large residential buildings in Hyderabad, *The Indian Express, 2022*

[105] Mana Capitol redefines sustainable construction with the green roof concept, *The Print, 2021*

[106] Performance simulation of grid-connected rooftop solar PV system for small households: A case study of Ujjain, India, *Chandrakant et al, 2018*

[107] Diu Smart City becomes first to run on 100% renewable energy during daytime, Ministry of Housing & Urban Poverty Alleviation, *Press Information Bureau*

[108] Policy backs rebate for solar water heaters, *The Times of India, 2022*

[109] For property tax rebate, vermiculture pips water harvesting, *The Indian Express, 2015*

- Mandate - Ujjain can mandate all new buildings to have solar water heaters and solar rooftops. This should be included in the building by-laws. BESCOM in Bengaluru requires developers to install solar water heaters in dwellings with a floor space of 600 ft², i.e., 56 m², or above. The mandatory solar thermal capacity is linked to room size and increases based on the interior space available[110].
- Awareness training workshops for resident welfare associations and large-scale distributors on benefits of implementing solar rooftop, available incentives, etc.
- Collaborating with NGOs or research students working in the energy space to develop a DIY solar tool: a step-by-step guidance to consumers on how to install solar PV, available financing subsidies, application process and policies. A similar tool was developed by an NGO in Bangalore which has been used by nearly 15000 citizens[111].

- **Inclusivity analysis:** Inability to pay capital costs and lack of credit could be one of the challenges limiting participation from low-income urban households. Providing financial incentives for RE projects, including cost subsidies, low-interest and long-term loans for property owners, project developers and small-scale purchasers would make it more accessible to low-income communities.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), MPUVN, Ujjain Smart City Limited and private agencies, RWAs, DISCOM and citizen forums.

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

- **Possible alignment with schemes:** MP Policy for Decentralized Renewable Energy Systems, 2016. MP RE Policy 2022, Solar Panel System Subsidy in Madhya Pradesh, 2022.

- **Monitoring indicators:** Increase in share of renewable energy from the residential sector, reduced energy costs, % of houses with solar water heater (disaggregated by income).

- **Alignment with CSCAF indicators:** Indicator 2, total electrical energy derived from renewable sources.

Action 4: Mandate installation of solar water heaters on rooftops of hotels in Ujjain

- **Challenges addressed at the city level:** As per the CSCAF 2.0 data, 0.07% of electricity generated is from RE sources.

- **Description:** The city can first conduct a survey to understand the current percentage of hotels in the city with solar water heaters, increase in solar water heater sales over the past few years, reasons for uptake and challenges faced if uptake is low. Ujjain in coordination with MPUVN and MP tourism board should mandate installation of solar water heaters in all private as well as MP tourism board's hotels in the city. The Uttar Pradesh government also mandated to install solar panels on hotels and guest houses under the Tourism Department[112]. The Non-Conventional Energy Development Authority (NEDA) has been directed to conduct a survey and to set up solar energy plants in the hotels run by the tourism corporation.

The city can also compliment the mandates through policy incentives such as subsidizing the capital costs for hotels, offering property tax or electricity bill rebates and other concessions for small hotels/motels, that are usually limited to the residential sector[113].

- **Inclusivity analysis:** Implementing this action might not be cost effective for smaller hotels, as they still require relatively high upfront costs for installation and long-term maintenance. This can be offset by cities incentivizing or engaging the hotel owners in collective purchase of RE.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, MPUVN, private technology manufacturers and suppliers, private hotel owners, JVs, DISCOM and citizens.

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

- **Possible alignment with schemes:** MP Policy for Decentralized Renewable Energy Systems, 2016. MP RE policy 2022, Solar Panel System Subsidy in Madhya Pradesh, 2022.

- **Monitoring indicators:** % of hotels with solar water heaters, reduction in energy/cost savings for hotels.

- **Alignment with CSCAF indicators:** Indicator 2, total electrical energy derived from renewables under Energy & Green buildings sector.

[110] Bangalore Electricity Supply Company Limited, *2007*
[111] Solar Toolkit: Your one stop guides for installation of Solar Rooftop Photo Voltaic (SRTPV) system, *Jhatkaa*
[112] Case of Uttar Pradesh for clean energy, *Business Standard, 2020*
[113] Solar water heaters in India: Market assessment studies & surveys for different sectors & demand segments, *MNRE, 2010*

Action 5: Explore common solar PV projects for community low- income housing

- **Challenges addressed at the city level:** As per the CSCAF 2.0 data, 0.07% of the total electrical energy is derived from renewables.

- **Description:** Ujjain can develop models integrating grid connected solar PV systems for common utilities like pumps, lightings, elevators, etc. in affordable housing, wherein members of the housing complex receive monetary compensation after adjusting with the grid consumption by the social housing common utilities, through net metering. UMC should first identify a suitable social housing scheme with:
    - Fossil fuel-based energy consumption for common utilities
    - Types of appliances
    - Availability of rooftop area without shadow for solar PV.

    A similar project has been successfully implemented at Rajkot's Krantiveer Khudiram Bose social housing project[114]. This housing consists of 5 buildings with 140 dwelling units. Common amenities like lifts, pumps and lights consumed 3000 Kwh units per month. A 31.5 KWp grid connected solar PV system was installed in the rooftop which generates 3780 units of electricity per month, with a potential to reduce 37 tCO_2e GHG emissions per year. Excess energy is sent to the grid and the residents get approximately Rs 12,000 credited to their accounts by the DISCOM each month. It was set up on a PPP basis for 10 years. There were 168 slums in Ujjain with a total slum population of 1,20,141 persons which was approximately 23% of total population of the city in 2019. Ujjain can consider piloting this action in these areas.

