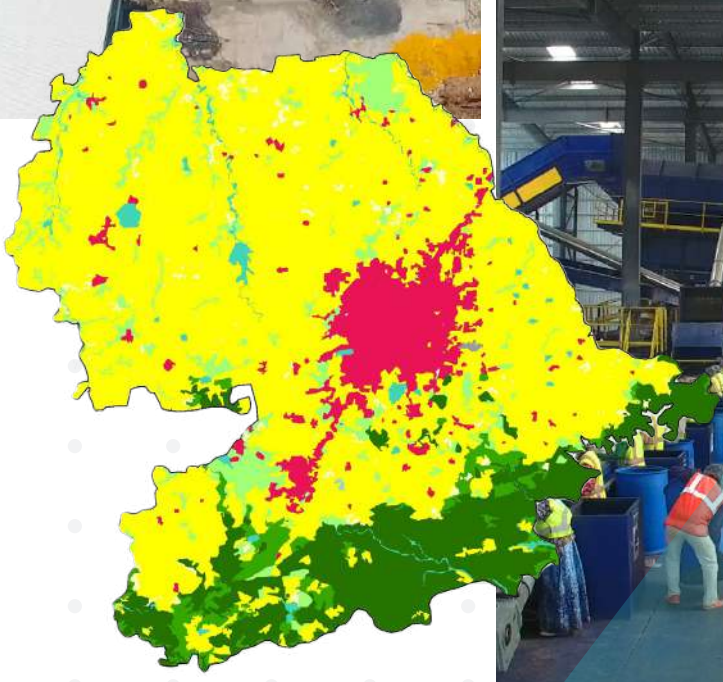
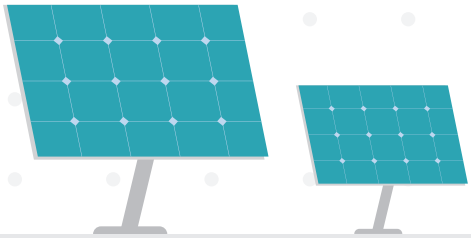
January, 2022

Climate Change and Environment Action Plan of

Indore District





Prepared By

VASUDHA FOUNDATION
Green ways for a good earth!

In Association with

SKMCCC, EPCO, Department of Environment
Government of Madhya Pradesh

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SHAKTI
SUSTAINABLE ENERGY FOUNDATION

The Climate Change and Environment Action Plans (CCEAP) have been developed for multiple districts of India by Vasudha Foundation with support from Shakti Sustainable Energy Foundation. For Indore, the plan was developed in collaboration with the State Knowledge Management Centre on Climate Change (SKMCCC), Environmental Planning & Coordination Organisation (EPCO), Department of Housing and Environment, Government of Madhya Pradesh.

The CCEAP aims to complement the State Action Plan on Climate Change (SAPCC) version 2.0 as prescribed by the Ministry of Environment, Forest and Climate Change (MoEF&CC) and align it to India's latest climate change commitments to the United Nations Framework Convention on Climate Change (UNFCCC). The rationale behind this action plan is to follow a bottom-up approach to climate-proof development priorities for the district.

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January, 2022
Indore, Madhya Pradesh

Cover page images

Top left image:
Bio-methanation facility at Chhoitram Mandi, Indore

Bottom right:
Material recovery facility, Indore (both sourced from Smart City Indore website)

Land use map of Indore district:
Created using data from Landsat 8, secondary data from NRSC/ISRO Bhuvan portal, Google Earth and ORNL-DAAC

Dense forest | Mixed forest | Shrubland | Cropland | Fallow Land | Built-up Land
Barren Land | Grassland | Wasteland | Waterbodies

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FOREWORD

Aniruddhe Mukerjee (I.A.S.)
Principal Secretary

D.O. Letter No.

Foreword

The recently concluded 26th convention of the UNFCCC at Glasgow has brought forth the need for tangible actions on emissions. India has made ambitious commitments at CoP26. As the second largest Indian state, with a population of more than 8 million, Madhya Pradesh's efforts in combating climate change would be of significant importance in the national context. The state currently has the largest area under forest cover, and is home to one of the largest solar power projects in India, with a 750 MW solar power plant at Rewa. The state has also been taking initiatives to tackle climate change as highlighted in its State Action Plan for Climate Change (SAPCC).

While national and state level initiatives lead the movement to address climate change, it is important to equip the districts and guide communities for the same at the local level. In this light, I would like to congratulate the State Knowledge Management Centre on Climate Change, Environmental Planning & Coordination Organisation and Vasudha Foundation, New Delhi for formulating this in-depth Action Plan for Indore district. I appreciate that a detailed study was undertaken in consultation with various stakeholders to develop the Climate Change Action Plan of Indore district. I am thankful to Shakti Sustainable Energy Foundation for supporting its preparation.

The action plan is a comprehensive assessment of the sectoral greenhouse gas emissions, current and future climate change scenarios, and climate change drivers in the district. Based on the assessment, the plan identifies various local level interventions, which are in line with the SAPCC, other state and national-level programmes, to tackle climate change at the district level in a sustainable manner.

I would encourage the district administration to adopt this Action Plan and take initiatives for its implementation on the ground.

(Aniruddhe Mukerjee)

PREFACE

Shriman Shukla, IAS
Executive Director
EPCO

Preface

District Climate Action Plan (DCAP) for Indore district has been developed by State Knowledge Management Centre on Climate Change, EPCO in collaboration with Vasudha Foundation, New Delhi with the support of Shakti Sustainable Energy Foundation to assess the transition in terms of both climate & policy, to address the key issues related to climate change in the district.

The Indore DCAP includes district-level baseline studies on climate variability and projections, an emissions profile, a budgetary analysis to estimate climate finance, and analysis of state and national level policies and programmes active in the district. It also incorporates a comprehensive set of recommendations, in alignment with Sustainable Development Goals (SDGs), for various climate-related sectors and environmental issues of Indore district, as well as case studies and estimates of mitigation potential.

I applaud the extensive efforts made towards developing this comprehensive DCAP for Indore district. I am proud to state that the Government of Madhya Pradesh is committed to long-term development. As a result, adopting a district plan that incorporates climate action is a key first step towards attaining state and national climate targets. I am certain that this action plan will serve as a roadmap for district-level planning efforts to integrate climate action and development.

I would like to thank my colleagues at State Knowledge Management Centre on Climate Change, Indore District Administration, Vasudha Foundation & Shakti Sustainable Energy Foundation, and appreciate the efforts of all for undertaking this study for Indore district.

(Shriman Shukla)

ACKNOWLEDGEMENTS

We would like to thank Shriman Shukla, IAS (ED, EPCO), Tanvi Sundriyal, IAS (previous ED, EPCO), Jitendra Singh Raje, IAS (previous ED, EPCO), Lokendra Thakkar (General Manager & Coordinator, EPCO), Prateek Barapatre and other team members from Environmental Planning and Coordination Organisation (EPCO), Government of Madhya Pradesh as their inputs and support have been vital in the development of the Climate Change and Environment Action Plan for Indore district.

We also extend our thanks to Manish Singh, IAS (Collector, Indore) for his inputs and appreciation of the CCEAP for Indore district.

We express our appreciation to V. Subramanian, IAS (Retd.) (former Secretary, MNRE, GoI), for sharing pearls of wisdom during the course of this research.

We extend our gratitude towards Aditi Garg, IAS (CEO, Smart Cities Indore) and her team as their suggestions and inputs have helped shape the action plan for Indore district.

We are grateful to Dr. Ashwini Kulkarni and from IITM, Pune and Dr. Koteshwar Rao Kundeti for developing the district climate profile and modelling climate change projections for the district.

We would also like to extend our thanks to participants from various academic institutions, CSOs and line departments who contributed to the development and refinement of CCEAP through their inputs during stakeholder consultations.

We are also grateful to Swati Prasad for proofreading and giving the finishing touches to the manuscript, the team at Aspire Design, New Delhi for designing the final report.

We are thankful to our colleagues from the GIS team and Energy team at Vasudha Foundation for providing their expertise to assist the research and development of the final action plan.

Last but not the least, we extend our gratitude to Shakti Sustainable Energy Foundation (SSEF), New Delhi, for supporting the endeavour and also to Shubhashis Dey and Aishwarya KS from SSEF.

CONTENTS

List of figures

List of tables

ACRONYMS

AICTSL	Atal Indore City Transport Services Ltd.
AFOLU	Agriculture, forestry and other land use
AMRUT	Atal Mission for Rejuvenation and Urban Transformations
APMC	Agricultural Produce Market Committee
ARR	Aggregate revenue requirement
ASP	Activated sludge process
AT&C	Aggregate technical and commercial losses
BAU	Business as usual
BCC	Behaviour Change Communication
BEE	Bureau of Energy Efficiency
BMW	Bio-medical waste
BOD	Biological oxygen demand
BRT	Bus Rapid Transit
C&D	Construction and demolition
CAGR	Cumulative annual growth rate
CAPEX	Capital expenditure
CAAQMS	Continuous ambient air quality monitoring system
CBWTF	Common bio-medical waste treatment facility
CETP	Common effluent treatment plant
CFA	Central Financial Assistance
CGWB	Central Ground Water Board
CHP	Combined heat and power
CPCB	Central Pollution Control Board
CPEIR	Climate Public Expenditure and Institutional Review
CPP	Captive power plant
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DG	Diesel generator
DISCOM	Distribution company
DRE	Decentralised renewable energy
EC	Electricity consumption
ECBC	Energy Conservation Building Code
EEPS	Energy efficient pumping system
EESL	Energy Efficiency Services Limited
EF	Emission factor
EPCO	Environmental Planning and Coordination Organisation
EV	Electric vehicle
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles
FMCG	Fast moving consumer goods
FSI	Forest Survey of India
FY	Financial year
GDP	Gross domestic product
GHG	Greenhouse gas
GHGPI	GHG Platform India
GIM	Green India Mission
GoMP	Government of Madhya Pradesh
GW	Gigawatt
HW	Hazardous waste
ICAP	India Cooling Action Plan
ICE	Internal combustion engine
IISS	Indian Institute of Soil Science
IMC	Indore Municipal Corporation
IMD	India Meteorological Department
IoT	Internet of things
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
IPT	Intermediate public transport
ISDCL	Indore Smart City Development Corporation Ltd.
ISRO	Indian Space Research Organisation
ISWM	Integrated solid waste management
JFM	Joint forest management
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KUSUM	Kisan Urja Suraksha evam Utthaan Mahabhiyan
KW	Kilowatt
kWh	Kilowatt hour
LED	Light emitting diode
LMV	Light motor vehicle
M&E	Monitoring and evaluation
MCF	Methane correction factor
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MI	Micro irrigation
MLD	Million litres per day
MMM	Multi-model mean
MPEDCL	Madhya Pradesh Energy Development Corporation Ltd
MPEDCL	Madhya Pradesh Energy Development Corporation Ltd.
MPEDC	Madhya Pradesh Energy Development Corporation
MPERC	Madhya Pradesh Electricity Regulatory Commission

MPIDC	Madhya Pradesh Industrial Development Corporation
MPPKVVCL	Madhya Pradesh Pashchim Kshetra Vidyut Vitaran Company Limited
MPPCB	Madhya Pradesh Pollution Control Board
MPPMCL	Madhya Pradesh Power Management Corporation Limited
MPSRTC	Madhya Pradesh State Road Transport Corporation
MPUDCL	Madhya Pradesh Urban Development Corporation Ltd.
MRF	Material recycling facility
MSME	Micro, small & medium enterprises
$MtCO_2e$	Million tonnes of carbon dioxide equivalent
MU	Million units
MW	Megawatt
NASA	National Aeronautics and Space Administration
NCAP	National Clean Air Programme
NDCs	Nationally determined contributions
NEMMP	National Electric Mobility Mission Plan
NEX-GDDP	NASA Earth Exchange Global Daily Downscaled Projections
NPK	Nitrogen, phosphorus and potassium
NRSC	National Remote Sensing Centre
NTPC	National Thermal Power Corporation
ORNL -DAAC	Oak Ridge National Laboratory Distributed Active Archive Centre
PAT	Perform, achieve and trade
PCCP	Personal care and cosmetic products
PLF	Plant load factor
PM	Particulate matter
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
PRIs	Panchayati Raj Institutions
PT	Public transport
PUC	Pollution under control
RCP	Representative concentration pathway
RE	Renewable energy
REC	Renewable energy certificate
RESCO	Renewable Energy Service Company
RO	Reverse osmosis
RPO	Renewable purchase obligation
RTS	Rooftop solar
RWA	Resident welfare association
RWH	Rainwater harvesting
RWHS	Rainwater harvesting system
SBR	Sequencing batch reactors
SDG	Sustainable Development Goals
SEZ	Special economic zone
SKMCCC	State Knowledge Management Centre on Climate Change
SLNP	Streetlight National Programme
SMB	Solar Municipal Bonds
SMNP	Smart Meter National Programme
STP	Sewage treatment plant
SUP	Singal use plastic
SW	Solid waste
SWM	Solid waste management
T&D	Transmission and Distribution
TOE	Tonnes of oil equivalent
TOU	Time of use
TPD	Tonnes per day
TPP	Thermal power plant
TSDF	(Hazardous waste) treatment, storage and disposal Facility
UDAY	Ujwal DISCOM Assurance Yojna
UJALA	Unnat Jyoti by Affordable LED for All
ULB	Urban local body
W	Watt
W2E	Waste to energy
WEEE	Waste electrical and electronic equipment
WSP	Waste stabilisation pond
WW	Wastewater
ZEV	Zero emission vehicle

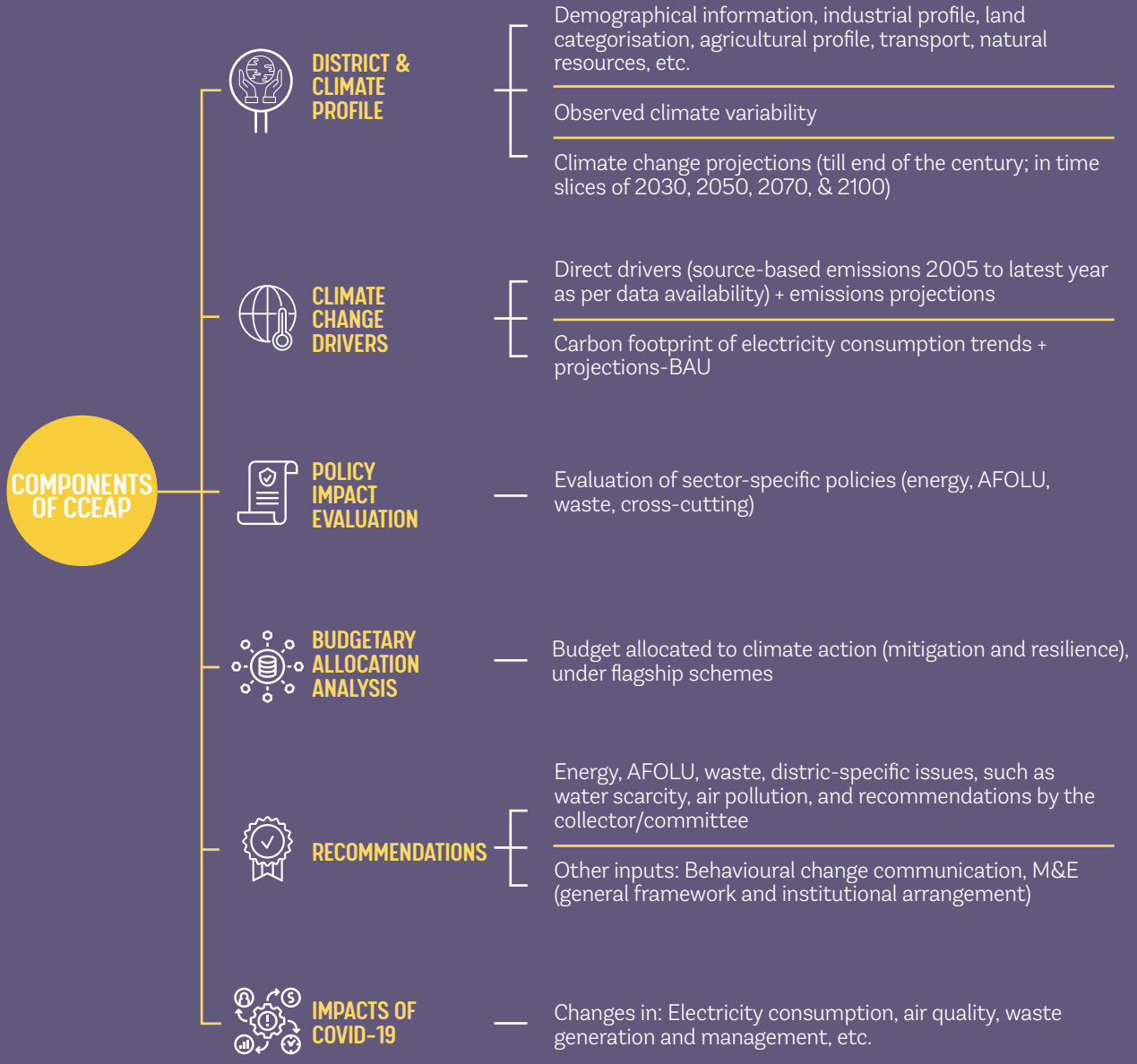
EXECUTIVE SUMMARY

This Climate Change and Environment Action Plan studies the past, present and the future of the district of Indore from both the climate and policy perspective to know where the district stands in terms of meeting India's climate commitments. Based on the findings, it evolves concrete recommendations and the way forward for the district collector and other in-line departments.

The ongoing COVID-19 pandemic, which began with a strict national lockdown, made it abundantly evident that anthropogenic activities have a far-reaching impact on the environment. On the flip side though, climate action has received a setback. A number of mitigation and adaptation-centric sectors have experienced unforeseen shifts. For instance, an overburdened health infrastructure has not been able to accommodate climate-related health issues. Considerable job losses have further diminished the adaptive capacities of the poor and vulnerable. Moreover, there has been a substantial spike in waste sector emissions with the rise in disposals of single use plastic and covid-related waste incineration.

This action plan, therefore, takes a holistic view of the current policies and recommends steps that need to be taken in the short-, medium- and long-term to bring about the necessary changes that are in compliance with India's overall climate goals and commitments.

The key components of this action plan are summarised in the following chart:



CLIMATE PROFILE AND PROJECTIONS

In this section, the historical data and projected changes in rainfall and temperature for Indore district were analysed using IMD and NASA's NEX-GDDP datasets following the multi-modal mean (MMM) approach.

- **Warm days have increased by 9 percent:** The maximum temperatures have shown a significantly increasing trend during summer, with the peak reaching up to 44°C in May. Mean monthly maximum temperature ranges from 35°C to 41°C during the season. The mean percentages of warm days have increased by 9 percent. The maximum temperatures may rise by 1°C to 2.5°C under RCP4.5 and 1.5°C to 4.5°C under RCP8.5. The percentage of warm days are projected to increase in the future by more than 70 percent of the current situation.
- **Cold days are decreasing:** Winter temperatures are also increasing and the number of cold days is showing a decreasing trend. The minimum temperatures project an increasing trend and cold days may decrease drastically in all the epochs under changing climatic conditions.
- **Rainy days are projected to increase:** The monsoon rainfall does not show any significant trend. The mean monsoon seasonal rainfall in the district is around 810 mm. The number of rainy days varies from 9 to 14 in the monsoon months. The variability in rainy days is higher and shows a slight decreasing trend in monsoon months during the period of 1951 to 2018. There may be an increase in precipitation of 7 to 21 percent under RCP4.5 and 16 to 42 percent under RCP8.5 emission scenarios compared to historical data between near-term (2030s) and end-century (2090s). The number of rainy days is projected to increase during the monsoon season.

SECTORAL GREENHOUSE GAS EMISSIONS PROFILE: CLIMATE CHANGE DRIVERS

- **Greenhouse gas have increased nearly three-folds:** Between 2005 and 2019, the total greenhouse gas (GHG) emissions of Indore district increased by 291 percent (from 0.65 million tonnes CO_2e in 2005 to 2.54 million tonnes CO_2e in 2019) with a CAGR of 10.23 percent. These estimates represent GHG emissions from 12 categories covering three major sectors – energy; agriculture, forestry and other land use (AFOLU); and waste.
- **Energy sector is the highest contributor of emissions:** Energy sector (direct fuel combustion in transport, agriculture, residential categories etc.) is the highest contributor of total economy-wide emissions. Although energy emissions of Indore district increased with a CAGR of 5.12 percent, its share has decreased from 88 percent in 2005 to 73 percent in 2019 due to increase in AFOLU emissions. There are no emissions from the industrial product use and processes (IPPU) sector because Indore district does not have any large-scale industries that fall under the IPPU industries as per the IPCC guidelines. However, the energy used in industries and the corresponding emissions are reported in the energy sector.
- **From a net sink in 2011, AFOLU sector is now witnessing high GHG emissions:** Until 2011, AFOLU was a net sink. Emissions from AFOLU peaked in 2015 and then started declining.
- **Share of waste sector emissions has dropped:** Waste sector emissions have grown at a CAGR of 4.52 percent. However, its contribution to total emissions has dropped from 12 percent (in 2005) to 9 percent (in 2019).

ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE

Several major national/state level policies and programmes of energy, AFOLU and waste sector were evaluated for their climate mitigation potential.

- **Power and energy:** For this sector 12 policies/programmes were evaluated (UDAY/IPDS/R-APDRP scheme and BRTS are the biggest contributors to GHG emissions mitigation)
  - Policies related to clean energy generation mitigated 24,326 tCO_2e emissions, annually.
  - Policies pertaining to energy-efficient buildings and processes helped to avoid 27,73,714 tCO_2e.
  - Transportation interventions have led to an emission avoidance of 4,04,000 tCO_2e.
- **AFOLU and cross-cutting:** Ten policies were assessed.
  - Forestry policies alone led to a mitigation of 59,502 tCO_2e.[1]
  - Policies pertaining to livestock proved to be beneficial for climate action by avoiding 5,859 tCO_2e.
  - GHG impact of agricultural policies could not be computed due to lack of availability of required information/data.