- **Inclusivity analysis:** This will give rise to new employment generation opportunities in renewable energy sector particularly for low-income areas and increase their access to low-cost electricity. This must be accompanied with training for residents in these low-income areas for management of solar panels. In Rajkot, residents were provided training by ICLEI-Local Governments for Sustainability on managing the solar panels[115]. Ujjain can also conduct such similar capacity building trainings by collaborating with NGOs and research organizations.

- **Implementing stakeholders:** MPUVN (lead), Ujjain Municipal Corporation, Ujjain Smart City Limited, multi-departmental stakeholders and agencies, private technology manufacturers and suppliers, private residential owners, JVs, DISCOM and citizens.

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

- **Possible alignment with schemes:** MP Policy for Decentralized Renewable Energy Systems, 2016, MP RE policy 2022.

- **Monitoring indicators:** % of low income housing with solar PV, electricity generation from implementation of rooftop solar and reduction in energy demand from conventional sources from implementation of solar heaters, reduced energy costs, increase in income for low-income communities.

- **Alignment with CSCAF indicators:** Indicator 2, total electrical energy derived from renewables under Energy & Green buildings sector.

[114, 115] Quick Win Project – Rajkot Solar PV in Social Housing, *ICLEI South Asia*

Goal 4: Greener, Inclusive Spaces for All in Ujjain

The total per capita green space in the city is 7-8 m², which is less than the average suggested by URDPFI but is higher than in most of the other Indian cities. There is only 6.8% green cover in the municipal area[116]. The city thus has a dispersed urban sprawl with inadequate green and open spaces. There is a need to increase the green cover in the city and develop inclusive green spaces for all. This will also contribute to reduced emissions, increase air quality along with health benefits. The total sequestration from all the five parks in the city was 553.38 kg/year and the total estimated carbon sequestered by all the trees in Ujjain was 12,306,772 tonnes per year in 2020, indicating a high mitigation potential for this goal[117]. This is also in line with the ABD plan where Ujjain envisions developing botanical gardens and parks in the ABD area with multi-use open space, cycle and jogging tracks, Japanese garden, bird sanctuary, children's play area, open air theatre, etc., particularly in the Vrindavan region[118].

| Identified Actions

Action 1: Promote green terraces or kitchen gardens in buildings

- **Challenges addressed at the city level:** The total per capita green space in the city is 7-8 m², which is less than the average suggested by URDPFI but is higher than in most of the other Indian cities. Ujjain faces regular heat waves with temperatures rising to 43-44°C[119].

- **Description:** Urban green terraces are an efficient way to integrate greening into existing urban infrastructure while also helping residents reduce food costs by cultivating their own produce. The government can take steps to increase awareness and interest in green terraces. An example is the case of Madurai, where the government is selling subsidized terrace garden kits[120]. The kits contain 10 seed varieties, grow bags and manure. The government of Tamil Nadu also provides 50% subsidy for procuring materials to start a green terrace under the "do it yourself" kit program. Each buyer can avail the subsidy five times[121]. Bihar has also started a similar program along with training workshops for farmers and residents[122]. Further incentives to reduce costs can be tax rebates for residential communities with terrace gardens. This action can first be implemented in municipal buildings for increased uptake.

- **Inclusivity analysis:** Neighborhoods with higher incomes, education levels, home ownership and populations of majority ethnic groups may have higher proportions of tree canopy cover. An equity index can be created to help incorporate equity in the spatial distribution of green infrastructure initiatives. More incentives can be provided for low-income communities without the necessary infrastructure for rooftop gardens, in the form of common community gardens.

- **Implementing stakeholders:** Ujjain Smart City Limited and Ujjain Municipal Corporation (lead), Ujjain Development Authority, NGOs, and citizens.

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

- **Possible alignment with schemes:** AMRUT: 2.5% of project cost is funded for development of parks with children- and elderly-friendly features, Nagar Van Scheme, Green Highways Mission, Van Mahotsav, National Clean Air Programme.

- **Monitoring indicators:** Percentage and spatial distribution of houses with green terraces, number of kits sold, rise in property values after implementation of green terraces.

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

Action 2: Engage citizens in urban green cover conservation

- **Challenges addressed at the city level:** The total per capita green space in the city is 7-8 m², which is less than the average suggested by URDPFI but is higher than in most of the other Indian cities. Ujjain

---

[116] CSCAF 2.0, *2020*

[117] Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh Ujjain, *School of Planning and Architecture, 2019*

[118] The smart city challenge under Smart City Mission, Phase II, *Ujjain Smart City Proposal*

[119] Heat Waves continue in 11 districts of MP, mercury rises to 43 degrees in Ujjain for first time in season, *Dainik Bhaskar, 2020*

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

[121] Subsidies for terrace gardens, Chennai, *Live Chennai.com, 2013*

[122] 70 people apply for roof-top farming project in Gaya, *Hindustan Times, 2019*

faces regular heat waves with temperatures rising to 43-44°C[123].

- **Description:** People's participation remains crucial in creating inclusive green spaces to tackle urban heat island effects particularly in low-income areas. Ujjain can implement measures to engage citizens and tourists in the mapping and conservation of urban green spaces. This will ensure higher uptakes and instill a sense of responsibility and ownership amongst citizens. Ujjain can organize a collective citizen driven mapathon to map out potential areas for new urban forests, gardens, or parks. Kochi did something similar within the Cities4Forest project implemented by WRI India[124]. Bengaluru also has an open-source platform providing guidance and tools for mapping trees in the city[125].

  The city can also implement apps to help citizens map trees and also identify the best type of native trees to plant based on the conduciveness of the location. Examples include Kerala[126], where an app was launched to help citizens identify the types of trees to plant based on their location and Goa[127], which helps citizens geotag trees and monitor their health. Household surveys can also be used as a method to build a resilience roadmap for urban forestry initiatives, like in Kochi[128].

- **Inclusivity analysis:** Engaging citizens is an important measure to increase the social inclusivity of urban greening projects. When practitioners work with communities, they can choose methods that intentionally involve diverse stakeholder groups, providing a space for their opinions, needs and knowledge before/ during the project implementation. A social and vulnerability analysis can be conducted to identify all relevant stakeholders for these initiatives, particularly vulnerable sections[129].

- **Implementing stakeholders:** Ujjain Smart City Limited and Ujjain Municipal Corporation (lead), councilors, local experts, Ujjain Development Authority, and citizens.

- **Timeframe:** Starting in short term (1-2 years) but continued.

- **Possible alignment with schemes:** AMRUT: 2.5% of project cost is funded for development of parks with children- and elderly-friendly features, Nagar Van Scheme, Green Highways Mission, Van Mahotsav, National Clean Air Programme.

- **Monitoring indicators:** Number of communities represented in the community engagement initiatives, increase in data on urban green cover, less resistance for projects.

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

Action 3: Initiatives to restore, maintain and enhance the city's biodiversity

- **Challenges addressed at the city level:** Ujjain boasts of rich biodiversity particularly in the Undasa wetland regions[130]. Despite data stating the formation of a city biodiversity committee, more data is needed to understand how active the committee is and who its members are. In 2016, the city saw a huge mass of dead fish floating in the Kshipra River, calling for urgent measures to protect biodiversity[131].

- **Description:** Ujjain can undertake initiatives such as the following to increase its city biodiversity index:
  - Baseline assessment of biodiversity hotspots and measuring the city biodiversity index
  - City should prepare a People's Biodiversity Register (PBR), a document which details availability of local biodiversity and traditional knowledge associated with them. It is a tool to help local bodies with conservation related decision making. All local bodies in MP are mandated to make a PBR. Guidance is also available by the Madhya Pradesh State Biodiversity Board[132].
  - Mandating use of only native species in all new constructions such as what is done in the MRIDA project
  - Developing local biodiversity strategies and action plan (LBSAP)
  - Mobile-based apps or toolkits for biodiversity management and awareness

[123] Heat Waves continue in 11 districts of MP, mercury rises to 43 degrees in Ujjain for first time in season, *Dainik Bhaskar, 2020*
[124] Mapathon begins today in Kochi, *The Hindu, 2020*
[125] Open Tree Map: Bengaluru
[126] This app will help green the landscapes of your city, *The Hindu, 2019*
[127] Tree-mapping app helps citizens preserve data on Goa's green cover, *The Times of India, 2020*
[128] Stakeholder Engagement, *Cities4Forest*
[129] Participatory Vulnerability Analysis, A step–by–step guide for field staff, *Action Aid International*
[130] Biodiversity of Undasa wetland Ujjain with special reference to its conservation, *EurekaMag, 2003*
[131] Dead fishes float in Ujjain's Kshipra River, Indore, *The Times of India, 2016*
[132] People's biodiversity register (PBR), *Madhya Pradesh State Biodiversity Board*

- QR codes on trees for information on tree species, age, ecosystem services and benefits like in Delhi[133].

- **Inclusivity analysis:** Engaging citizens is an important measure to increase the social inclusivity of urban biodiversity projects. When practitioners work with communities, they can choose methods that intentionally involve diverse stakeholder groups, providing a space for their opinions, needs and knowledge before /during the project implementation. A social and vulnerability analysis can be conducted to identify all relevant stakeholders for these initiatives, particularly the vulnerable sections[134].

- **Implementing stakeholders:** Ujjain Smart City Limited and Ujjain Municipal Corporation (lead), councilors, local experts, Ujjain Development Authority, and citizens, NGOs.

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

- **Possible alignment with schemes:** National Biodiversity Action Plan 2014, Integrated Development of Wildlife Habitats (IDWH) Scheme, Nagar Van Scheme, National Biodiversity Act.

- **Monitoring indicators:** Development of biodiversity strategies and action plan, calculation, and improvement along the City Biodiversity Index, increase in species diversity (as per species list and area map).

- **Alignment with CSCAF indicators:** Indicator 3, urban biodiversity within urban planning, green cover, and biodiversity.

[133] NDMC to geotag 1.8 lakh trees, give fresh QR codes, *The Times of India, 2022*
[134] People's biodiversity register (PBR), *Madhya Pradesh State Biodiversity Board*

Goal 5: Sustainable Waste Management for a Clean Ujjain

In 2019, the Madhya Pradesh government proposed that solid waste management in ULBs be undertaken through public private partnerships on a cluster basis, after it was reported that 90% ULBs could not implement all components of the Municipal Solid Waste Rules 2000/2016 in terms of collection, transportation, segregation, processing, and scientific disposal of MSW. The state had clustered ULBs for effective integrated SWM based on the regional landfill concept, wherein a larger ULB is chosen as a lead member and smaller ULBs within a distance of 50-80 km are cluster members. Approximately 26 clusters were formed covering all the 378 ULBs[135].