1 Data for Gair Vanbhoomi Par Vriksharopan of Indore was not available.

- The crosscutting sector: The National Mission on Micro Irrigation resulted in avoiding 1,407 tonnes of CO_2e emissions (from reduction in use of urea and reduction in energy consumption). The Pradhan Mantri Ujjwala Yojana has helped mitigate 9,39,397 tonnes of CO_2 e (scenario 1) and 82,562 tonnes of CO_2e. (scenario 2).

- **Waste:** Sixteen policies were assessed.
  - Policies pertaining to sanitation added 1,13,009 tCO_2e emissions
  - Composting as a part of solid waste management practices has mitigated 126,628 tCO_2e.
  - Domestic wastewater treatment interventions have led to 78,405 tCO_2e. emissions.

BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION

This section analyses the district expenditure to estimate spending on climate action. However, the district budget for Indore was not available and the following flagship schemes were analysed for the same. A total of 39 flagship schemes were reviewed to identify those with climate resilience and mitigation relevance. Of these, based on availability of information across districts as well as relevance to climate actions, five schemes were selected for further analysis.

Table 1: Summary of flagship schemes budgetary analysis for Indore district

Scheme selected	Climate relevant activities	Year	Total allocation to district under scheme (₹ lakh)	Allocation to climate action (₹ lakh)	% of total scheme budget for climate action at district level*
MGNREGS	Eleven out of 17 activities identified as climate relevant – drought proofing, fisheries, flood control and protection, land development, micro-irrigation, renovation of traditional water bodies, rural connectivity, drinking water, sanitation, water conservation and water harvesting	2018-19	3,952.64	742.64	19
		2019-20	3,834.24	1,612.20	42
PMKSY	Micro-irrigation activities	2016-17	69.00	47.61	69
		2019-20	560.00	386.40	
GIM	Enhancing forest cover, ecosystem restoration, agro-forestry, social forestry, wetland restoration, promoting alternative fuels	2018-19	5.37	5.37	100
		2019-20	30.67	30.67	
AMRUT	Water supply, sewage and septage management, urban transport, drainage, green spaces	2015-16	246.71	129.36	54.5
		2016-17	305.53	160.82	
		2017-20	365.25	191.51	
DDUGJY + Saubhagya	New and upgradation of substations, LT lines, feeder segregation, consumer metering, DTR metering etc	Up to April 2020	9,131.00	4,565.00	50

*Percentage has been attributed by using Climate Public Expenditure and Institutional Review (CPEIR) methodology of UNDP

RECOMMENDATIONS

The action plan provides comprehensive, sector-wise recommendations from a climate perspective. The aim is to align the district with India's climate commitments through this Climate Change and Environment Action Plan (CCEAP).

The recommendations factor-in state/district vision documents and development plans. They also list the current policies, programmes and schemes and identify concerned departments that can help streamline the actions. This section also provides information on SDGs and other co-benefits that will be addressed through these recommendations.

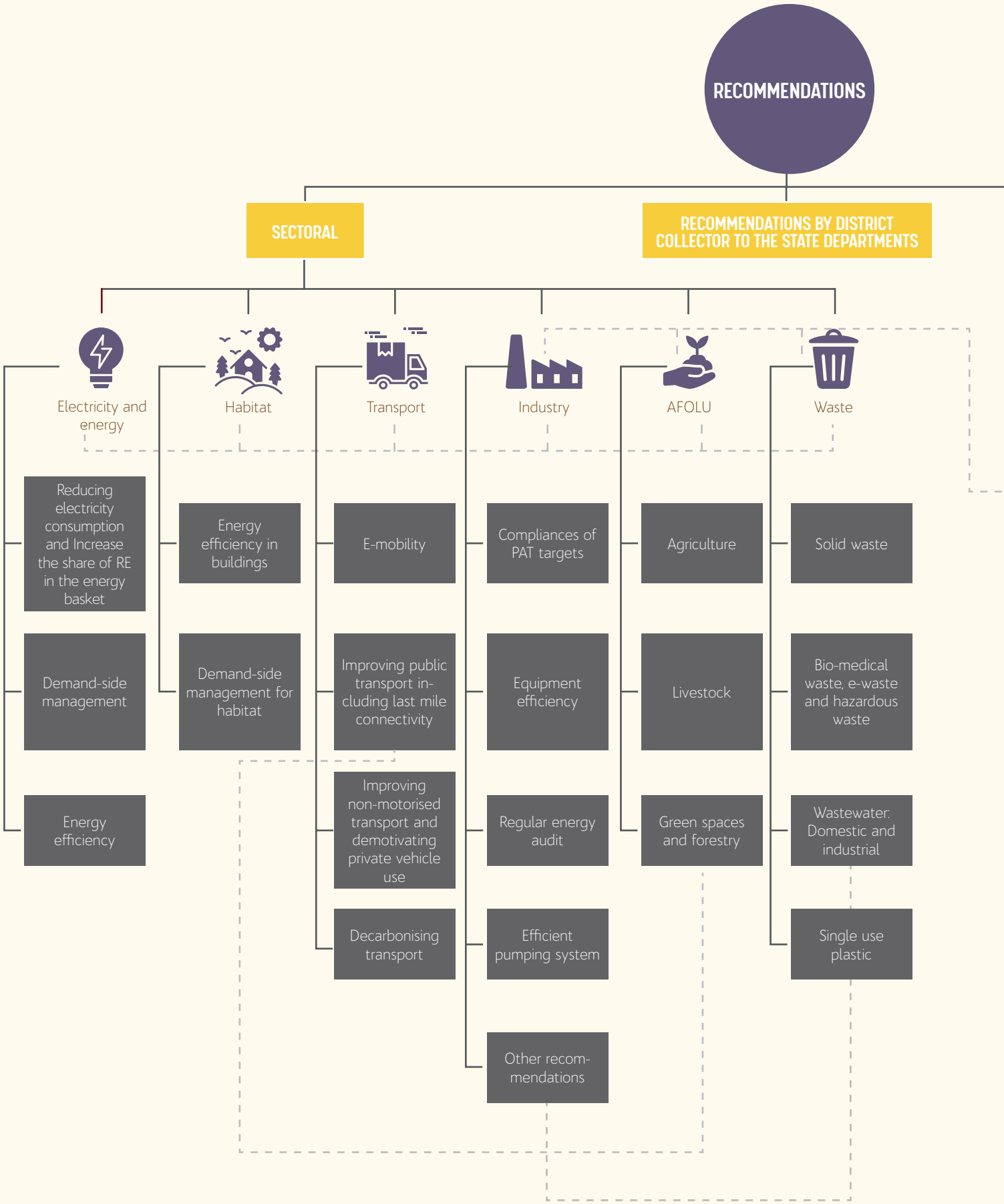
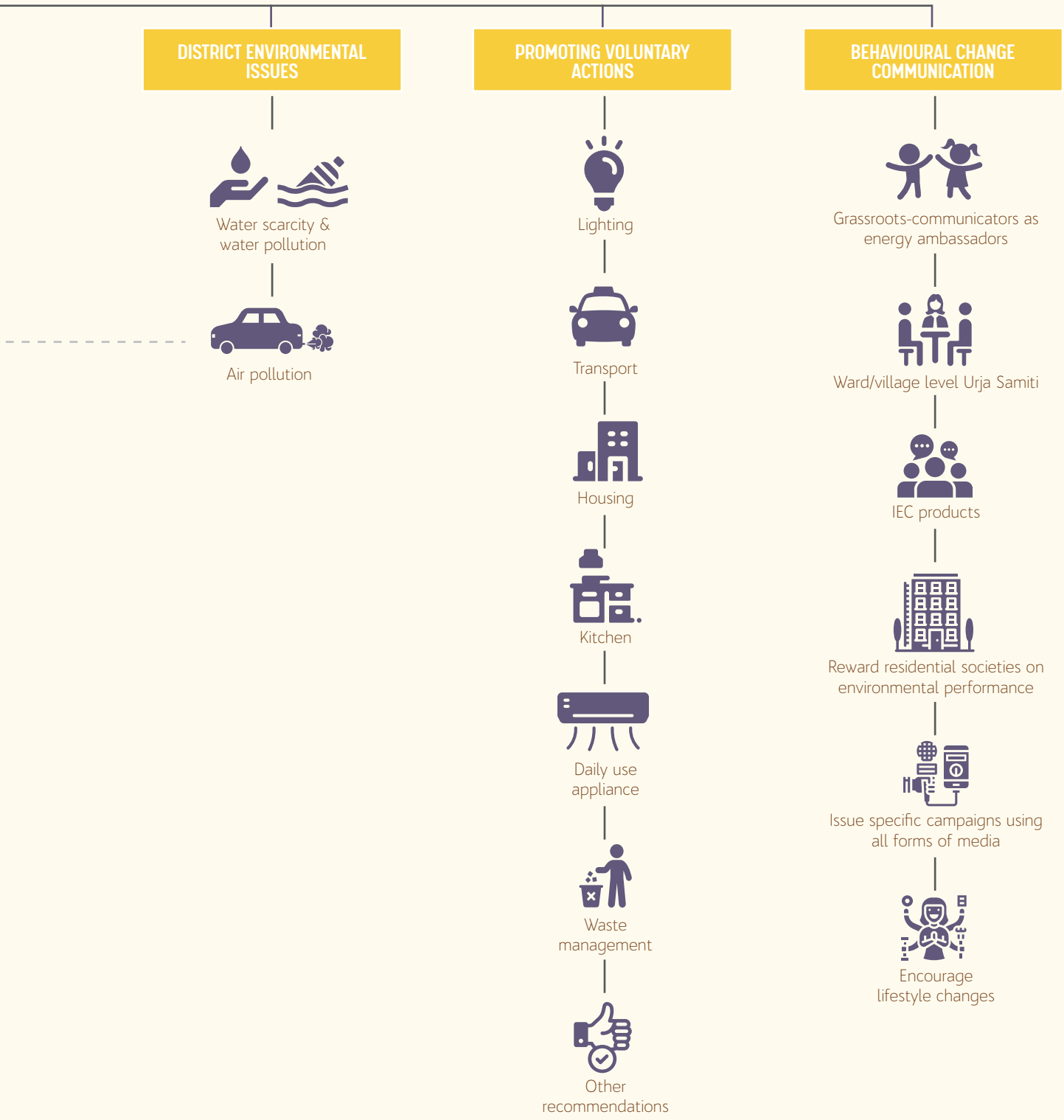


Figure 1 Recommendations for CCEAP Indore


DISTRICT ENVIRONMENTAL ISSUES
PROMOTING VOLUNTARY ACTIONS
BEHAVIOURAL CHANGE COMMUNICATION
Water scarcity & water pollution
Air pollution
Lighting
Transport
Housing
Kitchen
Daily use appliance
Waste management
Other recommendations
Grassroots-communicators as energy ambassadors
Ward/village level Urja Samiti
IEC products
Reward residential societies on environmental performance
Issue specific campaigns using all forms of media
Encourage lifestyle changes
: Interlinkages across sectors and sub-sectors (cross-cutting aspects)

Overall, the mitigation actions suggested in the recommendations can help mitigate 6.45 Mt CO2e per annum. The sectoral breakdown of the same is as following:

GHG mitigation potential of CCEAP recommendations (tCO_2e)

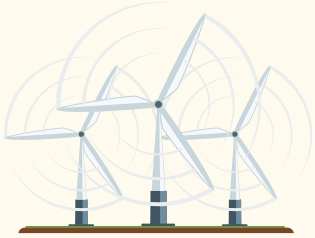
Energy
51,23,069

AFOLU
12,31,468

Waste
99,613

Here are some in-brief, sector-wise recommendations:

Power and energy



Though the energy sector is crucial to achieving India's growth ambitions, it is also responsible for around 70 percent of the country's annual GHG emissions. This calls for a paradigm shift in the energy sector.

Therefore, the action plan recommends (a) increasing the share of RE generation in the district by advancing on-grid and off-grid solar rooftop, ground-mounted installations and other RE installations; (b) encouraging faster penetration of energy-efficient and star-labelled fixtures and upgrading existing power-grid infrastructure to advanced metering infrastructure (in public, institutional and commercial setups); (c) promoting energy efficiency in the residential sector by encouraging the incorporation of ECBC in the building bye-laws, implementation of India Cooling Action Plan, 2018, etc.; and (d) promoting energy conservation in the industrial sector by introducing measures such as a "cap and trade" system for MSMEs at the district level.

Transport

Being one of the fastest growing sectors in India, transport contributes 12 percent of India's total GHG emissions. The action plan recommends (a) promoting e-mobility through awareness, increase of e-vehicles' modal share, transition of public transport (PT) and intermediate public transport (IPT) to electric-powered or hybrid vehicles, developing widespread charging infrastructure, incentivising e-vehicle owners, etc.; (b) ensuring last-mile connectivity and promoting increased use of PT and IPT; (c) augmenting non-motorised transport through dedicated cycle lanes; and (d) improving traffic flow.

AFOLU

For agriculture, forestry and other land use (AFOLU) sector, it's important to promote climate-conscious practices that do not have an adverse impact on the ecosystem, biodiversity and natural resource dependent communities. Our recommendations include: (a) promoting the use of organic fertilisers, solar pumps and practices such as micro-irrigation and alternative ways to manage crop-residue under agriculture; (b) having a good mix of high-yield cross-breed cattle and indigenous cattle, and encouraging the use of good quality fodder to bring down enteric fermentation emissions; and (c) maintaining the forest area and the tree cover of the Indore district through strict M&E, afforestation in fallow and wasteland, use of alternative funding like CSR, adoption of Miyawaki urban forestry and study on suitability of plantation sites/species, etc. The action plan also recommends involvement of regional agriculture universities to initiate research on high yielding, drought- and temperature-resilient genotypes for various crops, among other measures.

Waste

With the waste sector being one of the biggest contributor of methane emissions globally, major recommendations revolve around reducing landfill disposal of waste and managing wastewater to reduce GHG emissions from them through measures such as: (a) reducing waste at source; (b) proper segregation, collection and channelisation of different categories of waste (including bio-medical waste and e-waste) for recycling and treatment; (c) 100 percent conversion of organic waste to compost and gas management of composting units; (d) recycling, recovery and reuse of 100 percent inert waste (plastic, construction waste, etc); and (e) setting up of centralised aerobic wastewater treatment plants with closed sewer networks and sludge removal facility.

Given the unique environmental issues of the district, the action plan also recommends:

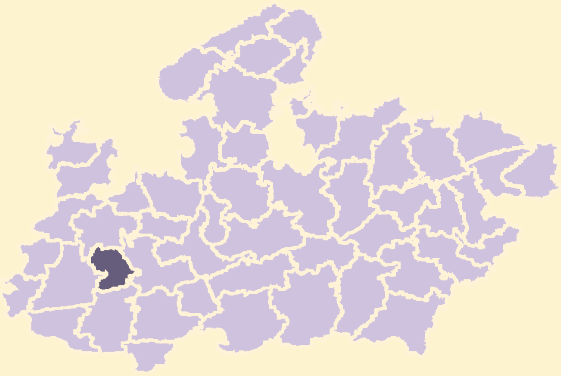
1. Adopting a holistic approach to water conservation and wastewater management, including conservation techniques such as rainwater harvesting, net zero water infrastructure, minimising losses in water supply, installing water-efficient fittings, water metering and adoption of inclusive and sustainable water governance.
2. Developing extensive infrastructure to monitor air pollution and suggestions on interventions for preventive measures.

COVID-19 IMPACT

This section presents an assessment of how the COVID-19 pandemic has impacted various sectors and the developmental measures. During the national lockdown in 2020, the total energy demand in India went down considerably. However, in Madhya Pradesh, power demand went up by 6.4 percent due to increase in consumption by the agricultural sector.

The pandemic has only underscored the need to increase focus on renewable energy and strengthen its integration into the grid. Indore district needs to increase implementation of RE generation through solar rooftops, biogas, solar pumps for agriculture and water supply.

Overall, the pandemic resulted in significant reduction in air pollution due to reduced transport and industrial activities during the lockdown and unlock periods. However, the most impacted sector was waste management with single-use plastic waste and bio-medical waste from both households and healthcare sector increasing manifold, leading to increased incineration, landfilling and single-use product consumption.



Madhya Pradesh

DISTRICT PROFILE

Aerial view of commercial city, Indore

1. DISTRICT PROFILE

Indore, situated in western Madhya Pradesh at the heart of the Malwa plateau and surrounded by Vindhya ranges, is an important commercial district of the state. While the political boundaries are Ujjain district in the north, West Nimar district in the south, Dewas district in the northeast and Dhar district in the west, Indore is physically bound by Kshipra river in the northeast, Chambal in the west and the water-parting line of the Vindhyas in the south between the Karam and the Choral rivers (tributaries of Narmada river). Thus, the drainage basin of the district lies partly in the Chambal sub-basin of the Ganga basin (75 percent) and partly in Narmada (25 percent). Administrative headquarter of the districts is Indore city, administered by the Indore Municipal Corporation. In terms of population, Indore is the largest city of Madhya Pradesh.

1.1 Key statistics

Table 2: District profile of Indore

General characteristics of the district (Census of India, 2011)			
Location	West-south Madhya Pradesh, west-central India		
Latitude	22.20° & 23.05° North	**Area**	3,898 sq km
Longitude	75.26° & 6.14° East	**Elevation**	553 msl
Agro-climatic zone (Department of Agricutlure, 2012)			
Agro-ecological sub region (ICAR)	Western Malwa plateau, semi-arid medium to deep vertisols		
Agro-climatic zone (Planning Commission)	Central plateau (IX)		
Agro climatic zone (NARP)	Malwa plateau agro-climatic zone		
Administrative units (District Indore, ND)			
Tehsil	10	**Gram panchayat**	335
Constituency	Parliament: 1 Assembly: 9	**Villages**	677
		ULBs	9 (municipal corporation: 1; municipality: 8)
Demography (Census of India, 2011)			
Population (total)	32,76,697	**Population density**	841/sq km
Population (urban)	24,27,709	**Household**	6,15,334
Population (rural)	8,48,988	**% urbanisation**	Population: 74% Household: 75%
Population growth	32.9%	**Women headed household**	56,854
Land use pattern (area: hectare) (DACNET, 2018)			
Area under non-agricultural uses	40,054	**Fallow lands other than current fallows**	4,466
Barren and unculturable land	11,401	**Current fallow**	2,747
Permanent pasture and other grazing land	19,023	**Net area sown**	2,50,635
Land under misc. tree crops and groves not included in net area sown	75	**Cropped area**	4,93,222
Culturable waste land	2,488	**Area sown more than once**	2,42,587

Agriculture profile (agriculture, 2012)					
Major crop season	Kharif (rainfed/irrigated) and rabi (rainfed/irrigated)				
Major field crops (Farmer Welfare & Agriculture Development Corporation, 2019)	Food grain: wheat, bajra, jowar, maize, pulses (tur, urad, mung) Oilseeds: soybean, gram				
Soil type	Deep soil (60.9%), shallow soil (33.4 %). Common type: Black soil				
Industrial profile (MSME, 2016)					
Registered industrial units	14,075	**Registered medium and large unit**	21	**No. of industrial areas**	07

Table 3: Indore vs. Madhya Pradesh: A comparative profile

Particular	Indore district	Madhya Pradesh	% contribution
Total population (2011)	32,76,697	7,26,26,809	4.5%
Urban population (2011)	24,27,709	2,00,69,405	12%
Percentage of urban population	74%	27.6%	Almost three times higher than the state
Geographical area (sq. km)	3,898	3,08,252	1.26%
Forest cover (sq. km) (FSI, 2019)	678.73 (Very dense: 0; moderately dense: 349.08; open forest: 329.65)	77,482 (Very dense: 6,676; medium dense: 34,341; open forest: 36,465)	0.87% (No dense forest in the district)
Per capita forest cover (ha/ person)	0.02	0.1	One-fifth of the state
Total registered vehicles	*Data gap	6,88,64,960	
Total rice production (in '000 tonnes) 2018-19	Insignificant	7,858	Insignificant
Installed capacity of electricity generation (conventional, in MW)	0	22,502.5	0%
Major types of industries (MSME, 2017)	Agro & food processing, milk and milk products, chemicals & pharma, textile, etc.	Mineral production, mineral based industries, such as cement, thermal power, coal ossuary, ceramic, hydrated lime, asbestos, clay, marble, granite products, etc.	--
Industrial land acquired and developed (hectare) under DTIC (MSME, 2016)	576.45 & 415.02	7,340.37 & 4,185	7.8 % & 9.9 %
Human Development Index (HDI) (UNDP, 2008)	0.710	0.375	Almost two times higher than the state

1.2. Power and energy sector

Indore district gets its electricity from the state's west-zone DISCOM – Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited (MPPKVVCL), which in turn procures electricity from Madhya Pradesh Power Management Company Limited (MPPMCL). Agricultural is the predominant electricity consuming sector in the district, followed by industrial, domestic, and commercial sectors. The overall electricity consumption increased at a CAGR of 8.38 percent between 2007 and 2019, with the consumption mix remaining unchanged for that period (MPERC, 2021).