Ujjain being a major pilgrimage center has its own set of challenges linked with waste generation due to its floating population. In 2016, a study on the water quality of River Kshipra during the Kumbh Mela in 2016 highlighted that the ghats were severely polluted with solid and organic waste, risking the spread of diseases. The water quality was termed to be unhealthy and unfit for consumption or domestic use[136].

Ujjain has 100% door to door collection of segregated waste in vehicles with segregated compartments for wet and dry waste[137]. There is also a yellow bin for sanitary items and a red bin for sharp objects and glass. City has two material recovery centers cum transfer stations with capacities of 136 and 127 MT each[138]. Ujjain also has a fully operational bio-methanation plant which uses vegetable waste from markets and turns them into biogas. The plant consumes 5TPD waste and has generated 81,181 units of electricity till date and saved a tipping fee of Rs. 55 Lakhs since its inception in 2018[139]. Ujjain is also hailed for its best practice of converting temple waste at the Mahakaleshwar temple into incense sticks and herbal color. The plant has a capacity of 3 TPD with 18 lakh investment and has been generating a revenue of Rs. 1.5 Lakh per month with 11 employees[140]. City requires an additional of 8 mini collection trucks and 8 collection trolleys as per the district environmental plan. It is also planning to construct a sanitary landfill. As of 2021[141], city was yet to authorize waste pickers into the formal system, link with producers for extended producer responsibility and involve NGOs in the waste management process – some of the areas which the city can work on.

Identified Actions

Action 1: Exploring decentralized composting at the zone level

- **Challenges addressed at the city level:** Waste sector contributes to 7% of total GHG emissions.

- **Description:** Ujjain has successfully implemented a 5TPD bio-methanation plant for vegetable waste from markets. Similarly, 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. City has 9 such units. Only segregated wet waste comes to these units. It is managed by NGO, SHG or Stree Shakti Sangha. Vehicles are provided by the corporation along with a support of Rs. 95,000 per month. It generates a revenue of about Rs. 30,000 per month. Compost is sold to nearby farmers at a minimum cost of Rs 1200/tonne with 5% retained by the municipality for its gardens[142]. Land attached to MRFs, open land, near railway station or parks in Ujjain can be used. Decentralised biodegradable processing plants do not require high cost or expensive technology and are a tried and tested method to replicate especially in Tier 2 and Tier 3 cities, where resources are limited for urban local bodies.

- **Inclusivity analysis:** The waste sector provides livelihoods for recyclers and informal waste pickers who collect recyclable waste from the street, open dumps, and landfills. At present the waste is being collected by community waste pickers/kabadiwalas in Ujjain. Integrating a mechanized system for source segregation and treatment should ensure that informal waste workers are integrated into the system and provided with ID cards, health insurance, etc. For example, each ward can have a ward level waste management officer. For example, to avoid exclusion of these informal workers, Pune Municipal Corporation signed an MoU with SWaCH[143], a fully

[135] Annual Report for year 2Ol9-202O under Solid Waste Management Rules, 2016, *MP Pollution Control Board, 2020*

[136] Assessment of Water Quality of River Kshipra during Simhastha Mahakumbh Mela 2016 in Ujjain, Madhya Pradesh, *Rahul Singh Pawar and RK Bhatia, 2016*

[137, 141] District Environmental Plan for Ujjain, Madhya Pradesh, *MPPCB, 2021*

[138] How does urban India manage its waste? An almanac of best practices, *NIUA, 2020*

[139] Best Practices Compendium, *NIUA, 2019*

[140] Chandigarh team visits Ujjain, see floral waste and bio-methanation plants, *India News Calling, 2022*

[142] Waste Wise Cities, *NITI Aayog & CSE, 2021*

[143] SWaCH Waste Management covers over 70% of Pune, *Swachcoop website*

owned cooperative of waste pickers to handle door-to-door collection. It provided equipment to these workers and handled administrative costs. This would ensure inclusivity and ensure equitable distribution of climate impacts.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), MPPCB, Ujjain Smart City Limited, private technology providers, informal waste pickers, citizen forums, RWAs.

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

- **Possible alignment with schemes:** Swachh Bharath Mission - Urban 2.0.

- **Monitoring indicators:** % of zones with composting units, % of wet waste composted, reduction of GHG emissions due to improved processing and treatment facilities, creation of new jobs for informal sector through expanded waste management infrastructure.

- **Alignment with CSCAF indicators:** Indicator 1, waste minimization initiatives undertaken by the city. Indicator 4, extent of wet waste processed.

Action 2: Public-private partnership models for managing construction and demolition waste

- **Challenges addressed at the city level:** Of Ujjain's MSW, C&D waste amounts to 20 TPD as of 2021. As per the Ujjain DEP 2021, city has a recycling facility for C&D. However, the waste is only dumped in low lying areas and there is limited awareness of amongst the public on C&D waste.

- **Description:**
  - Assessment of C&D waste generation ward wise, number of organizations, current method of processing (% of waste reused in low lying areas) - Ujjain should create a database of bulk waste generators, amount of C&D waste generated from each generator and the percentage of waste sent to low lying areas and the percentage recycled.
  - Public private partnership for managing recycling facility: In Gurugram, considered as a best practice[144], the municipal corporation appointed two agencies - Pragati for primary collection and transport and IL&FS Environmental Infrastructure and Services Limited (IEISL) for secondary collection and processing. Pragati also manages the collection centres, maintains a database and customer interface. They also have the authority

to fine generators for not providing challan on waste generated. IEISL is also the nodal agency for managing waste in Delhi. Separate vehicles were also deployed to transport C&D waste with geotagging and colour coding. Ujjain can consider entering into a public-private partnership for managing its C&D waste.
  - Appointing dedicated UMC staff in each ward to monitor C&D waste management - In cities like Gurugram and Delhi, one junior engineer is deputed at each ward to monitor waste collection and recycling. They ensure collection of waste and provision of challan. Regular night patrolling is also done to prevent illegal dumping. In Delhi, the junior engineer manages each waste collection centre to monitor waste collected and recycled. A penalty is fined if the generator does not disclose the waste generated.
  - 24x7 toll free number to complain about C&D waste - Gurugram has also initiated a toll-free number where citizens can register complaints about illegal dumping of C&D waste.
  - Recycling of waste - At present, the construction waste in Ujjain is dumped in low lying areas. Ujjain can convert the waste to manufacture paver blocks, bricks, kerb stones and concrete blocks which can be used in new constructions. For example, in Delhi, over 16 lakh recycled blocks from C&D waste are being used in the new supreme court annex building[145]. It has saved 45 acres of urban land and reduced burden on landfills. C&D waste can be used in new roads and development of new colonies or areas. City can also explore feasibility of using C&D waste in heritage restoration of buildings.

- **Inclusivity analysis:** This action would incorporate effective coordination between public and private agencies and stakeholder engagement for collection and disposal of C&D waste. Jobs can be provided for informal workers from low-income groups to manage the recycling facility, monitor the waste, etc. For example, Municipal Corporation of Gurugram had provided ID cards and uniforms for the employees in these centers along with authorization letters for collection and enforcement. Effective public engagement would also increase awareness and accountability for managing the waste.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), MPPCB, Ujjain Smart City Limited, private builders and real estate agencies, private technology providers, informal waste pickers, citizen forums, RWAs.

[144, 145] Waste Wise Cities, *NITI Aayog & CSE, 2021*

- **Timeframe:** Short term (1-2 years), require long term monitoring (>5 years).

- **Possible alignment with schemes:** SBM- Urban 2.0, National Clean Air Action Plan.

- **Monitoring indicators:** % of C&D waste recycled, % new jobs created reduction in air pollution due to dumping of construction waste, % of new buildings with recycled construction waste.

- **Alignment with CSCAF indicators:** Indicator 1, waste minimization initiatives undertaken by the city. Indicator 3, construction & demolition (C&D) waste management.

Action 3: Upgrade collection and transportation infrastructure to electric vehicles

- **Challenges addressed at the city level:** As per the district environment plan, the Ujjain Nagar Nigam Palika has an inadequate waste transport infrastructure. Purchase of eight more mini collection trucks and eight waste collection trolleys is proposed.

- **Description:** Ujjain has initiated an Ujjaiyini app which alerts citizens on the arrival time of the SWM collection vehicle into the colonies, with a real time monitoring and geotagging of vehicles. As per the DEP 2021, city is planning to purchase 8 additional mini collection trucks and 8 collection trolleys. Given the city's initiatives to increase its electric infrastructure by implementing a tender to set up electric charging stations in the city, Ujjain can also consider converting their existing and proposed waste transportation fleet into electric vehicles. Steps can include:
  - Including incentives like higher tipping fees or issuing a mandate that a certain percentage of the fleet should be electric in new tenders
  - Incentives like designated parking spots, no parking fees, road tax exemptions, scrappage incentives, etc. can be provided.
  - Charging infrastructure can be implemented in vacant lands, transfer stations, vegetable markets, UMC offices, etc.

  For example, Tamilnadu has 1700+ battery operated waste pickup vehicles with 3 bins for segregated waste, they have a range of 50km and can run for 6 hours on a single charge[146].

- **Inclusivity analysis:** UMC should ensure that the drivers of these new electric waste pick-up trucks, who may be from low-income communities are provided training and capacity building on operating and managing the fleet. New jobs can also be created through the setting up and management of charging infrastructure.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, private players.

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

- **Possible alignment with schemes:** FAME phase 2, SBM-U 2.0.

- **Monitoring indicators:** Reduced emissions from transport sector, % of EV vehicles in the fleet for Light Duty freight vehicles, % of electric vehicles in the waste transport fleet, reduction in air pollution from freight.

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

---

[146] NEWSPollution Free Garbage Vehicles All Set to Revamp Door-To-Door Waste Collection System In Tamil Nadu, *NDTV, 2018*

Goal 6: Water for Everyone in Ujjain

As per a study in 2018, Ujjain had a water supply for once a day for an hour[147]. In spite of adequate water resource and treatment capacity, 52% of the municipal households had in-house water supply connection and 10% of the households below poverty line had in-house water supply connection in 2018[148]. This calls for interventions for improving the distribution network. The absence of sewerage/ wastewater network and dependency on septic tanks as a means of wastewater disposal can lead to contamination of surface and ground water.

Total water produced is 110 MLD and 65 MLD is sold amounting to 41% NRW as per CSCAF 2.0 data[149], arising from leakages, thefts, and free supply to some institutions and the poor. Ujjain has surplus supply compared to the current demand. Yet the high amount of unaccounted water, and physical losses being the largest contributor raises concerns for the city.