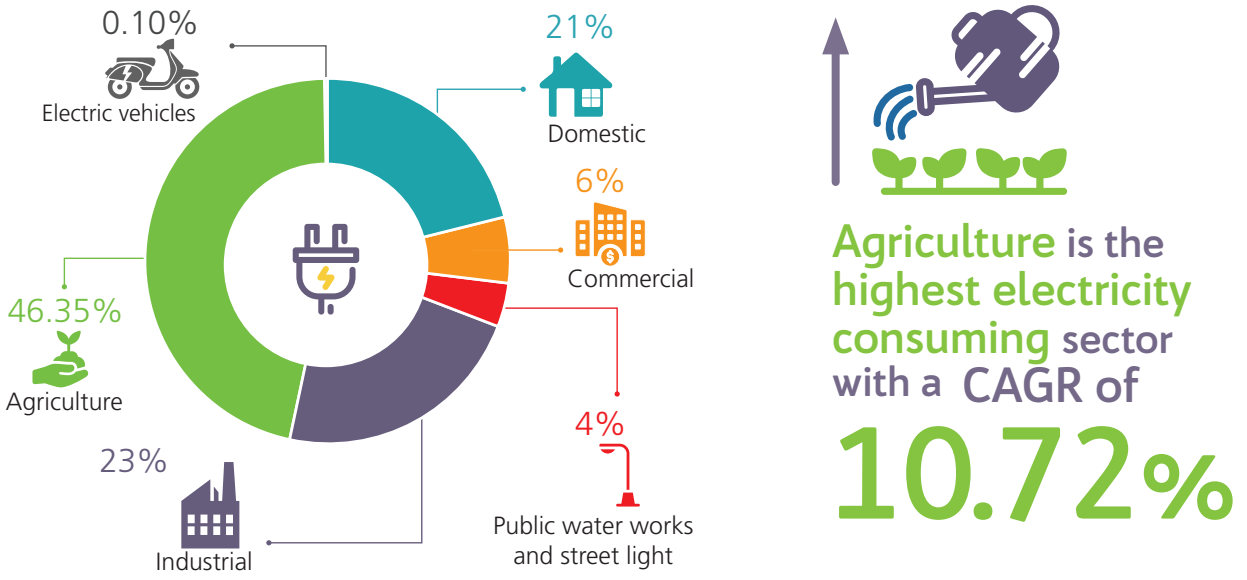


Figure 2: Consumer-wise electricity consumption in Indore (2019)

For FY 2019-20, MPPMCL purchased 90,858 MUs of electricity, of which about 79 percent came from coal, followed by renewable sources, hydel, nuclear, and gas-based generation, illustrated in Figure 3 (MPERC, 2021; Vasudha Power Info Hub, 2021). Out of the total renewable energy (RE) purchased, non-solar sources (wind, small hydro, biomass and waste to energy) contributed to around 56 percent (MPERC, 2021) (Vasudha Power Info Hub, 2021).

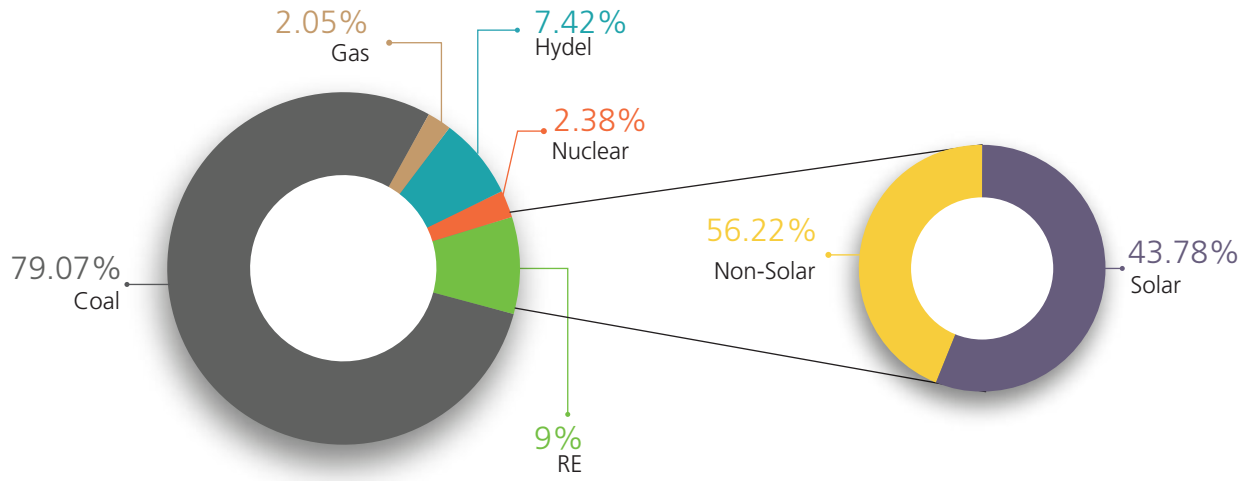


Figure 3: Electricity procurement mix of MPPMCL (2019-20)

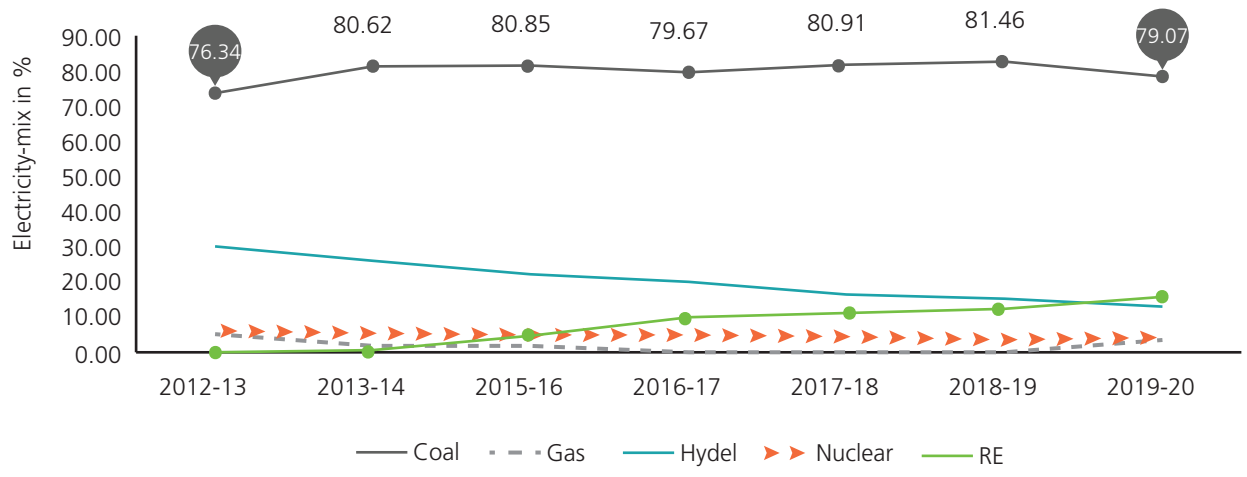
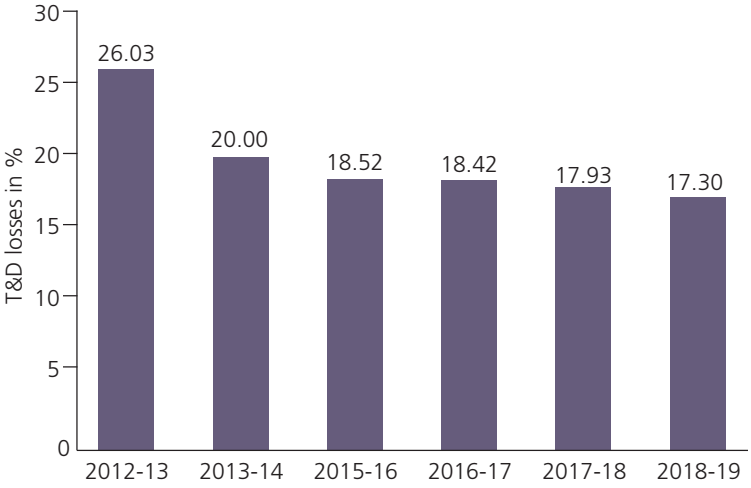


Figure 4: Electricity procurement mix of MPPMCL over the years



T&D losses for MPMKVVCL is slightly lower than the national average and has scope to improve.

Figure 5: T&D losses (in %) for MPPKVVCL over the years

The transmission and distribution losses (Figure 5), for MPPKVVCL were 18.42 percent during FY 2016-17, (MPERC, 2017) a little less than the national average of 21.42 percent (Central Electricity Authority, 2020). For FY 2018-19, the T&D losses of MPPKVVCL stood at 17.30 percent (MPERC, 2020).

Information on category-wise electricity consumption (EC)[2] of Indore district and the projections of electricity consumption (based on long-term and short-term CAGR calculations i.e., CAGR between 2007-19 and 2015-19 respectively) are depicted in Figure 6 and 7.

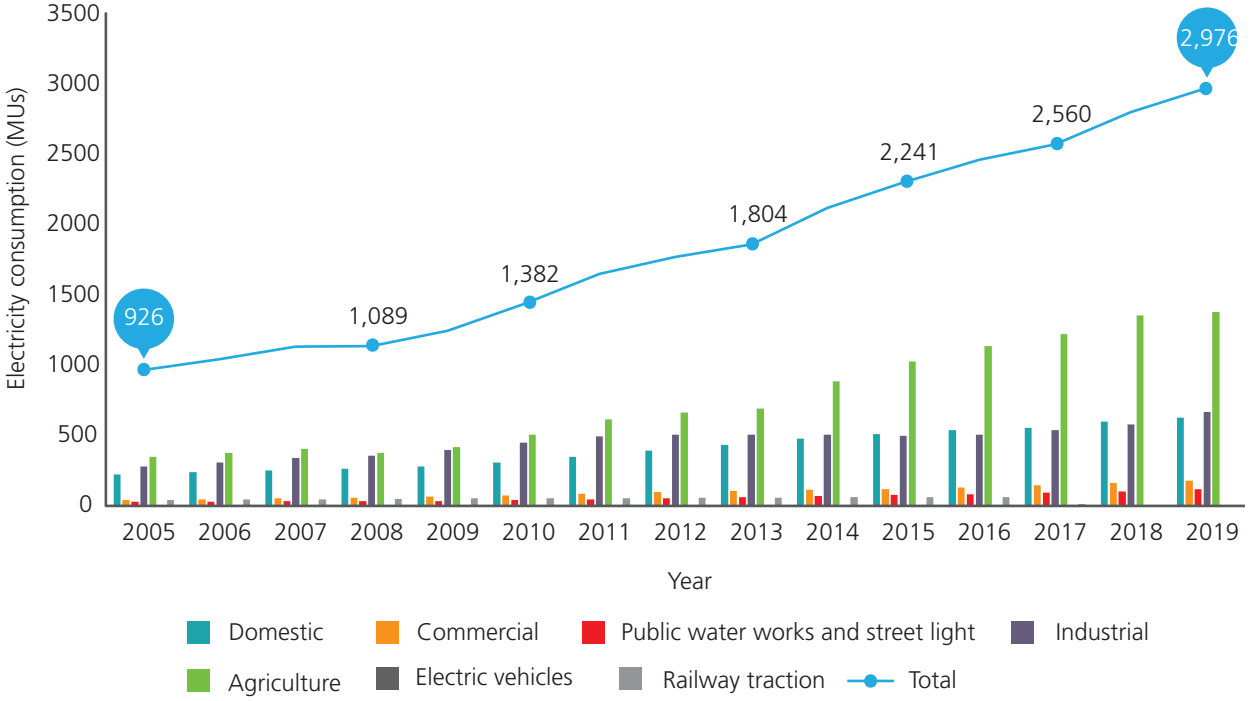


Figure 6: Category-wise electricity consumption in Indore district over the years (MUs)

2 Electricity is supplied in the district by MPPKVVCL Discom.

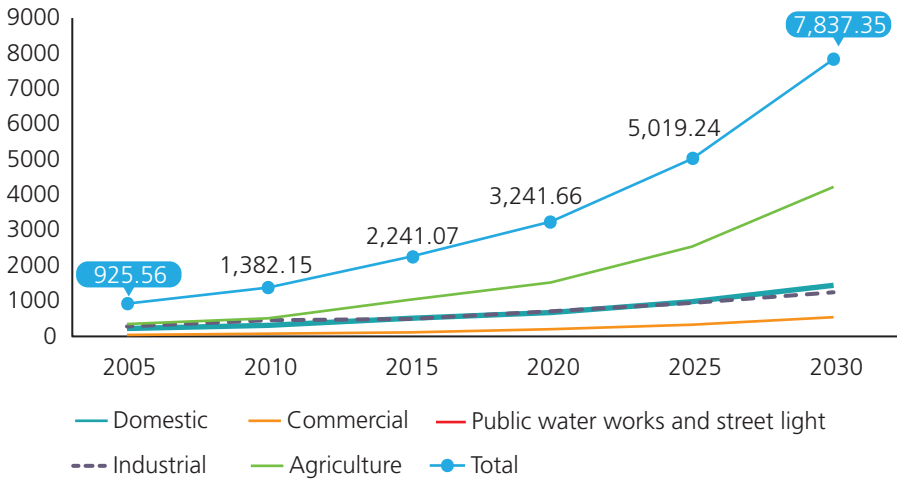
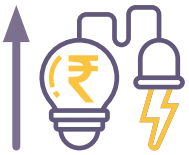
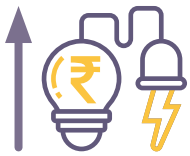


Figure 7: Projections of electricity consumption (long-term; CAGR between 2007-19)



Indore's electricity consumption is projected to increase by **746%** in 2030 w.r.t. 2007-19 CAGR.



Considering 2015-19 CAGR, the district is projected to see a **609 %** jump in its electricity consumption.

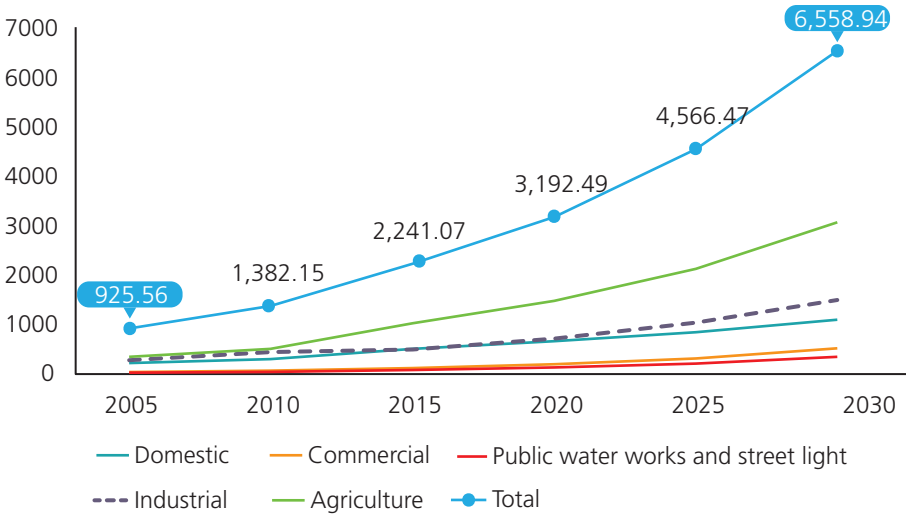


Figure 8: Projections of electricity consumption (short-term; CAGR between 2015-19)

1.3. Transport and related infrastructure

The city has been developed along two national highways and one state highway. These highways account for more than 50 percent of incoming and outgoing traffic of the city. The total road network length in Indore is nearly 1,710 km of which main roads cover 234 km, intermediate roads cover 211 km and city roads cover 936 km. However, only 60 percent of the total road length in Indore is paved. The roads also have insufficient carriageway width. Further, essential road facilities such as medians, footpaths, etc. are non-existent.

The public transport system in the city is monitored and maintained by Atal Indore City Transport Services Limited (AICTSL). The public transport infrastructure in Indore consists of AICTSL City Buses, BRTS, intercity buses, privately-operated buses and midi buses, taxis, and auto rickshaws. As per the Comprehensive Mobility Plan of Indore, 2010, the modal share of public transport was 19 percent. The AICTSL procured 40 electric buses for the city transport fleet in 2019. Further, there are approximately 1,800 electric rickshaws plying on the city roads.

Private vehicles are the preferred mode in the city as the connectivity of public and intermediate public transport is limited. Bicycle and bike rental options are available; however, their popularity is low. Further, non-motorised transport infrastructure also needs an upgrade to make it convenient and affordable.

Table 4 lists the total registered vehicles in Indore city.

Table 4: Total registered motor vehicles in Indore (2015-16) (MoRTH, 2016)

Mode	Vehicle type	Number
Public transport	Omni buses	29,170
	Bus	225
	Electric bus	40
	Midi bus	65
IPT	Minibus	NA
	Taxi/cab	6,365
	Auto-rickshaw	21,437
Private	Two-wheeler	13,52,243
	Four-wheeler	2,65,143

Indore supports **4.5%** of the state population with just **1.26%** of the state area

1.4. Habitat (urban and rural)

Indore has 74.09 percent of its population residing in urban areas, about three times higher than the state average (Census of India, 2011). With a geographical area of 1.26 percent of the state, the district supports 4.5 percent of the state population and 12 percent of the state urban population indicating a huge pressure on its resources and infrastructure. A highly urbanised district, Indore has the second highest population density in Madhya Pradesh (841/sq km), which is around 3.5 times that of the state[3] average and more than twice the national[4] average. Indore Municipal Corporation is the apex urban local body in the district. The increase in urban sprawl of Indore city is summarised in Figure 9.

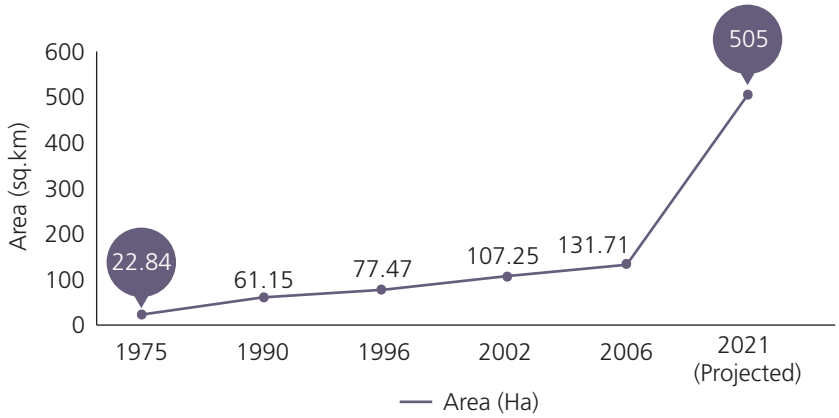


Figure 9: Urban sprawl (Directorate of Town and Country Planning, MP) in Indore city over the years

1.5. Industrial profile

Indore has a total of seven industrial areas with 2,094 units in production, covering an area of 576 hectares. The district also has one of the seven Audyogik Kendra Vikas Nigam (AKVN) headquarters set up by the state government for the 51 districts of MP.

Indore district has a total of 14,075 registered industry units, of which 21 are medium and large category. There are 12 large-scale industries/ public sector undertakings in the district, and emissions from some of them fall in the industrial processes and product use (IPPU) category.

Further details about industrial units in the district are available in Annexure 1.1 and 1.2.

1.6. Natural resources

Indore district lies in the Malwa plateau agro-climatic zone in the western Malwa plateau region. The district has a net sown area of 2,64,200 hectares with a cropping intensity of 165.1 percent. The net irrigated area is 1,76,700 hectares while 2,54,900 hectares of agricultural land is rain-fed. Major crops are soybean, maize, sorghum, wheat, chickpea, mangoes, guavas, potatoes, onions, etc.

3 236/sq. km

4 382/sq. km

Total livestock population of Indore is 2,66,727 (Livestock Census, 2012). There are 12 veterinary hospitals and 28 veterinary dispensaries in the district. Further, the district has 10,37,800 poultry animals. Inland fishing activities are spread over 2,267 hectares. There are 21 farmer-owned ponds, 41 reservoirs and 244 village tanks being used for fishing activities with a yield of 1 tonne/hectare *(Department of Agriculture, Cooperation and Farmer Welfare, 2012)*.

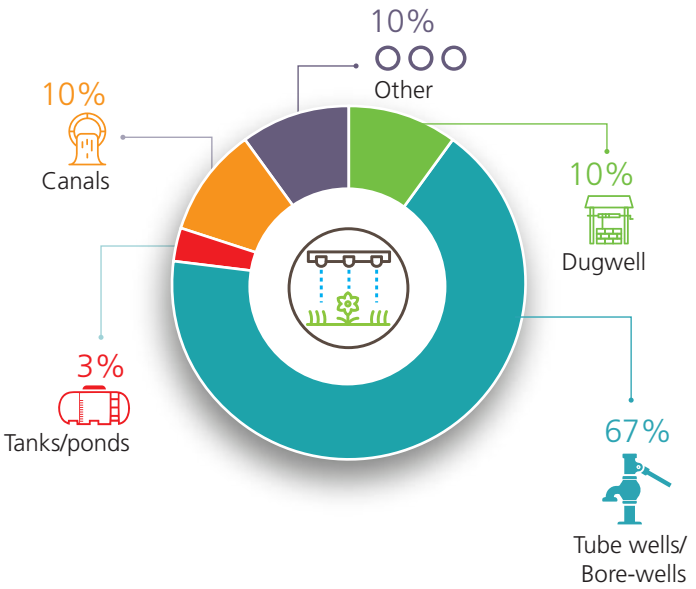


Figure 10: Percentage share of irrigation type in total irrigated area

Only 17.41 percent of the district's geographical area comprises of forest cover, which is much below the state average of 25 percent (Forest Survey of India, 2019). As per the latest assessment by FSI, Indore has maintained its forest cover at 67,900 hectares. The details of forest cover (by forest type) are given in Table 2.

Indore has 26 wetlands, covering an area of 8,503 hectares, comprising a little more than 2 percent of the district's geographical area. The major wetland sites in and around the district include Yeshwant Sagar, Bilawali, Kishanpura and Jhalaria among others. These wetlands are critical for balancing the local ecosystem as well as important sites not only for fisheries but also for nature education, birding, etc. (ISRO, 2011).

Groundwater status is an issue of concern. The extent of groundwater extraction is alarmingly high – at 104 percent – putting the district in the over-exploited category. A CGWB study indicated both rise and decline in groundwater level in different parts of the district. In general, a rise in water level is in the range of 15.88 to 26.44 cm/year, whereas the decline is in the range of 10.06 to 12.14 cm/year.

Table 5: Indore district Livestock population (2012)[5]

Livestock Category	Number
Cattle	1,77,584
Buffalo	1,55,290
Sheep	629
Goat	96,272
Horses and Ponies	715
Donkeys and Mules	81
Elephants	74
Poultry	61,023

As per IWRIS data,[6] the pre-monsoon groundwater level data of 21 stations located in four tehsils/blocks of Indore district indicates a decline in the groundwater level at a few places, particularly in the western Deepalpur and Mhow tehsils as well as in Indore city (Figure 11). This trend indicates high groundwater extraction rate and lower recharge rate. A similar comparison of post-monsoon groundwater levels indicates that the level is increasing in post-monsoon season due to rainfall (Figure 12). In case of rain deficiency, the scenario could change as pre-monsoon ground water level is already declining.

5 Department of Animal Husbandry: https://doah.gujarat.gov.in/Images/animalhusbandary/pdf/Bulletin-2017-18.pdf

6 India Water Resources Information System (IWRIS) by the Ministry of Jal Shakti provides single window solution for all water resources data and information in a standardised national GIS framework (Weblink: https://indiawris.gov.in/wris/#/about).

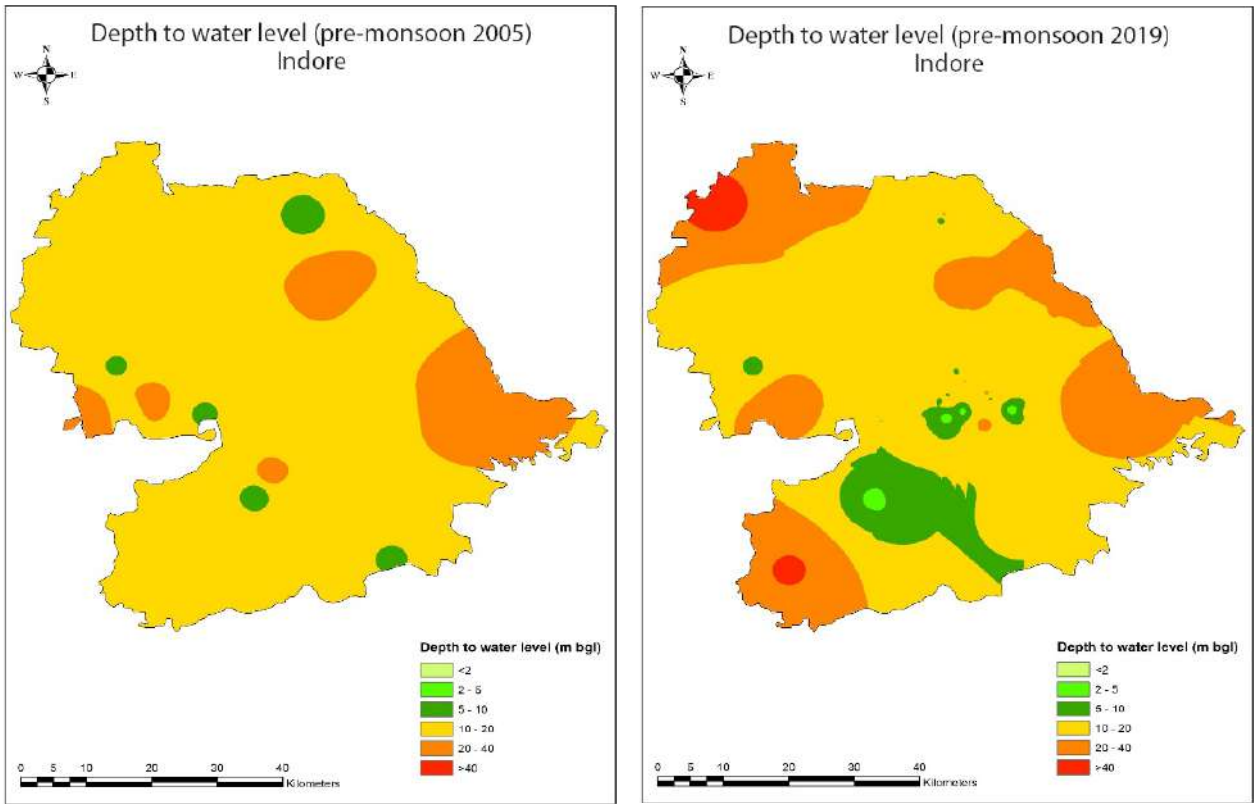


Figure 11: Pre-monsoon groundwater levels in Indore district a) 2005 and b) 2019

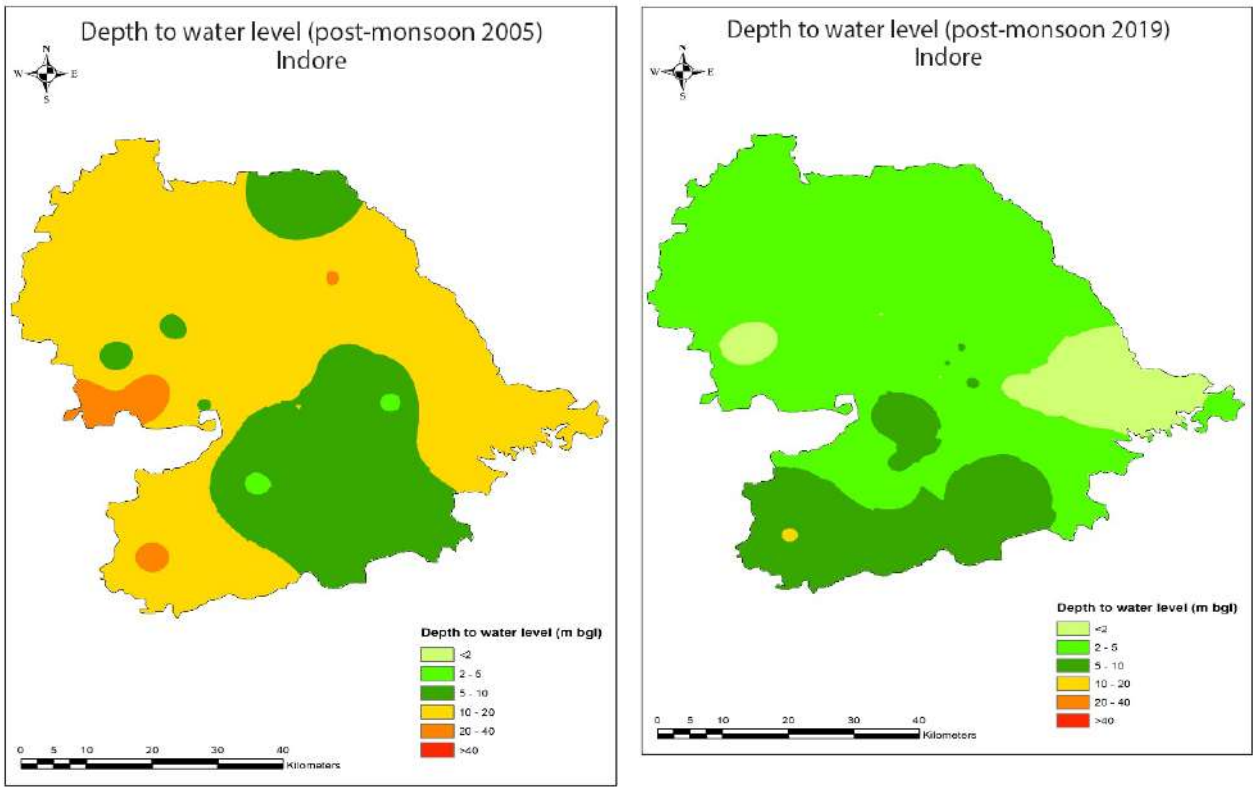
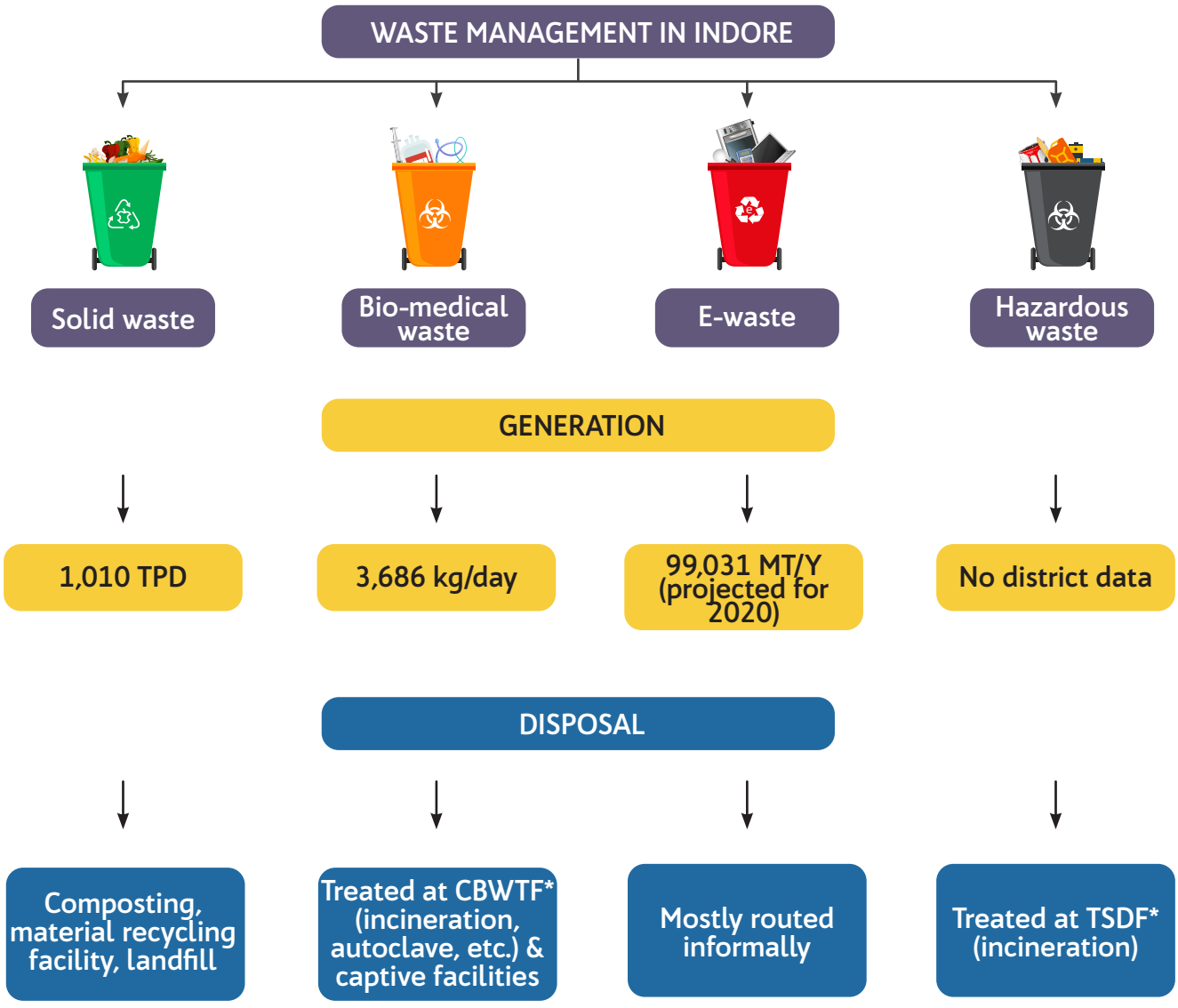


Figure 12: Post-monsoon groundwater levels in Indore district a) 2005 and b) 2019

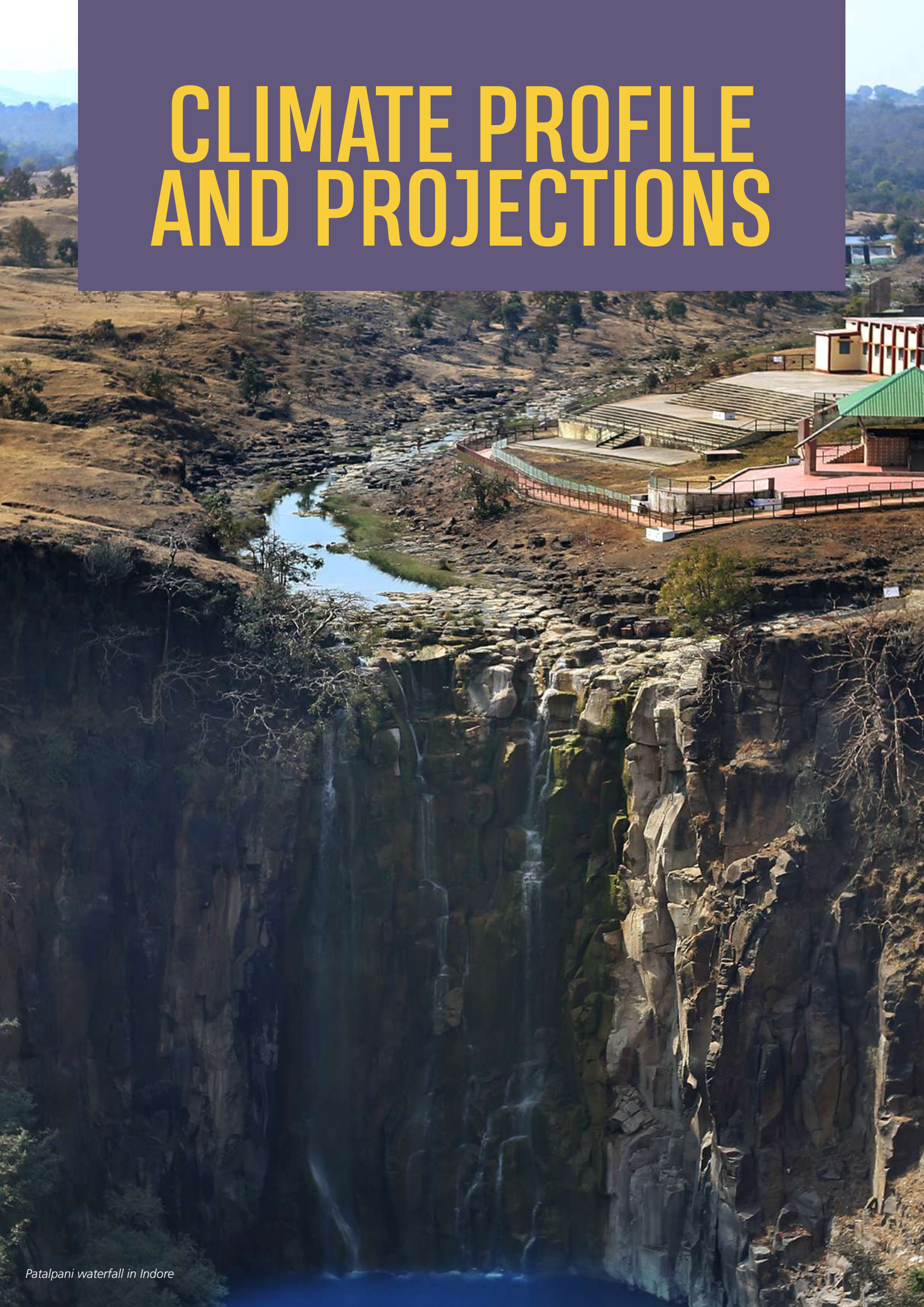
1.7. Waste sector

Indore was ranked the cleanest city in India by 'Swachh Survekshan' (a cleanliness, hygiene and sanitation survey) for four consecutive years from 2017 to 2020. In 2016, it was declared the first 'open defecation free' (ODF) district in Madhya Pradesh (MoHUA, Swachh Survekshan 2020). The state has adopted a cluster-based model of ULBs for integrated solid waste management (ISWM). Indore ISWM cluster has eight ULBs – Betma, Depalpur, Hatod, Indore, Manpur, Mhowgaon, Rau and Runji-Gautampura. Maintenance of the waste records too are at the cluster level and not by the districts. Devguradiya, the common landfill site for the cluster, is 20-23 km away from Indore city (MPPCB, 2018). Though not fully-covered by underground sewerage, the district has two STPs of anaerobic type for domestic liquid waste treatment with a total capacity of 90 MLD (CPCB, Inventorisation of sewage treatment plants, 2015). Though there are several industrial clusters in the district, data on industrial wastewater generation or treatment is not in public domain.



*CBWTF: Common bio-medical waste treatment facility; TSDF: Treatment, storage & disposal facility

CLIMATE PROFILE AND PROJECTIONS



Patalpani waterfall in Indore

2. CLIMATE PROFILE AND PROJECTIONS

2.1. Observed climate variability over Indore district

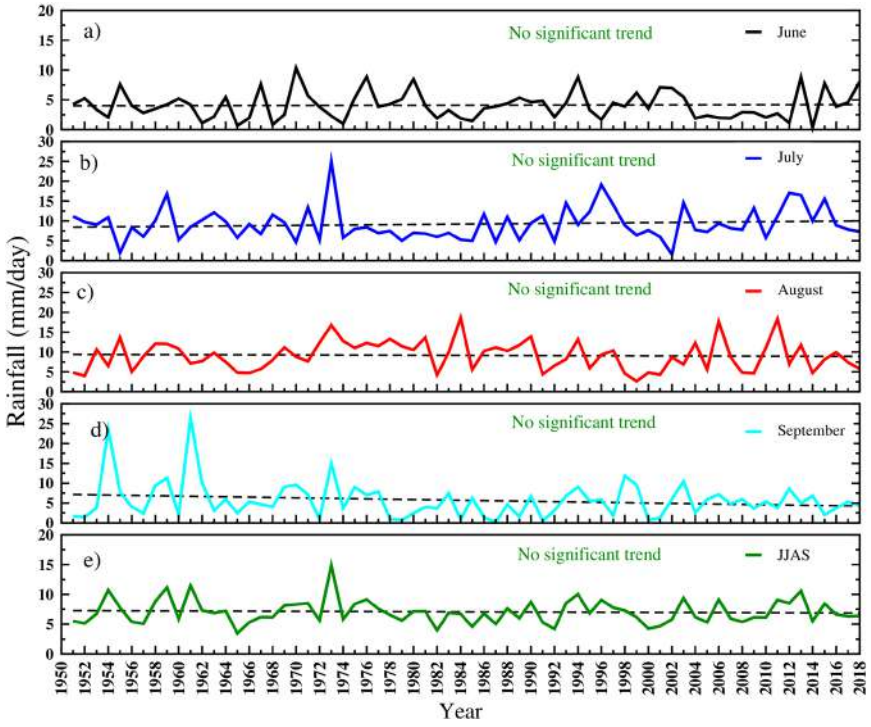
Climate variability refers to variations in the mean state of the climate (temperature, rainfall, etc.) and other statistics (such as standard deviations, statistics of extremes, etc.) on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or due to variations in natural (e.g., solar and volcanic) external forcing (external variability).

This section focuses on the current mean climate variability in Indore district, analysing the observed data of the past 68 years. Precipitation and temperature are used as the key climate variables in this analysis.[7]

2.1.1 Precipitation variability

Indore district lies in the catchment area of the river Chambal. This district receives majority of rainfall through south-west monsoon. The district comes under rain-shadow area of the Western Ghats and hence, has a semi-arid climate type. The mean monsoon rainfall in the district is around 810 mm. The number of rainy days (days with rainfall of ≥ 2.5 mm) vary from 9 to 14 in July and August, with more than 45 days of good rainfall during the summer monsoon season.

The monsoon rainfall does not show any significant trends over monthly or seasonal cycles. In recent years, higher number of dry days can be seen during monsoon. July and August are the principal rainy months. It has been observed that the variability in the number of rainy days is higher in July and August, showing a slight decreasing trend during 1951 to 2018 (Figure 14).



Indore district falls within the rain-shadow area of Western Ghats with a mean monsoon rainfall of around 810 mm

Figure 13: Inter annual variability of rainfall (mm/day) over Indore for 1951-2018

7 Refer to Annexure 2.1 and 2.2 for background note of climate projections and methodology, respectively.

Higher number of dry days are observed in recent years during monsoon

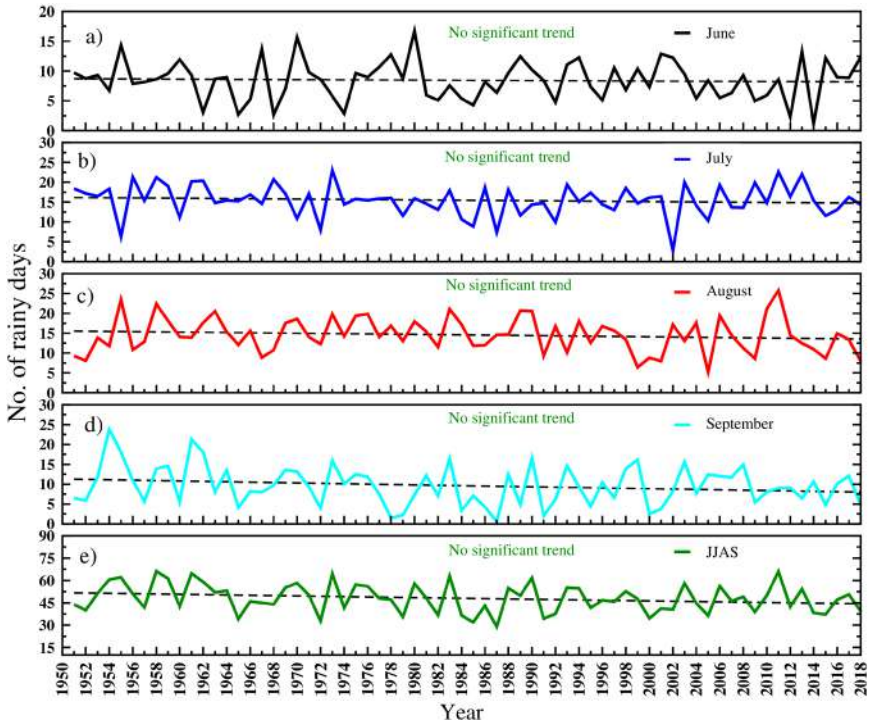
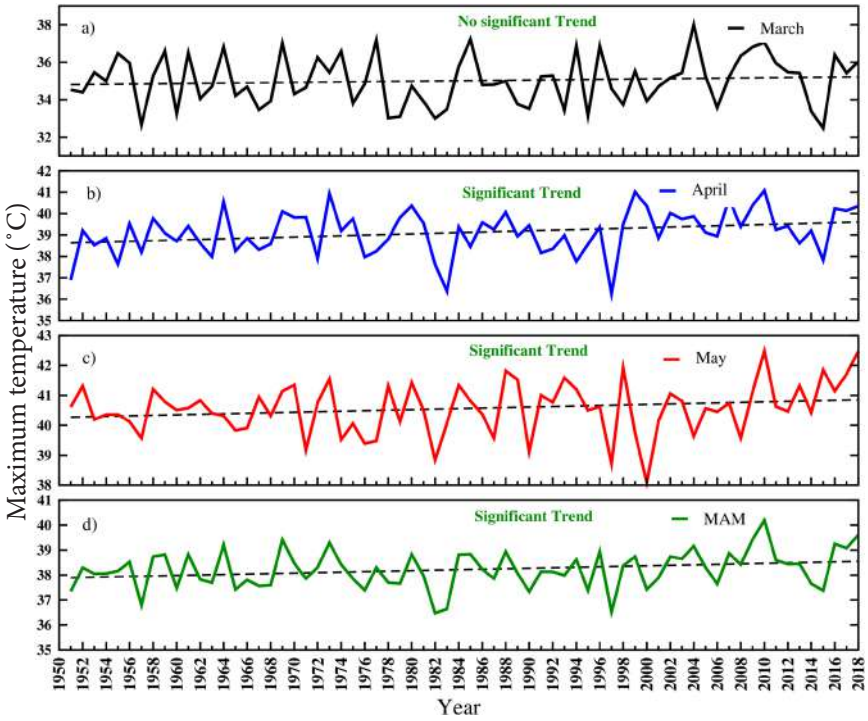


Figure 14: Inter-annual variability of rainy days (number of days) over Indore for 1951-2018

2.1.2 Temperature variability

Indore district enjoys moderate temperature. April to June is the summer season with the maximum temperature in May going up to 44°C. The mean monthly maximum temperature ranges from 35°C to 41°C during summer. The maximum temperatures show a significantly increasing trend during April and May, resulting in sharp heat waves (Figure 15). The mean percentage of warm days have also increased by about 9 percent over the district during the period of 1986 to 2005 (Figure 16).[8]



A significantly increasing maximum temperature during summer is leading to sharp heatwaves

Figure 15: Inter-annual variability of maximum temperature (°C) over Indore district for 1951-2018

8 Warm days - Correspond to cases when the maximum temperature exceeds the 90th percentile of the temperature distribution of the season.