Furthermore, climate risks like higher total annual rainfall and more frequent/heavy rainfall events will likely exacerbate potential flood risk and may have 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). Baseline water stress (BWS) shows the city's current water withdrawals from freshwater sources expressed as a percentage of the total annual available water[150]. A threshold of 40% water use relative to supply signifies severely water-stressed conditions. In 2010, Ujjain accounted for 80% Baseline Water Stress (BWS), which signifies extreme stress[151]. In this situation, the dependency on rainfall is very high, and periods of low rainfall can drastically reduce the amount of water circulated in the system. To maintain resilience of the city in times of need and to ensure future availability of water, the total water withdrawals need to be significantly reduced.

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

| Identified Actions

Action 1: Strengthen the implementation of the NRW action plan

- **Challenges addressed at the city level:** As per the CSCAF 2.0 data, 41% NRW in the city.

- **Description:** Ujjain municipal corporation had already developed an action plan for reduction of NRW in 2016[152]. The city can further revise it and strengthen its implementation through the following measures:
  - Revise the plan for 2023 baseline to understand the current water demand, current sources, water intake and treatment capacity, supply, charges, and connections.
  - Monitoring water consumption and improving estimation/measurement techniques, meter calibration policy, meter checks, identifying improvements to recording procedure. Since Ujjain has SCADA system, this can be accurately implemented.
  - Network audit to quantify leakage and apparent losses – In 2016, the NRW plan for Ujjain could not measure physical losses due to the absence of flow meters and check meters. The city should redo this in the revised NRW strategy through leakage studies (reservoirs, transmission mains, distribution network), operational/customer investigations, illegal connections, etc.
  - Review of network operating practices – investigating historical reasons, poor practices, quality management procedures, poor materials/infrastructure, number of connections billed
  - Upgradation and strategy development – updating records systems, introducing zoning and leakage monitoring, initiating leak detection/repair policy, designing short-/medium-/long-term action plans
  - Policy change, training, and operation & maintenance – for training – improving awareness, increasing motivation, transferring skills, introducing best practice/technology; for operation & maintenance - community involvement, water conservation and demand management

[147, 148] Status of water flows in Ujjain, *Heinrich Böll Foundation-India & Development Alternatives, 2018*

[149] CSCAF 2.0, *2020*

[150, 151] Freshwater Sustainability Analyses: Interpretive Guidelines, *ISciences, 2011*

[152] Action Plan for Reduction of NRW, *Ujjain Municipal Corporation, 2016*

- **Inclusivity analysis:** Inequitable distribution is a major issue, with some areas receiving 80 LPCD, and others receiving 200 LPCD. There is a total of 1.25 lakh households, out of which 56,000 households have water connections and only 28,000 pay a flat rate of Rs 120 per month as of 2018[153]. 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. Ujjain city may 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 ensures equitable access to piped water supply to low-income and vulnerable households.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, MPPHED, resident welfare associations and citizen forums.

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

- **Possible alignment with schemes:** AMRUT: Funding for projects strengthening water supply; the proposed water demand management strategy and implementation plan (2006) developed by UN-Habitat and ADB can be used as a starting point and revised according to latest data; Smart Cities Mission; Smart Meter National Programme; Madhya Pradesh Urban Services Improvement Project.

- **Monitoring indicator:** Reduced NRW loss, reduced water usage and tariffs for consumers, monitoring water losses, reduced supply needs.

- **Alignment with CSCAF Indicators:** Indicator 2, (Extent of non-revenue water) within water management.

Action 2: Disaster risk reduction by developing and implementing an integrated flood and storm water management plan incorporating nature-based solutions

- **Challenges addressed at the city level:** Flooding, pollution of water bodies and ground water contamination, lack of sewerage network, improving resilience against future climate risks due to more frequent/heavy rainfall events. Ujjain has not carried out a flood risk assessment[154].

- **Description:** Flooding is an issue in Ujjain, with waste and dirt coming up in low lying areas of the city, causing health issues and concerns. The Kshipra River is flood prone during monsoons. Ujjain should first carry out a flood risk assessment. As an ad-hoc solution, planting of shrubs near the riverbanks may be considered to reduce the impact on nearby settlements. Possibility of draining stormwater from the north-eastern direction needs to be considered.

A network of surface wells may be constructed, which may lead to re-spread of the water, slow down its flow along the surface and increase percolation into the ground to the maximum extent possible. The location of these surface wells needs to be determined scientifically at potential points which will ensure maximum water recharge and minimize surface runoff.

The city can also incorporate sustainable urban drainage systems[155], 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 of local water bodies. Examples include green infrastructure solutions like permeable paving on driveways and footpaths, garden beds designed for infiltration (rain gardens), lawns and vegetation, bioswales, soak wells, etc.[156] 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. They not only typically lack basic infrastructures that mitigate flooding or heat (e.g., trees for shade, proper stormwater drainage channels), but they also typically lack political representation. Ujjain city needs to regularly collect census data on informal, migrant, and low-income communities in order to capture the magnitude of risk for these communities. This disintegrated data should be utilized for a data-driven informed decision making.
  - Green infrastructure on public property, such as more street trees, green lawns, and roofs and bioswales may also raise nearby real estate prices that outprice low-income residents and unintentionally usher in "green gentrification"[157]. While implementing this action, the city must conduct participatory stakeholder meetings in partnership with the low-income communities,

[153] Status of water flows in Ujjain, *Heinrich Böll Foundation-India & Development Alternatives, 2018*
[154] CSCAF 2.0, *2020*
[155] Sustainable Drainage, *SusDrain*
[156] Require Planning for Strong Storm water Management in India, *EcoNaur, 2022*
[157] How to Prevent City Climate Action from Becoming "Green Gentrification", *WRI Ross Center, 2019*

city planners, chief engineers, and local NGOs to understand how this action will impact different parts of the urban population, and particularly those most in need. These partnerships and holistic consultations with the different players push revitalization to be productive, rather than destructive, to low-income communities.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, Ujjain Development Authority, Water Resources Department (GoMP), PHED (GoMP).