Mean percentage of warm days has increased by about 9%

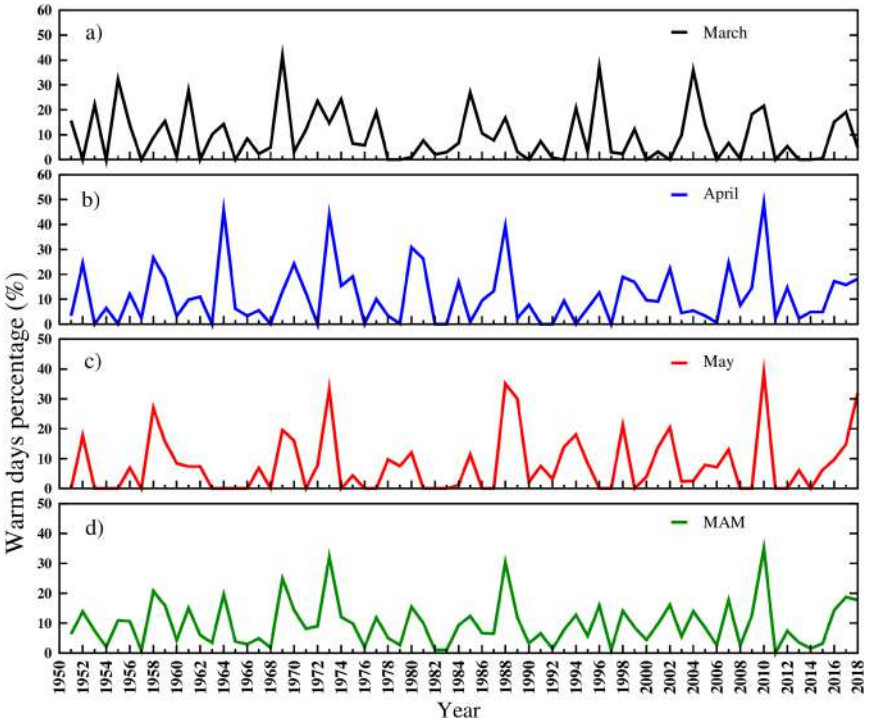
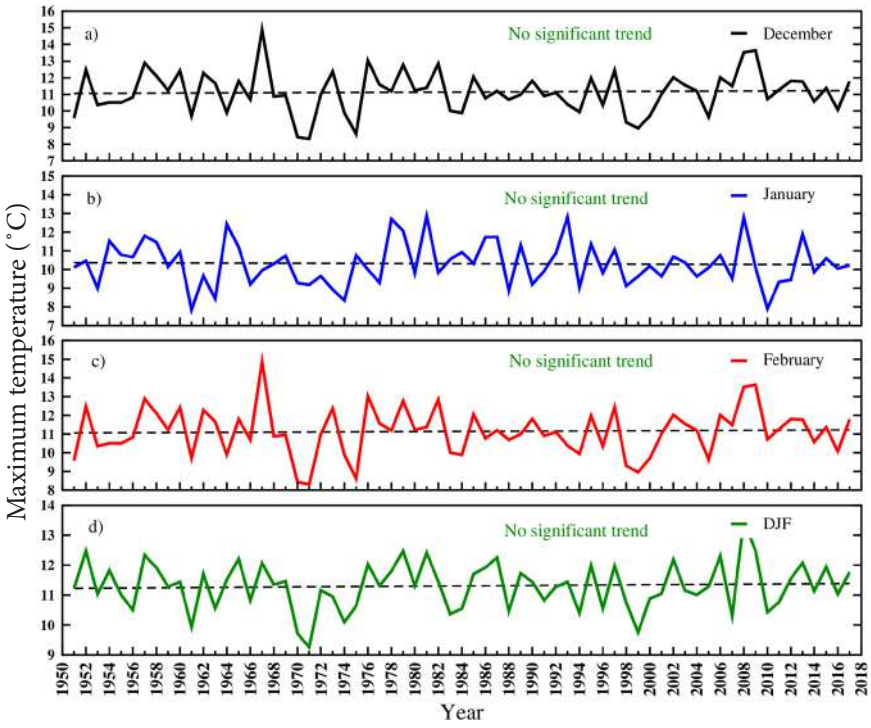


Figure 16: Inter-annual variability of warm days (%) over Indore district for 1951-2018

The minimum temperatures during winter season (December, January and February) average around 10°C (Figure 17). The year-on-year variability of minimum temperature does not show any increasing or decreasing trend. However, the number of cold days show large variability during all the winter months (Figure 18).[9]



Minimum temperature during winter averages at around 10°C

Figure 17: Inter-annual variability of minimum temperature (°C) over Indore for 1951-2018

9 Cold days - Correspond to cases when the minimum temperature falls below the 10th percentile of the temperature distribution of the season.

Cold days show large variability during all winter months

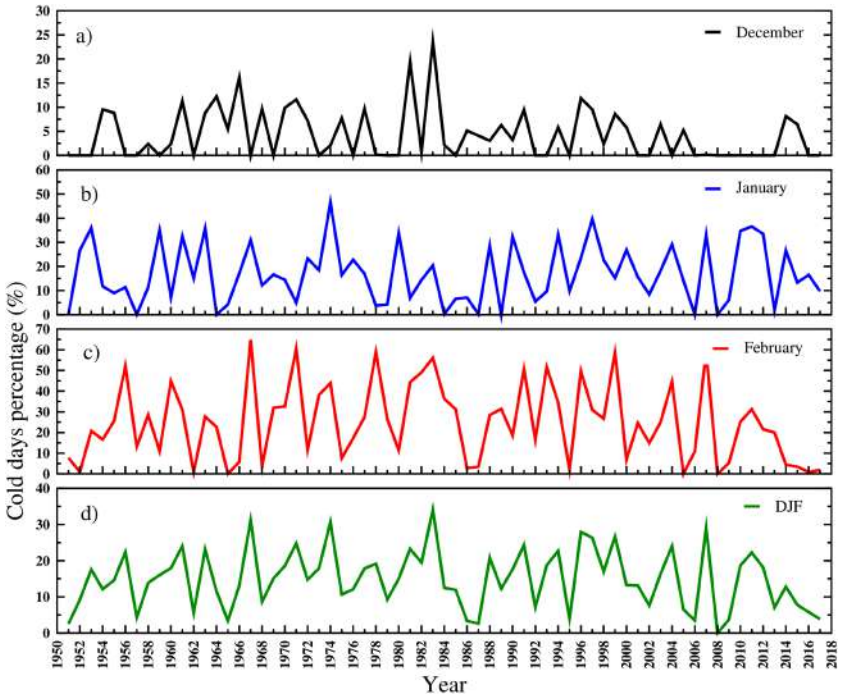


Figure 18: Inter-annual variability of cold days (%) over Indore for 1951-2018

2.2. Future climate projections for Indore district

The precipitation and temperature over Indore district for the period 1986 to 2005 has been simulated using the multi model mean (MMM) ensemble. The district is projected to experience an increase in the mean rainfall during the monsoon months in different epochs (2021-2040, 2041-2060, 2061-2080 and 2081-2100) under medium (RCP4.5) and high (RCP8.5) emission scenarios (Table 6). The projection shows an increase in seasonal mean precipitation under RCP4.5 by 7 to 21 percent and 16 to 42 percent under RCP8.5 compared to historical data between near-term (2030s) and end-century (2090s) epochs. The number of rainy days is also projected to increase during the monsoon season, particularly during July and August (Table 7).

Table 6: Observed (1986-2005), simulated (1986-2005) and projected (RCP4.5 and RCP8.5 emission scenarios) mean monthly and seasonal rainfall (mm) for Indore district

Rainfall (mm)	June	July	August	September	JJAS (total of June, July, Aug and Sept)
Observed	133	281	248	143	810
Simulated	108	248	266	166	792
RCP4.5					
2030s (2021-2040)	112	243	278	214	852
2050s (2041-2060)	109	250	306	217	887
2070s (2061-2080)	115	258	321	253	952
2090s (2081-2100)	118	282	324	231	960
RCP8.5					
2030s	112	261	338	201	918
2050s	118	287	363	256	1,029
2070s	115	258	322	252	1,045
2090s	128	288	410	297	1,129

Table 7: Observed (1986-2005), simulated (1986-2005) and projected (RCP4.5 and RCP8.5 emission scenarios) mean monthly and seasonal number of rainy days (days with rainfall ≥ 2.5mm) for Indore district

Rainy days	June	July	August	September	JJAS (total of June, July, Aug and Sept)
Observed	9	14	13	9	45
Simulated	7	15	16	9	48
RCP4.5					
2030s (2021-2040)	7	15	16	11	49
2050s (2041-2060)	7	15	17	11	50
2070s (2061-2080)	7	15	16	11	50
2090s (2081-2100)	7	16	16	11	51
RCP8.5					
2030s	6	15	17	10	48
2050s	7	15	17	11	50
2070s	6	15	16	11	49
2090s	6	15	16	12	50

The projected changes in maximum and minimum temperatures were analysed on a monthly scale during the summer/ winter season. The projections in different time epochs show that the maximum temperatures may increase by 1°C to 2.5°C under RCP4.5 and 1.5°C to 4.5°C under RCP8.5. Temperatures in May are higher compared to the temperatures in other summer months. The rising temperatures might have adverse impacts on biodiversity, forests, water resources, agriculture, etc. The percentage of warm days is also projected to increase, particularly by end of the century (Table 9). In the winter season, minimum temperatures also show a projected increasing trend with the percentage of cold days decreasing drastically in all epochs under changing climatic conditions. The analysis shows there is a clear increase in temperature towards the end of the century (Table 10).

Table 8: Observed (1986-2005), simulated (1986-2005) and projected (RCP4.5 and RCP8.5 emission scenarios) mean monthly and seasonal maximum temperature (°C) for Indore district

Temp max (°C)	March	April	May	MAM (average of March, April and May)
Observed	34.9	39.1	40.4	38.1
Simulated	34.4	38.5	40.4	37.8
RCP4.5				
2030s	35.7	39.7	41.4	39.0
2050s	36.3	40.3	42.1	39.6
2070s	36.7	40.9	42.5	40.0
2090s	37.0	41.1	42.8	40.3
RCP8.5				
2030s	35.8	39.8	41.8	39.2
2050s	36.8	40.9	42.6	40.1
2070s	38.1	42.1	43.8	41.3
2090s	39.3	43.3	44.9	42.5

Table 9: Observed (1986-2005), simulated (1986-2005) monthly and projected (RCP4.5 and RCP8.5 emission scenarios) mean monthly and seasonal warm days (%) for Indore district.

Warm days (%)	March	April	May	MAM (average of March, April and May)
Observed	9	9	9	9
Simulated	9	10	10	10
RCP4.5				
2030s	32	36	41	37
2050s	44	51	57	51
2070s	50	62	65	60
2090s	58	66	72	66
RCP8.5				
2030s	35	40	48	42
2050s	55	63	71	64
2070s	77	82	89	83
2090s	88	92	95	91

Table 10: Observed (1986-2005), simulated (1986-2005) and projected (RCP4.5 and RCP8.5 emission scenarios) mean monthly and seasonal minimum temperature (°C) for Indore district

Temp min (°C)	Dec	Jan	Feb	DJF (average of Dec, Jan and Feb)
Observed	10.8	10.3	10.8	10.7
Simulated	10.8	10.0	12.1	10.9
RCP4.5				
2030s	12.0	11.4	13.3	12.2
2050s	12.8	12.1	13.9	12.9
2070s	13.3	12.7	14.4	13.4
2090s	13.4	12.8	14.6	13.6
RCP8.5				
2030s	12.3	11.5	13.4	12.3
2050s	13.3	12.7	14.7	13.5
2070s	14.9	14.1	16.1	14.9
2090s	16.2	15.6	17.3	16.3

Table 11: Observed (1986-2005), simulated (1986-2005) and projected (RCP4.5 and RCP8.5 emission scenarios) mean monthly and seasonal cold days (%) for Indore district

Cold days (%)	Dec	Jan	Feb	DJF (average of Dec, Jan and Feb)
Observed	4	18	26	15
Simulated	7	15	36	19
RCP4.5				
2030s	2	4	18	8
2050s	1	3	12	5
2070s	0	1	8	3
2090s	1	1	6	3
RCP8.5				
2030s	2	6	17	8
2050s	1	2	8	3
2070s	0	0	3	1
2090s	0	0	1	0

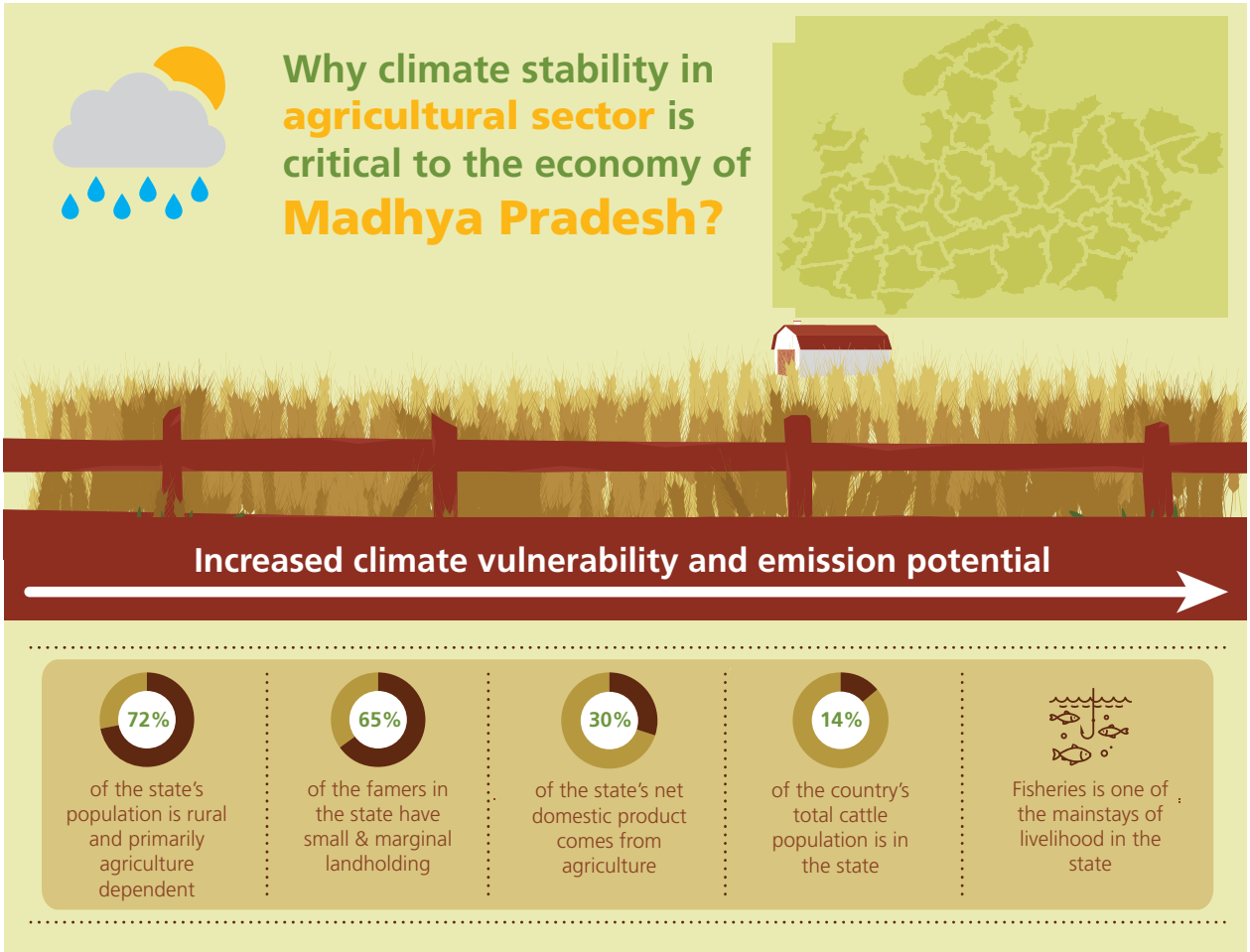
2.3. Sectoral impacts of climate change

2.3.1 Agriculture and allied sectors

Madhya Pradesh has its fair share of vulnerability to climate change. About 72 percent of the state's population is rural and depends primarily on agriculture and allied activities (horticulture, fishery, livestock, poultry and forestry). Agriculture sector in MP consists majorly of small and marginal landholdings (65 percent), making the sector highly vulnerable. However, considering that the sector contributes 30 percent to the state's net domestic product, sectoral stability is critical to the state's economy. Animal husbandry is an important sector from the context of both the emission potential and vulnerability to climate change, with the state constituting 14 percent of the country's total cattle population. Fisheries too is a mainstay of the economically weaker sections in the state -- a livelihood completely dependent on the availability of water resources (EPCO, 2013).

Changing climatic conditions and variabilities (inter-annual variation and erratic distribution in rainfall, extreme events, like heat and cold waves, etc.) are expected to impact these natural resource-based livelihood sources significantly. Extreme weather events, such as frost, excess rain or high temperatures have reportedly resulted in huge productivity losses in the state. Erratic rainfall patterns have often led to seasonal shifts that affect cropping patterns. Heavy rain, intense storms and hailstorms cause physical damage to standing crops as well as horticulture (during flowering and fruit bearing stage). Rise in temperature during an initial stage of cropping leads to the emergence of pests. Changing climate has led to several new diseases. Similarly, livestock health is threatened by factors such as increase in vector borne diseases, heat and water stress, and reduced availability of feed and fodder. Rising temperatures impact availability of fish seeds, as also the suitability of fish species to particular temperatures of water. This leads to retardation of inland fish species and a shift in the breeding period, thereby ultimately affecting productivity (EPCO, 2013).

A vulnerability assessment of Madhya Pradesh in the State Action Plan for Climate Change has categorised Indore as a low vulnerability district with comparatively higher adaptive capacity due to factors such as its economic capacity, access to infrastructure, literacy rate, irrigation potential, forest area and less exposure to extreme climatic events. However, owing to the high emission potential, it is critical to address the climate concerns of Indore (EPCO, 2013).



A climate change impact (simulation) study on specific crops reveals an overall decline in wheat yield (by 15 to 45 percent) in all agro-climatic zones in the state with southern part being more impacted due to higher temperatures. The crop maturity duration will also be reduced by five to 11 days in all agro-climatic zones depending on production environments and locations. Accelerated maturing and reduced grain size at temperatures above 34°C along with a projected increase in temperature coupled with increased frequencies of extreme weather events could significantly constrain wheat production. Another study on the effect of elevated temperature and CO_2 concentration on wheat productivity in MP shows an average of 8 percent decrease in wheat grain and biomass yield per 1°C increase in temperature. For rice too, the irrigated yield is projected to reduce by 6 to 14 percent, while the rainfed rice yield is projected to reduce by 15 to 45 percent across the state by 2050, depending on the different agro-climatic zones. High temperatures are also leading to (a) water shortage in rainfed rice during *kharif* due to long dry spells; (b) compromised pollination and grain filling in transplanted rice; and (c) increased water demand by crop canopy. Soybean yields are also projected to decline by 4 to 16 percent and maturity duration are projected to extend by three to four days for all agro-climatic zones with higher surface air temperatures. Heavy rainfall events will lead to water logging, leading to higher incidence of disease and a reduction in yield (Ventakeswarlu & Rao, 2015; Mall, Sonkar, Sharma, & Singh, 2016; Mohanty, Sinha, Hati, Reddy, & Chaudhary, 2015).

2.3.2 Forest and water resources

Over the last two decades, the forest area in the state has remained stable. Climate change simulation study for forested grids indicate a change in vegetation distribution, particularly in the dry forest areas of northern and western Madhya Pradesh which are likely to be replaced by wetter or moist forest types, more visible in the long-term, i.e., 2080s. Changes are majorly attributed to higher precipitation levels and increased CO_2 concentration. Evidently, the dry tropical thorn and scrub forests of MP are found to be highly disturbed, containing thorny and deciduous species. In fact, a comparative study done in 2013 found an increase in moisture in the 'very dry teak forests' of MP as compared to a 1968 delineation and there is a suggestion to rename these forests as 'dry teak forests'.