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

- **Possible alignment with schemes:** AMRUT-thrust areas like sewerage facilities and septage management and storm water drainage management; Madhya Pradesh Urban Services Improvement Project by ADB.

- **Monitoring indicators:** Reduced flooding frequencies, reduced water stagnation, improved vegetation and ground 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 indicator, water sensitive urban design[158] considerations can also be incorporated into the city's master plan.

Action 3: Implement a demand management plan for optimal usage of water resources

- **Challenges addressed at the city level:** 52% of the municipal households had in-house water supply connection and 10% of the households below poverty line had in-house water supply connection as of 2018[159].

- **Description:** The city does not have a metering policy to install water meter at the consumer level. Hence the quantity of water consumption and the physical loss in the city is difficult to be estimated. Additionally, the water charges are decided by the state government, currently, the water works department is running into deficits as the revenue earned is much lower than the cost of production. It is proposed that water used for city services such as gardening, and cleaning be

metered. According to CSCAF 2.0, the city should assess the water usage according to 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 planned to install 275,000 meters by 2023[160]. These meters helped residents reduce their water consumption and allowed corporation to charge according to usage rather than a uniform rate. Housing societies can use this information to further come up with water conservation strategies. AI based water meters will enable remote readings. These apps can also enable consumers to understand where they stand with respect to their neighbors through labels. These can be installed first in municipal buildings. Standards for meter quality and design must also be established.

- **Inclusivity analysis:** A city-wide initiative to create incentives and techniques to save and store water on a household level (e.g., water metering) should consider that low-income, informal, and migrant communities may lack household connections to the piped water and sewerage network, making them hard to reach. Further, space to construct water management infrastructure (e.g., rain barrels, storage) may be unavailable in dense informal settlements. The implementation of demand side management interventions by Ujjain city needs to incorporate concerns of these communities.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, MPPHED, resident welfare associations, water meter suppliers.

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

- **Possible alignment with schemes:** Smart Cities Mission, Smart Meter National Programme, Madhya Pradesh Urban Services Improvement Project.

- **Monitoring indicators:** Reduced water usage and tariffs for consumers, monitoring water losses, reduced supply needs.

- **Alignment with CSCAF indicators:** Indicator 1, water resources management within water management

---

[158] Water sensitive urban & building design, *Climate Adapt*
[159] Status of water flows in Ujjain, *Heinrich Böll Foundation-India & Development Alternatives, 2018*
[160] Pune chooses sensus iperl meters to deliver its pioneering 24x7 water project, *Sensus website, 2019*

Action 4: Develop inclusive business models for wastewater treatment and reuse

- **Challenges addressed at the city level:** Only 61.36% of the wastewater is recycled and reused[161].

- **Description:** Kshipra is not a perennial river and gets much of its regular flow from the Kanh River, which carries industrial and domestic wastewater of Indore city. The domestic sewage flow of Ujjain town also finds its way to River Kshipra through various nallas, which worsens the quality of water in the river.

  This issue may be addressed through developing inclusive business models of decentralized wastewater treatment. Many social enterprises have developed solutions that not only address domestic wastewater disposal, but also facilitate recycling of the wastewater such that it can be used for cleaning, irrigation, flushing and other non-drinking purposes. These enterprises treat greywater as well as blackwater. The household systems generally have a capacity that ranges from 1.5 m³ to 150 m³ and serve 1-20 households or small enterprises[162].

- **Inclusivity analysis:**
  - The decentralized techniques may be unaffordable for low-income, informal, and migrant communities because of high one-time costs and costly maintenance over time with inflexible payment schemes. These techniques may also be impractical for tenants or residents in temporary housing if they require property modification. The city in partnership with technical providers can support the implementation of the decentralized wastewater treatment systems (DEWATS)[163] wastewater treatment model in such low-income households. The process needs to ensure coordination amongst government agencies and active participation from all significant stakeholders through training programs on installation, operation, and maintenance. To generate practical awareness, involvement, and participation from local users for the decentralized approach, an online web-based tool — MOUNT (Menu on Un-Networked Technologies for Sewage and Septage Management) created by the Centre for Science & Environment, India[164] which comprises successfully implemented decentralized wastewater treatment technologies can also be used by the city during the training modules.

  - Existing city programs providing information on how to install and use wastewater management systems may be inaccessible to these groups and ineffective if they do not target women, who typically manage household water use. Thus, women should be placed at the center of the action while doing such city programs.

- **Implementing stakeholders:** Ujjain Municipal Corporation (lead), Ujjain Smart City Limited, MPPHED (GoMP), MP Pollution Control Board, resident welfare associations, citizen forums, builders' associations.

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

- **Possible alignment with schemes:** Government of Madhya Pradesh State Level Policy (2017) for Wastewater Recycle & Reuse, AMRUT- Funding for water reuse projects, Smart Cities Mission

- **Monitoring indicators:** Increased water availability, reduced water treatment costs, Increased % of wastewater treated and reused.