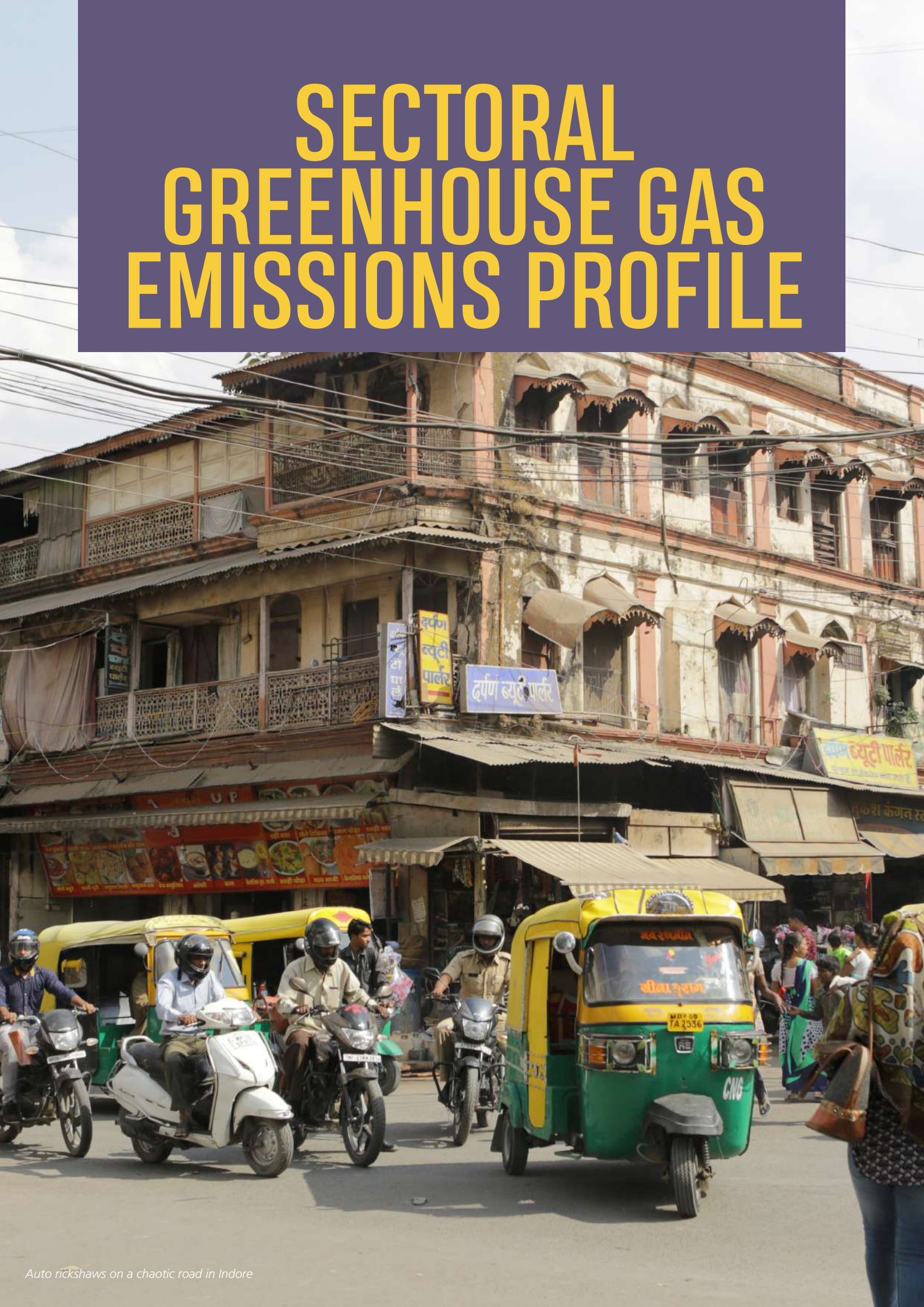
Net primary productivity (NPP) of current vegetation in MP in the same study shows a higher productivity in the southern and eastern part compared to the northern and western parts.

In the projected climate scenarios of RCP4.5 and RCP8.5 by 2030s and 2080s, the NPP is likely to increase all over the state mainly by the CO_2 fertilisation effect and increased precipitation projections. However, the study states that in the long-term, NPP increase is likely to be countered by increased losses from heterotrophic respiration, leading to a decline in the net ecosystem productivity. For the same reason, the biomass carbon density and soil carbon density are also projected to increase all over the state in both the scenarios by 2030s and 2080s. At present, soil carbon density is higher in the southern, western and eastern parts of the state. But post-2050, the soil carbon is likely to decline (Chaturvedi, 2015).

A study for impacts of climate change along the Narmada basin shows a considerable decrease of extreme flood events in the basin and no significant variability during the time zones of 2006-40, 2041-2070 to 2071-2099. This may be due to the moderation effects of the dams located upstream. However, with no hydraulic interventions at the virgin basin sites, the extreme flood events are expected to increase substantially (Sudheer, 2016). For groundwater resources, a reduction in groundwater recharge and substantial increase in evapotranspiration is projected in the state along its major river basins of Godavari, Narmada, Mahi, Tapi and Ganga (Gosain, et al., 2017).

At present, the water requirements of Indore are met from Narmada an d Gambhir rivers. These monsoon-fed and groundwater regeneration dependent rivers are expected to receive increased average annual rainfall (10 to 30 percent of the current average annual rainfall). The increase in average rainfall is expected to be around 200 mm to 400 mm for Narmada basin and 150 mm to 200 mm for Gambhir basin. Due to the lack of local reservoir capacity as well as deteriorating quality of water as a result of construction within the catchment areas, the city might have to depend mostly on Narmada resources even with increased precipitation (Karanth, et al., 2012).

SECTORAL GREENHOUSE GAS EMISSIONS PROFILE



Auto rickshaws on a chaotic road in Indore

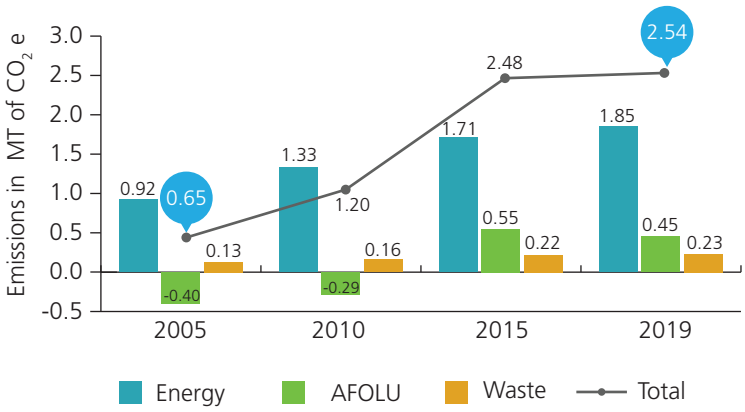
3. SECTORAL GREENHOUSE GAS EMISSIONS PROFILE: CLIMATE CHANGE DRIVERS

This section of the action plan estimates GHG emissions for the district using the guidelines laid down by the Intergovernmental Panel on Climate Change (IPCC).[10] Estimates have been done for 12 categories covering three major sectors – energy, agriculture, forestry and other land use (AFOLU), and waste for the years 2005 to 2019.[11] Indore does not have any large-scale industries that fall under the listed industrial processes and product use (IPPU) industry categories of the IPCC guidelines. Therefore, there are no emissions from the IPPU sector. However, the energy used in industries and the corresponding emissions are reported in the energy sector.

The activity data was sourced from government-approved datasets for all the sectors, and wherever possible, country-specific emission factors were used in place of default emission factors.[12]

3.1. Direct emission estimates

3.1.1 Economy-wide emissions



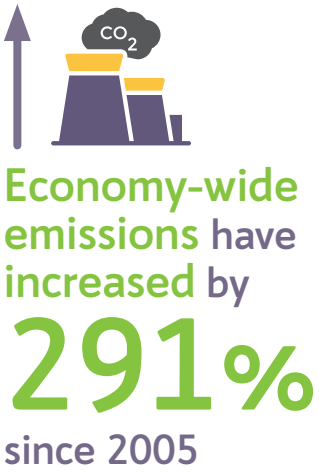


Figure 19: Economy-wide emissions of Indore district (million tonnes of CO_2e.)

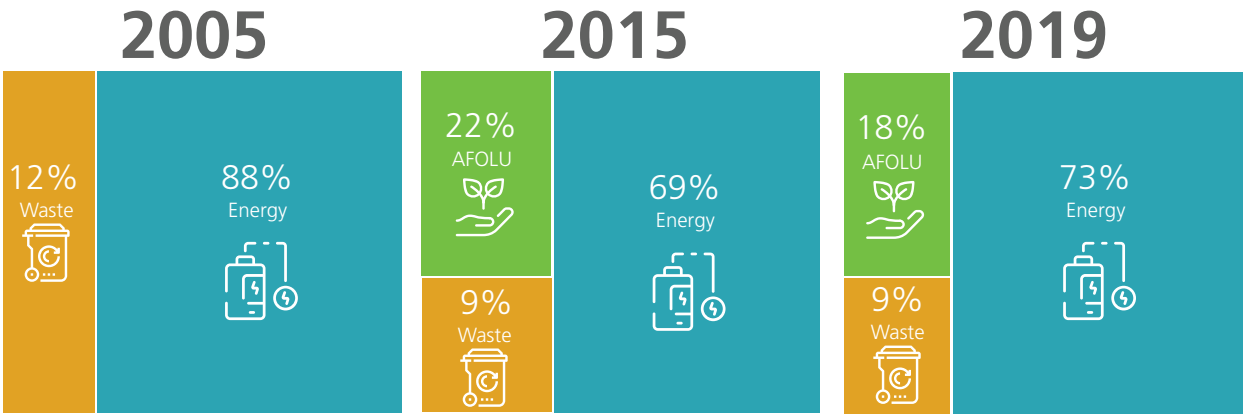


Figure 20: Contributions of different sectors in economywide emissions in 2005, 2015 and 2019

10 The guidelines for National Greenhouse Gas Inventories laid down by the Intergovernmental Panel on Climate Change (IPCC) were adopted to estimate emissions of Indore district. The 2006 IPCC guidelines were followed to the extent possible; and for a very few categories, the 1996 IPCC guidelines were referred to.

11 Emissions for 2017, 2018, 2019 are estimated by applying CAGR of the latest possible GHG estimates of each category.

12 Emissions from category-wise activity data sources are provided in Annexure 3.2.

- Between 2005 and 2019, the total emissions of Indore district increased by 291 percent (from 0.65 Mt CO_2e in 2005 to 2.54 Mt in 2019). The CAGR for economy-wide emissions during this timeframe was 10.23 percent.
- Energy sector accounts for highest emissions. Although its emissions increased at a CAGR of 5.12 percent, its share in economy-wide emissions dropped from 88 percent in 2005 to 73 percent in 2019 due to increase in AFOLU emissions.
- Till 2011, AFOLU was a net sink. Emissions from AFOLU peaked in 2015 and then started declining (details for this trend are given in the AFOLU sub-section of this chapter).
- Waste sector has grown at a CAGR of 4.52 percent and its contribution dropped from 12 percent (in 2005) to nine percent in 2019.
- IPPU sector is not applicable in Indore district.
- Sectoral details and analyses is given in the following sections

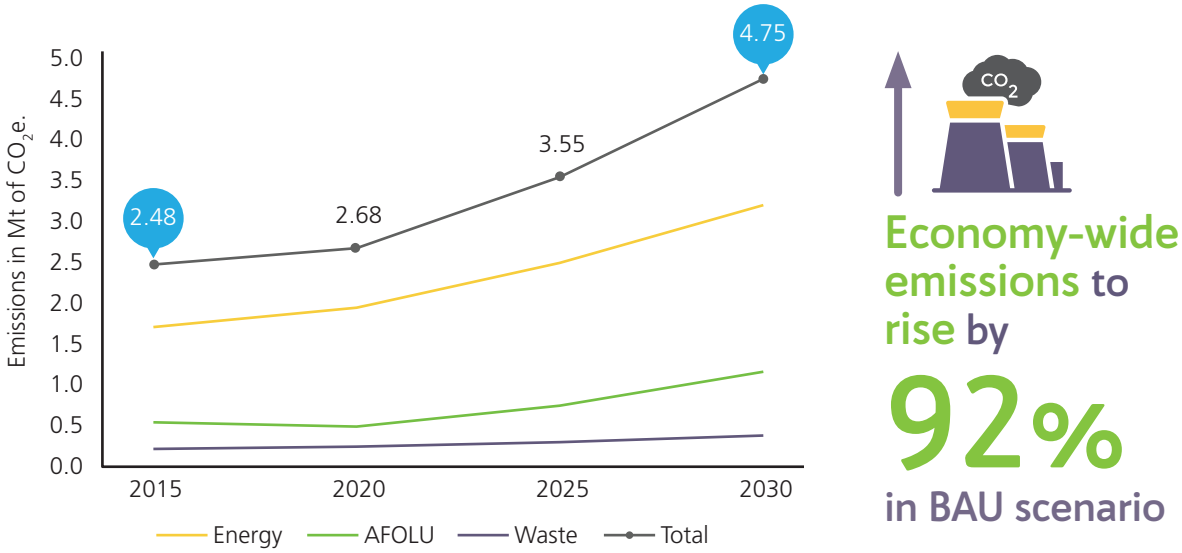


Figure 21: Projections economy-wide emissions (BAU)

- In business-as-usual scenario (i.e no actions/policies are put in place to mitigate the emissions), the total emissions of Indore are likely to increase by 92 percent by 2030 with respect to 2015 levels.
- It may be noted that projections of total emissions (i.e. economy-wide emissions) is the sum of the sectoral emissions projections. In other words, CAGR is not applied on total emissions; on applying CAGR, the total projected emissions in 2030 would be 7.10 Mt of CO_2e (i.e. 190 percent increase over 2015 levels). This difference is because of changes (both decline and growth) in AFOLU sector emissions over the years. Details are given in AFOLU section.

3.1.2 Per capita emissions

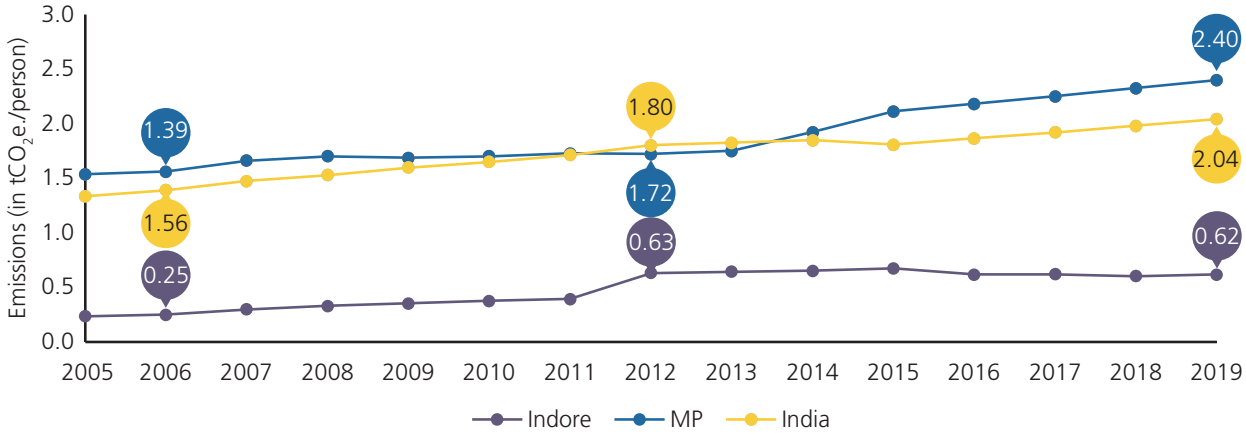


Figure 22: Per capita emissions (tonnes CO_2e./person) – comparison

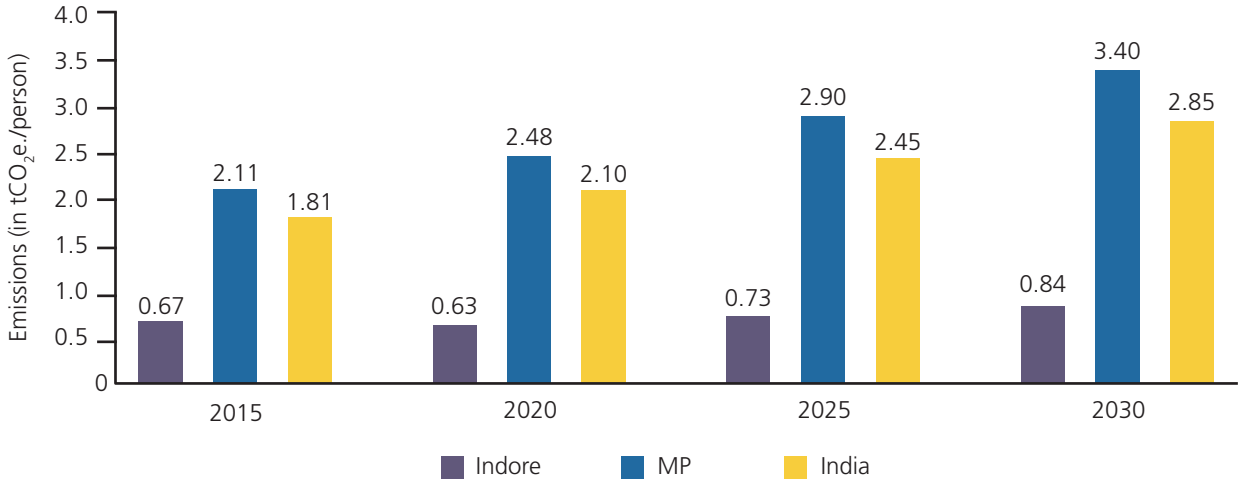


Figure 23: Projected per capita emissions (tonnes CO_2e./person) – comparison

- The per capita emissions of Indore district were computed using the district's total emissions that were estimated in this analysis (therefore, it does not include emissions from CPP, use of CNG and PNG etc.).
- As per this analysis, the per capita emissions of Indore district are very modest in comparison to MP and the national average.
- The district does not have thermal power plants and industries that contribute to IPPU emissions. This is a major reason for overall low emissions of Indore with respect to state emissions.
- However, it may be noted that Indore's per capita electricity consumption is 724 kWh/person.
- Indore's electricity consumption leads to higher emissions in some other region.

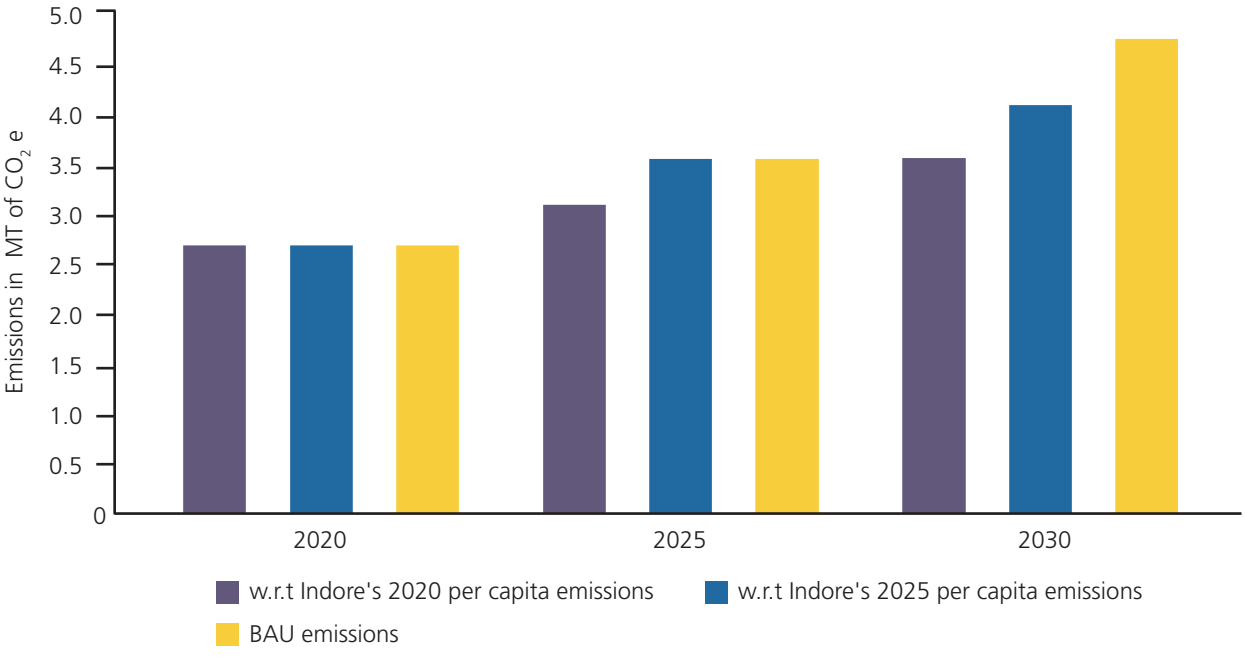


Figure 24: Projected total emissions (Mt of CO_2e) with different per capita emissions scenarios

In 2030, total emissions (w.r.t. BAU) will be:

33% more if 2020 per capita emission levels are maintained.

16% if 2025

- Business as usual projections of per capita emissions indicate that total emissions will increase by 92 percent between 2015 and 2030 (as shown in economy-wide projections).
- However, if the per capita emissions of 2020 are maintained, the overall growth in emissions would be only around 44 percent (between 2015 and 2030).