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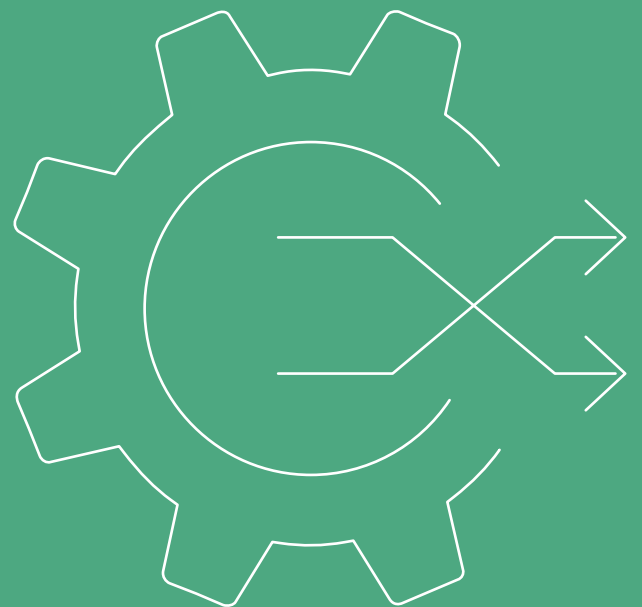
---

[161] CSCAF 2.0, *2020*

[162] Decentralized Wastewater Treatment, *BORDA*

[163] Decentralised wastewater treatment systems to improve water security, *Mongabay, 2023*

[164] MOUNT tool for decentralized wastewater treatment technologies, *Centre for Science & Environment*

IMPLEMENTATION AND GOVERNANCE OF UJJAIN CLIMATE ACTION PLAN

Creation of Ujjain Climate Change Cell

Ujjain Municipal Corporation is responsible for infrastructure development and citizen service. On the other hand, Ujjain 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 and incorporate them in the 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 Ujjain climate change cell

- **Description:** To align with the State Action Plan on Climate Change and implement the Ujjain City Climate Action Plan, there needs to be a dedicated climate cell with representatives or nodal officers from line departments concerned. Many cities including Coimbatore, Mumbai, Aurangabad etc. have developed such a cell which is tasked with the implementation and monitoring of the plans. The climate cell needs to coordinate with State Knowledge Management Centre on Climate Change, EPCO, Department of Environment, Government of MP, which is the state nodal agency for climate change to implement and report the progress of the actions proposed in the plan. Potential roles of the climate cell include to:
  - Facilitate coordination between EPCO and the city on climate change related issues and projects
  - Support and advise on key amendments to statutory policy regulations and liaise with parastatal agencies for data collection and information
  - Build internal capacity for climate knowledge and science
  - Engage and coordinate across departments within the city corporation to mainstream climate resilience thinking in existing and proposed projects
  - Facilitate implementation of the actions proposed in the plan
  - Report implementation and monitoring status of the plan to the state nodal agency
  - Work with sectoral experts and scientists to periodically update the plan including city GHG inventory for monitoring the GHG emissions and respective causes and challenges

- **Tentative staffing and stakeholders:**
  - Municipal Commissioner, Ujjain 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, Ujjain Smart City, or nominated official (Member Secretary)

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

Creating an Ujjain City-level Climate Budget in Municipal Finance

Identifying and creating funding streams for climate action has the potential to catalyze climate responsive development. It is estimated that for every $1 spent on flood protection infrastructure[165] in India results in $248 in avoided damages until 2050 and reduces the likelihood of areas being flooded from 4% to 2%. This will also deliver co-benefits of aligning urbanization in line with the sustainable development goals.

As per the Madhya Pradesh State Budget allocation FY2021-22[166], the state has allocated Rs 112 crore for the launch of Mukhya Mantri Swarozgar Yojana to provide loans at low interest rates 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 by a green transition. Rs 2,581 crore which has been allocated to Atal Grah Jyoti Yojana, has also been aligned with some of the actions proposed in the plan. Rs 5,762 crore has been allocated towards 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 green economy in the city.

It is prudent that the city creates a city climate budget for implementation of the city climate action plan. The allocation of municipal level climate budget will create accountability to implement climate actions and to ensure better coordinated outcomes. To achieve this, it is

necessary to have this city-level climate action plan 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 Climate Change Department (CCD) adopted a budget called 'Climate Change Budget Scheme[170] which earmarks funds for specific climate change programs. Odisha has a climate budget framework[171] institutionalized for its cities. Chhattisgarh, Assam, and Maharashtra are tracking the climate change relevance of their developmental projects through budget coding[172]. Thus, the state of MP and its cities also need to step up in action, considering its estimated climate risks, vulnerability score and the climate performance of its 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 7: State vulnerability score and financial expenditures

State	State Vulnerability Score[167]	Overall Average CSCAF Scores of MP's SMART Cities[168]	SDG Progress[169] (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, Government of MP after the launch of the Climate Action Plan.

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

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

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

[168] Climate Centre for Cities, *NIUA*

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

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

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

[172] 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 emission profile of the city included in the plan may be used as a guiding analysis to prioritize 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 regularly with the latest emissions profile of the city. Instituting a climate change cell at the city-level with representation of concerning ULB departments, Smart city, citizen forums, academic institutions and civil society becomes 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.

State Knowledge Management Centre on Climate Change (SKMCCC)
Environmental Planning and Coordination Organisation (EPCO)
Department of Environment, Government of Madhya Pradesh

Paryavaran Parisar, E-5. Arera Colony, Bhopal – 462016, India
Ph: 0755-2970499, 2970299, 2460255