3.1.3 Sectoral analysis

Energy sector

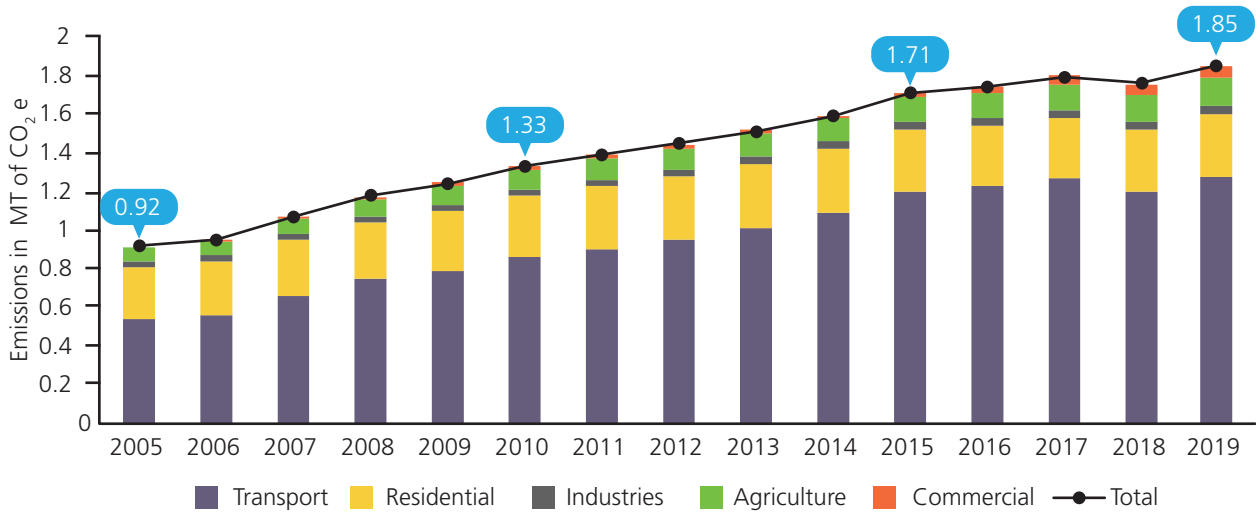


Figure 25: Energy sector emissions of Indore district (in Mt of CO_2e)

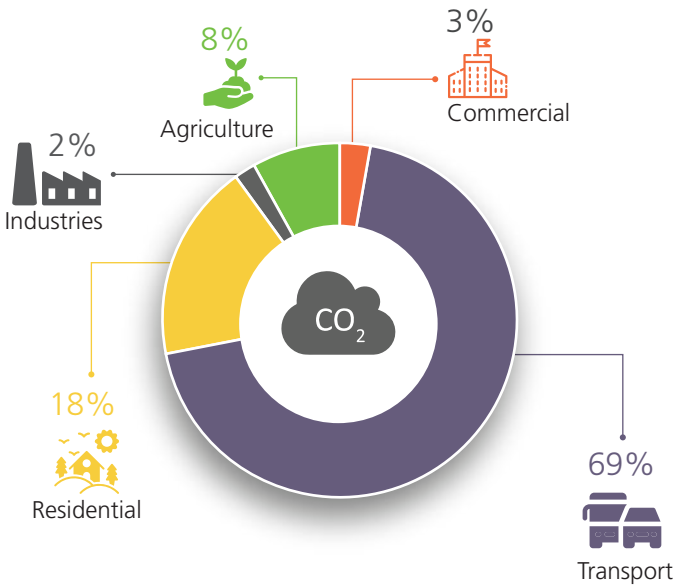


Figure 26: Percentage share in total energy emissions (2019)

- This sector estimates the emissions due to fossil-fuel consumption by various sub-sectors.
- Between 2005 and 2019, emissions from energy sector have doubled (from 0.92 Mt of CO_2e in 2005 to 1.85 Mt of CO_2e in 2019).
- In the absence of electricity generation in Indore, transport is the highest contributor to energy emissions.
- This is followed by residential, agriculture, commercial and industries.
- Despite very low contribution to overall energy emissions, emissions from commercial category have seen the fastest growth rate between 2005 and 2019 (CAGR of 14.35 percent).

Table 12: Growth in energy sector emissions (2005-18)

Category	Sub-category	CAGR (2005-18)	% share to energy emissions (2019)	
Transport (CAGR: 6.33% Share: 69%)	Road (88.3% in transport emissions)	5.75%	60.45%	Total share of transport is 69%
	Aviation (5.94%)	18.31%	5.91%	
	Railway (3%)	5.84%	2.05%	
Residential		1.32%		18%
Agriculture		5.48%		8%
Commercial		14.35%		3%
Industries		2.24%		2%

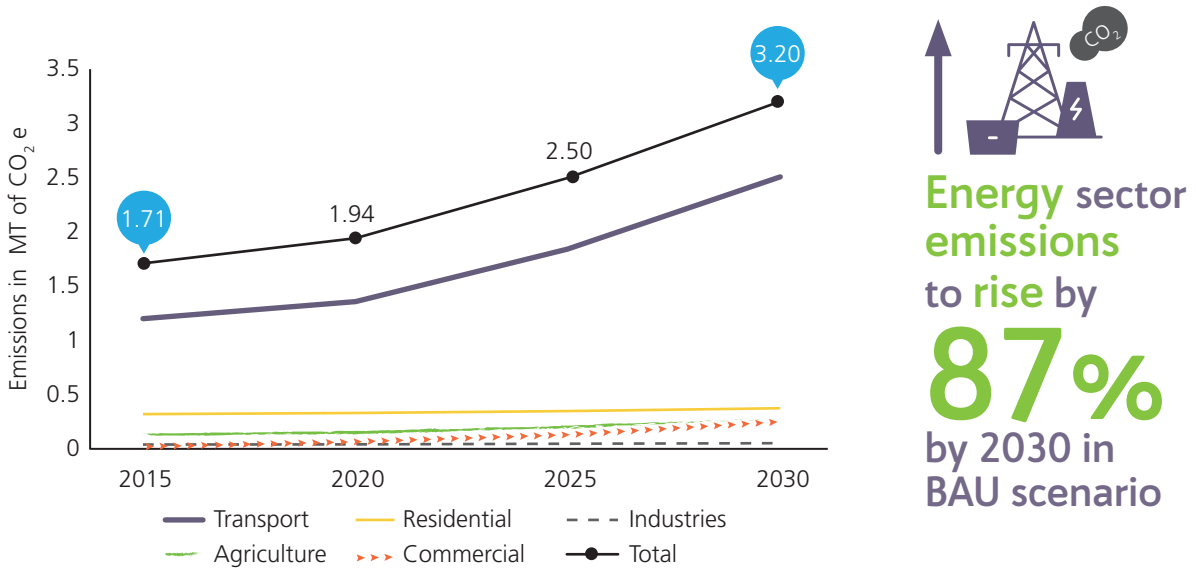
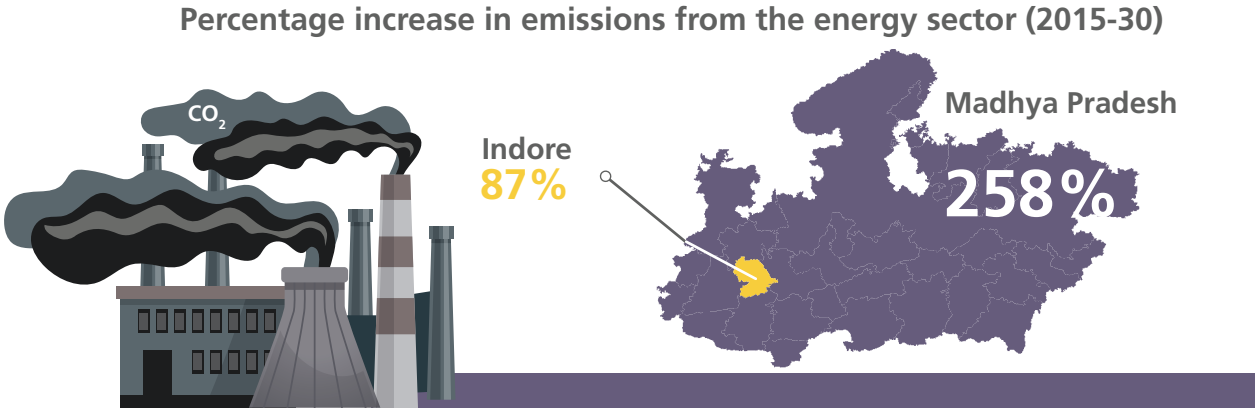


Figure 27: Projected emissions of energy sector (BAU)



- In business-as-usual scenario, the total energy emissions of the district are likely to grow at 5.12 percent CAGR and the overall emissions will rise by 87 percent by 2030 (from 2015 levels).
- However, a similar projection for MP suggests that the state energy emissions will grow by 258 percent during the same time period

Agriculture, forestry and other land use (AFOLU)

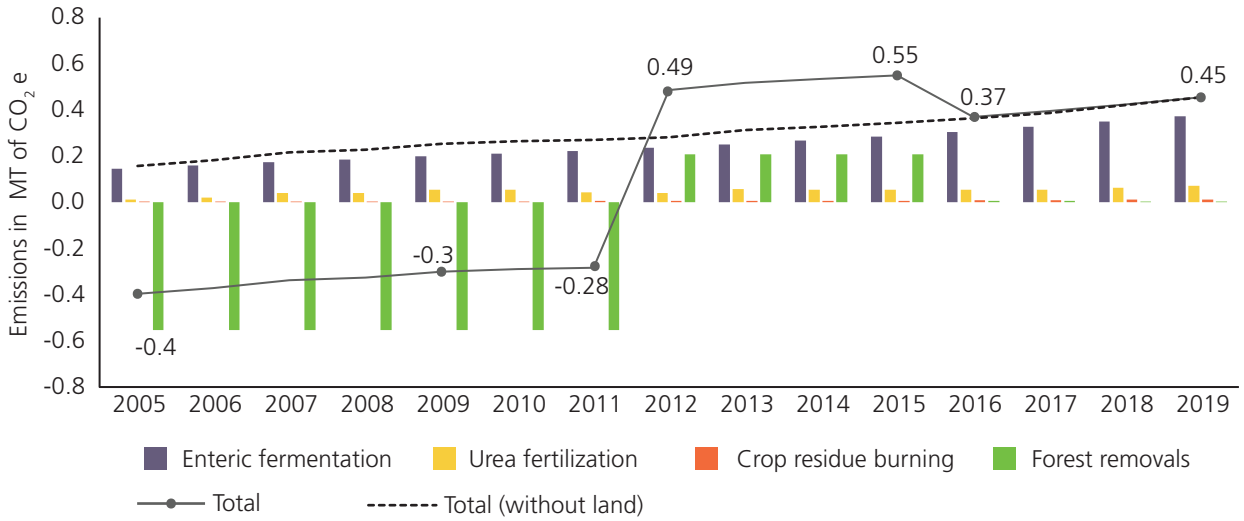


Figure 28: AFOLU sector emissions of Indore district (Mt of CO_2e.)

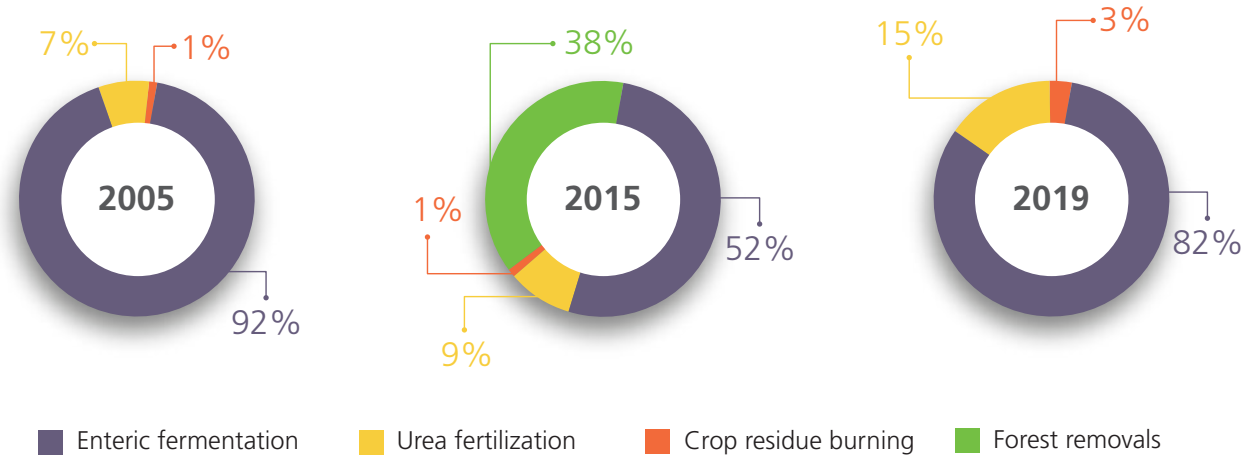


Figure 29: Contribution of categories in total AFOLU emissions in 2005, 2015, and 2019

Table 13: Growth in AFOLU emissions (2005-15) and % share

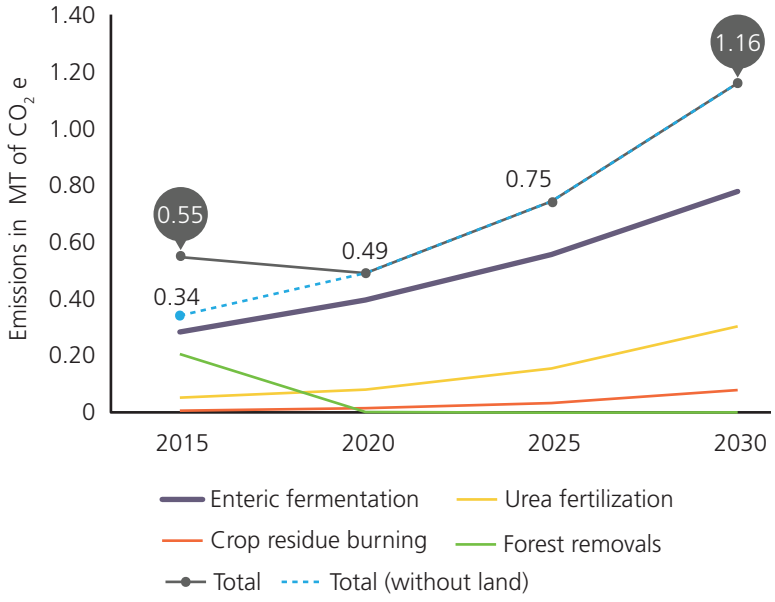
Category	CAGR (2005-17)	% share in AFOLU emissions (2005)	% share in AFOLU Emissions (2015)	% share in AFOLU emissions (2019)
Enteric fermentation	6.98%	92%	52%	82%
Forest removals	-50.54% (between positive values 2012 and 2017)	Was a sink	38%	0.33%
Urea fertilisation	14.35%	7%	9%	15%
Crop residue burning	18.81%	1.5%	1%	3%
Total emissions	-4.17% (between positive values 2012 & 17)	NA	NA	NA

AFOLU sector emissions to rise by

112%

by 2030 in BAU scenario

- Due to the substantial increase in forest area between 2004 and 2011 (from 587 sq km to 704 sq km) AFOLU sector was a net sink until 2011.
- Post 2011, the forest area dropped by 25 sq km (until 2015). This decline led to high emissions from the 'forest removals' category.
- Although the decline in forest area continued, the rate of reduction was extremely low between 2015 and 2017. As a result, the emissions (positive) from forest removals and AFOLU reduced in comparison to 2015.
- The CAGR is calculated between positive values only. Owing to the decline in emissions (as mentioned above), the CAGR of total emissions (between 2012 and 2017) comes out to be negative.
- However, for projections of the total emissions from AFOLU, this negative CAGR is not used. Rather, projections of individual categories have been added up.
- There is no significant rice cultivation in Indore district. Therefore, emissions from this category have not been accounted for.



- Assuming that the pace of reduction in forest land will remain low (as it has been between 2015 and 2017, it is projected that emission from 'forest removals' category will be negligible.
- In this scenario, the overall increase in AFOLU sector emissions will be 112 percent by 2030 (from 2015 levels).

Figure 30: Projections of AFOLU emissions (BAU)

Projections for livestock sector

Bovine population density	
Region/district	**Cattle count/sq.km**
 India	91.23
 MP	90.15
 Indore	85.39

- Density of bovine animals in Indore is lower than the state average, as per the 2012 livestock census.
- A scenario is assumed wherein Indore will not exceed the state average of bovine density until 2030.
- Based on this scenario, enteric fermentation calculations are done and compared with BAU projections.
- Under this scenario, the emissions will be 228 percent lower than the BAU projections for enteric fermentation.

Table 14: Projected emissions from enteric fermentation

Year	2005	2010	2015	2020	2025	2030
Projected population (BAU)	1,97,703	2,94,032	4,09,443	5,78,132	8,16,321	11,52,643
BAU projected emissions (t of CH_4)	6.39	9.40	12.99	18.69	26.38	37.25
Projected population (keeping Indore's 2030 bovine population density equivalent to the current bovine population density of MP)	1,97,703	2,94,032	3,35,856	3,40,961	3,46,143	3,51,405
Projected emissions (bovine population and emissions decrease w.r.t MP's bovine population density) (t of CH_4)	6.39	9.40	10.86	11.02	11.19	11.36

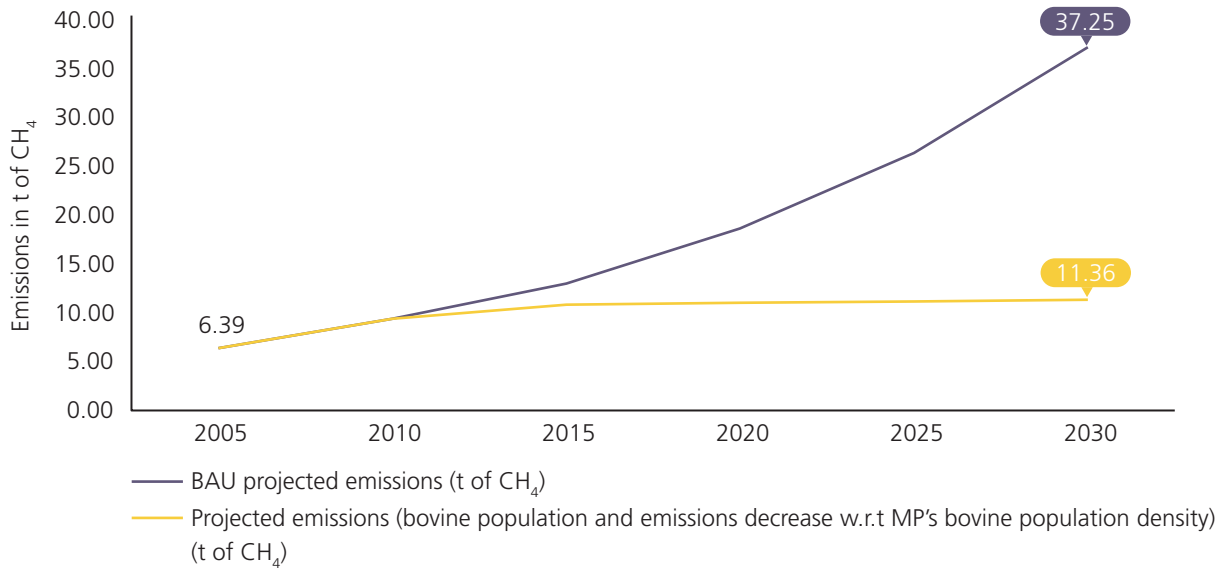


Figure 31 Projected enteric fermentation emissions – comparison

Waste sector

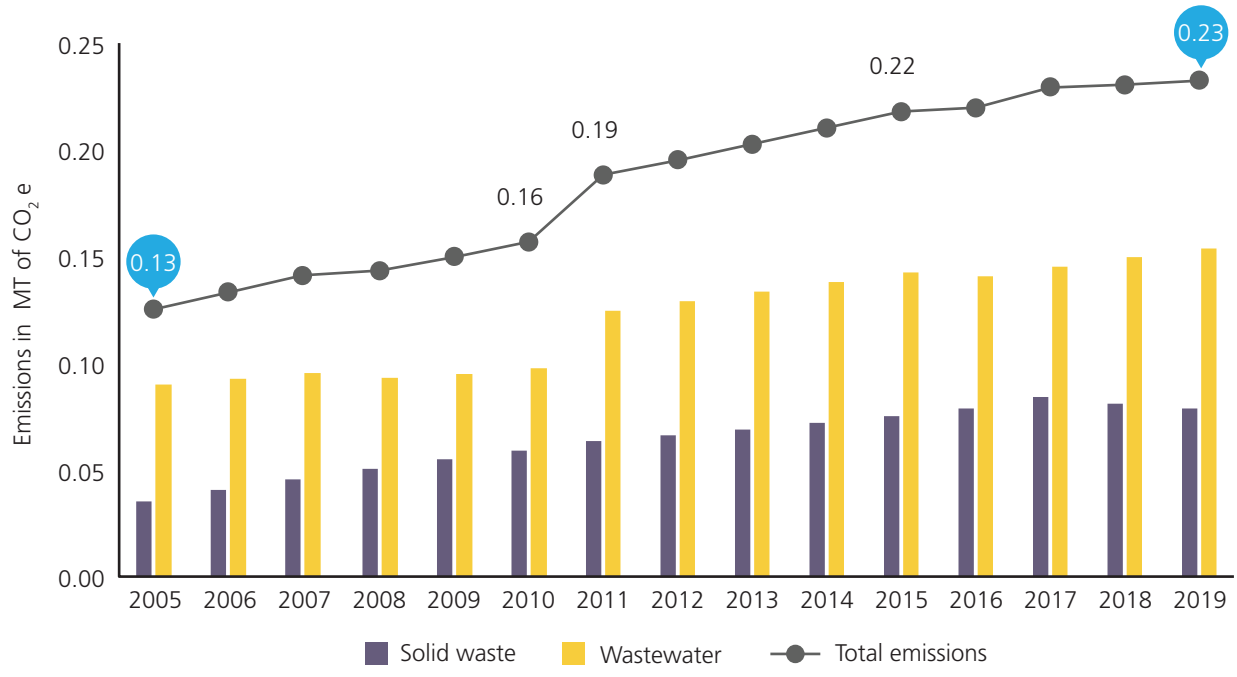
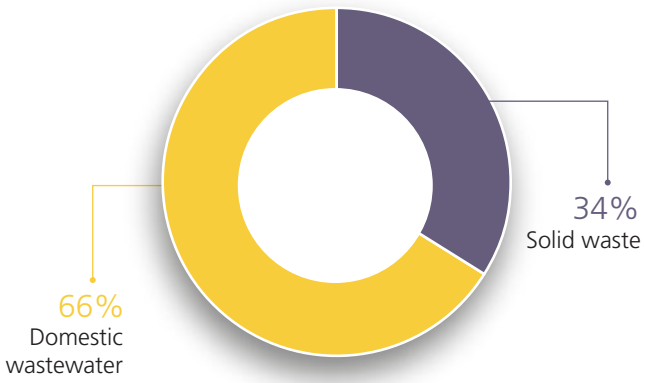


Figure 32: Waste sector emissions (Mt of CO_2e.)

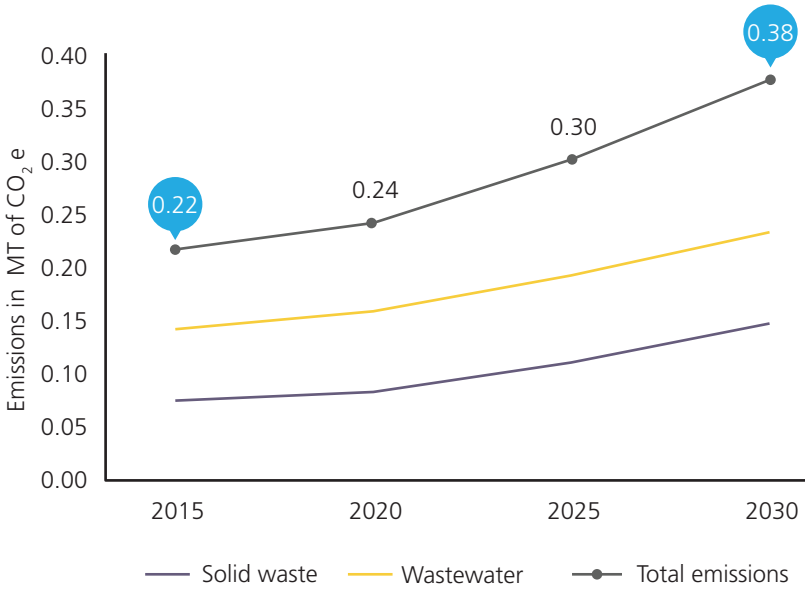
Waste sector emissions have increased by 77% since 2005

- Overall, waste sector emissions have witnessed slow growth in emissions between 2005 and 2019 (at a CAGR of 4.52 percent).
- Due to significant improvement in both sewerage treatment facility and sanitation coverage with respect to 2005 levels, total waste sector emissions have increased by 85.61 percent between 2005 and 2019.



Growth in emissions (2005-19)		
Category	CAGR	% share in waste emissions
Solid waste	5.92%	34
Domestic wastewater	3.89%	66

Figure 33: Share in waste sector emissions (2019)



Waste sector emissions to rise by 73% in BAU scenario

Figure 34: Projections for waste sector emissions (BAU)

3.2. Carbon footprint due to electricity consumption[13]

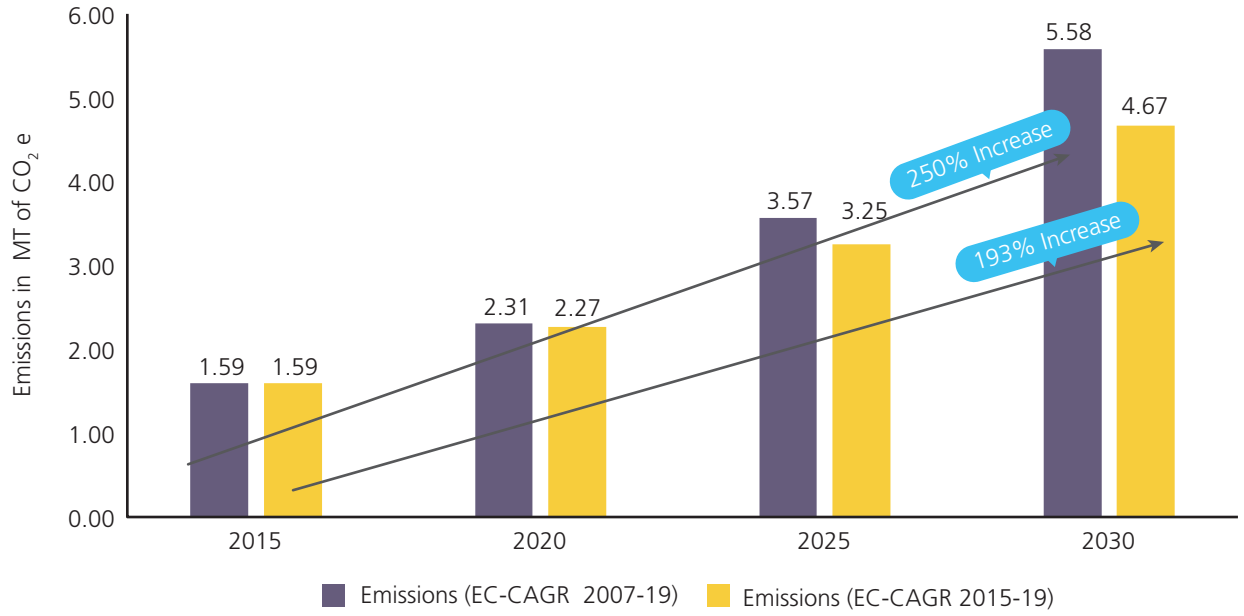


Figure 35: Carbon footprint of electricity consumption in Indore district (Mt of CO_2e)

- In 2018, besides emissions from the energy sector (1.76 Mt of CO_2e), electricity consumption in Indore led to another 1.99 Mt of CO_2e emissions at the site of electricity production, which is outside the district.
- These emissions are likely to grow by 193 percent (if the CAGR of shorter timeframe i.e., between 2015 to 2019 is applied on electricity consumption patterns).
- If the longer timeframe CAGR on electricity consumption (between 2007-19) is applied, the increase in emissions is 250 percent.

Table 15 Per capita electricity consumption in India and its cities[14]

City/region	kwh/person
Bhopal	588
Indore	**724**
MP	1,084
India	1,181
New Delhi	1,548
Mumbai	1,121
Ahmedabad	1,564
Chennai	1,366
Bengaluru	1,074

Emission from electricity consumption to increase

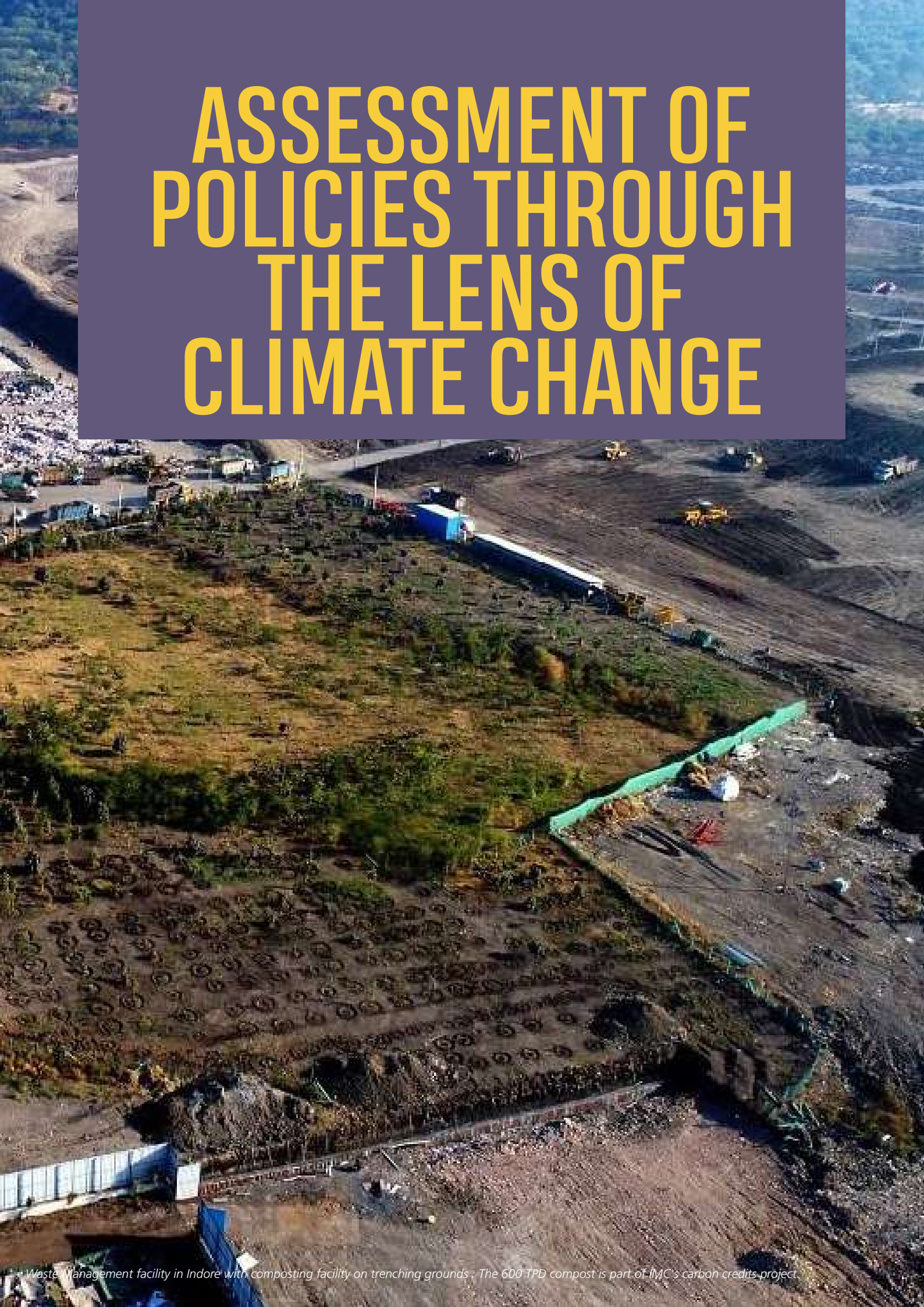
2.5 folds
w.r.t. CAGR 2015-19 and

2 fold
w.r.t. CAGR 2007-19

13 Grid emissions factor for electricity generated through coal = 0.86 kg CO_2/kWh; and through gas = 0.42 kg CO_2/kWh

14 Per capita electricity consumption for states is sourced from the following government website: https://pib.gov.in/PressReleseDetailm.aspx?PRID=1592833. For cities it is calculated on the basis of total electricity consumption.

ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE



Waste Management facility in Indore with composting facility on trenching grounds . The 600 TPD compost is part of IMC's carbon credits project

4. ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE

This section evaluates the impacts of various national and state level policies/programmes of three sectors – energy, AFOLU and waste – in Indore from the perspective of climate change mitigation. A total of 38 policies have been evaluated for these three sectors.

Emission calculation methodology for evaluating the policies has been derived from the 2006 IPCC Guidelines, peer-reviewed papers on policy impact evaluation, briefing papers and Phase III work of GHGPI. Relevant methodological assumptions were made after consulting the sectoral experts.

4.1. Sector-wise policy impact analysis

4.1.1 Power and energy sector

This section includes policies on clean energy, power, energy efficiency, residential and industrial energy, and transport. A total of 12 policies/ programmes have been evaluated for analysing the climate impact by computing the GHG emissions added or avoided by these policies.[15]

List of policies evaluated

Clean Energy

1) Solar Rooftop Policy, 2012, 2) Madhya Pradesh Policy for Decentralised Renewable Energy Systems, 2016, 3) Policy for the implementation of Solar based projects in Madhya Pradesh, 2012, 4) Madhya Pradesh Policy for Net-Metered Renewable Energy Applications, 2016.

Energy Efficiency in buildings, public infrastructure and industrial processes

1) UJALA Scheme, 2015, 2) Streetlight National Programme (SLNP), 2015, 3) Integrated Power Development Scheme (IPDS), 4) Restructured Accelerated Power Development and Reforms Programme (R-APDRP), 5) UDAY Scheme, 2015, 6) PAT (Perform, Achieve and Trade) Scheme, 7) BEE-SME Programme

Transport

1) BRTS Indore

Emissions evaluation

Amongst the policies evaluated,

- Solar energy generation helps in avoiding 24,326 tCO_2e emissions annually.
- Enhancing energy efficiency in buildings and processes has led to avoiding 27,73,714 tCO_2e emissions (UJALA Scheme- 1,98,354 tCO_2e; SLNP- 22,121 tCO_2e; IPDS, R-APDRP, UDAY – 25,27,151 tCO_2e; PAT Scheme- 25,868 tCO_2e; BEE-SME Programme – 220 tCO_2e), and
- 4,04,000 tCO_2e emissions have been avoided due to efficient interventions in the transport sector.

15 The detailed impact analysis of policies and programmes (giving information on input indicators, calculation methodology etc.) for energy is given in Annexure 4.1

Information gaps

1) Policies pertaining to renewable energy (a) Electricity generation from solar plants is not available (b) Installed capacity/electricity generation from W2E is unavailable.
2) Energy efficiency (a) Year-on-year data on the number of UJALA LEDs distributed and the number of LED streetlamps installed in the district is not available (b) Electricity consumption for the district is unavailable. Electricity consumption has been calculated by apportioning the population to the electricity supplied by the Discom.
3) Transport: Latest modal-share of transport for the district is required.

4.1.2 Agriculture, forestry and other land use (AFOLU) and cross-cutting[16]

The policies, programmes and schemes pertaining to agriculture, animal husbandry/livestock rearing and forestry have been grouped together as AFOLU sector initiatives to understand their impact on climate mitigation.

List of policies evaluated

For Indore district a total of eight policies/programmes under AFOLU sector and two additional policies of cross-cutting sector (agriculture and energy) have been considered for this evaluation.

Agriculture

(1) Soil Health Card Scheme, and (2) National Food Security Mission

Livestock

(1) Breed Improvement Programmes, (2) Vats Paalan Protsahan Yojana, and (3) Accelerated Fodder Development Programme

Forestry

(1) Gair Van Bhoomi par Vriksharopan Neeti, (2) Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980, and (3) Wildlife Protection Act, 1972

Cross-cutting (agriculture and energy)

(1) National Mission on Micro Irrigation, and (2) Pradhan Mantri Ujjwala Yojna

16 The detailed impact analysis of policies and programmes (giving information on input indicators, calculation methodology etc.) for AFOLU is given in Annexure 4.2 and for cross-cutting (agriculture and energy) in 4.3.

Emissions evaluation

An attempt has been made to quantify GHG emissions avoided/added by each initiative. However, for a few policies/programmes it could not be computed due to lack of required data/information.

- This exercise helped identify the total emissions avoided due to forestry policies at 59,502 tonnes of CO_2/annum.
- The breed improvement programmes proved to be beneficial for climate action as well by avoiding 5,859 tonnes of CO_2e.
- Agricultural policies could not be computed due to lack of required data for input indicators.
- Under the cross-cutting sector, the National Mission on Micro Irrigation resulted in avoiding approximately 1,407 tonnes of CO_2e emissions (from reduction in use of urea and reduction in energy consumption). Whereas, the Pradhan Mantri Ujjwala Yojana has helped mitigate 9,39,397 tonnes of CO_2e (scenario-1) and 82.562 tonnes of CO_2e. (scenario-2)

Information gaps

In order to accurately quantify the impact of these policies on the GHG emissions, the following data/information is needed:

1) Annual district-level data on diversion of forest area for non-forest purpose,
2) Livestock category-wise number of calves born through 'Vats Paalan Protsahan Yojana.
3) Area covered under Soil Health Card Scheme.
4) Reduction of chemical fertiliser use due to recommendations (followed by farmers) given in the soil health cards.
5) Percentage of pulses production that can be attributed to National Food Security Mission.

4.1.3 Waste management[17]

Waste sector policies implemented in the district were categorised into sanitation, waste management (solid, BMW and HW) and wastewater management (domestic and industrial).

List of policies evaluated

A total of 16 national and state-level policies/programmes were analysed to evaluate their contribution as emission mitigation strategies.

Sanitation

1) Total Sanitation Campaign, 2) Nirmal Bharat Abhiyan or Clean India Campaign, 3) Swachh Bharat Mission Urban, 4) Integrated Low-Cost Sanitation Scheme (ILCS), 5) Swachh Bharat Mission Rural, 6) Pradhan Mantri Awas Yojana, 7) Integrated Urban Sanitation Programme (IUSP)

Waste management

1) Solid Waste Management Rules, 2016 & Amendment, 2018: Integrated Solid Waste Management Projects (ISWM), Indore Smart City Development Corporation, 2) Bio-medical Waste Management Rules, 2016 & Amendment, 2018, 3) Hazardous & Other Wastes (Management and Transboundary Movement) Rules, 2016

Domestic and industrial wastewater

1) National River Conservation Plan, 2) Jawaharlal Nehru National Urban Renewal Mission on Urban Infrastructure and Governance, 3) MP Urban (ADB) Project, 4) Atal Mission for Rejuvenation and Urban Transformation (AMRUT), 5) Common effluent treatment plant (CETP) for medium and small-scale industries, 6) Online Continuous Emission Monitoring Systems (OCEMS)

17 Detailed impact analysis of policies and programmes (giving information on input indicators, calculation methodology etc.) for waste is given in Annexure 4.4.

Emissions evaluation

Along with the methane emission concerns from sanitary measures and sewerage treatment plants, the current evaluation has also considered the waste incineration emission potential for bio-medical waste and hazardous waste. The policy activities have led to an annual average:

- emission of 26,196 tCO_2e from individual household latrines (IHHL: two pit latrine) and 86,813 tCO_2e from community latrines (septic tank) constructed under sanitation programmes/policies,
- emission mitigation of 126,628 tCO_2e for biological treatment (composting) of MSW and 111.83 tCO_2e for incineration of bio-medical waste,
- emission of 78,405 tCO_2e for STPs constructed under sewerage connection programmes.

It must be noted that the implementation of these activities has avoided an annual average emission (with respect to baseline)[18] of 25,007 tCO_2e and 3,459 tCO_2e by sanitation and liquid waste management developmental/policy initiatives respectively in the district.

Information gaps

1) Sanitation: For old and completed policies, there is a gap in availability of data in public domain. In most cases, district-level data was not available.
2) Waste: District level hazardous waste incineration data was not available.
3) Domestic wastewater: No policy-wise data is available.
4) Industrial wastewater: Industry category-wise wastewater treatment and discharge data was not in public domain.

Gaps in policy and implementation

Power and energy sector

- **Renewable energy:**
  - Madhya Pradesh ranks #7 in total solar installed capacity among all the states in India. The current total solar installed capacity of Madhya Pradesh stands at 2.46 GW, 96.88 percent of which is ground-mounted and 3.12 percent is solar rooftop (MNRE). It is noteworthy that GoMP provides 30 percent subsidy to domestic consumers to install solar panels on rooftops or in any space available on the ground. Government buildings get 45 percent subsidy and certain government undertakings get a subsidy of 50 percent. Colleges and educational institutions can also install solar power units wherever free space is available on the ground. Despite these efforts, the state is deficient by around 3.24 GW of the state target of 5.7 GW installed solar capacity by 2022. Therefore, the state needs to enhance its endeavours in implementing solar projects. Madhya Pradesh already hosts Asia's largest single-site solar plant of 750 MW capacity in Rewa. The completion of the proposed solar power plants in Neemuch, Shajapur, Agar, Omkareshwar and Chhattarpur would not only help the state achieve its target, but also help it emerge as a leader in solar installations.

Current total solar installed capacity of Madhya Pradesh stands at 2.46 GW

96.88% of which is ground-mounted and

3.12% is solar rooftop

18 Quantification of impact of policies (considered in this study) on GHG emissions takes the baseline emissions into account

- Under CM Solar Pump Yojna (GoMP), in tandem with PM KUSUM Yojna (GoI), two decentralised solar plants have been installed in Indore district for captive electricity consumption by the farmers, under Scheme-A of PM KUSUM Yojna. However, Scheme-B of PM KUSUM Yojna is still in the application phase and stand-alone solar pumps are yet to be installed in the state. Enhanced endeavours of the state in implementing and capturing mass attention towards CM Solar Pump Yojna and PM-KUSUM Yojana would strengthen the RE infrastructure.

- **Transport sector policies:**
  - The modal share of public transport in Indore by ridership is 31 percent. However, currently most of the buses in the district still use diesel and CNG, indicating a critical gap in addressing easing out of policy restrictions on the procurement of e-buses.
  - Policy-level intervention is needed to improve BRTS and other public transport modes in terms of robustness, reliability, frequency and better reach in the district.
  - There is also a need of policies or programmes for greening of the transport sector.

AFOLU

- As seen in Chapter 3, the bovine population density of Indore is quite close to the state average. The trend in growth of livestock population of the district is also high. Indore may soon cross the state average of livestock/bovine population density. A rise in the number of low yield cattle will significantly add to enteric fermentation emissions. In order to curb emissions from the livestock sector, ground-level implementation needs to be strengthened for important policies like the 'breed improvement programme'.
- Indore's forest cover is currently decreasing at a very slow pace (compared to earlier). To ensure that the district's forest cover does not get impacted by rapid urbanisation, district-level initiatives are needed to not only curb the loss of forest cover but also to enhance it. These interventions, in the form of programmes, schemes and campaigns would help in the following ways:
  - The green cover will act as a sink for the district's GHG emissions.
  - Reduce the urban island effect.
  - Help India achieve the NDC target of creating additional carbon sink of 2.5 to 3 billion tonnes CO_2e by 2030.
  - Strengthen the dwindling ground water resources etc.
- The nexus between power and agriculture sector has a lacuna in policy-level interventions. Agricultural activities, such as non-judicious irrigation practices, lead to high electricity consumption patterns. Policies pertaining to electricity pricing, subsidies, and collection of tariffs must be revised.

Waste management

- Although waste generation and treatment reporting is mandated at the state level, the policy doesn't mandate districts to maintain and report data on the waste treatment methods adopted for any categories of waste, except for bio-medical waste.
- There are no policies that mandate the maintenance of data on domestic and industrial wastewater (industry category-wise) generation, treatment and discharge pathways.
- Waste policies do not suggest gas management/capture facilities for composting and incineration units for waste disposal.
- Reducing emissions in the area of waste transportation is not addressed in waste policies
- Although mentioned in the Solid Waste Management Rules, 2016, the producer take-back mechanism for disposables in municipal solid waste is never implemented as the policy does not suggest any monitoring or reporting framework for the same.
- E-waste Management Rules, 2016 recommends states to have e-waste inventory. Though Madhya Pradesh has an inventory for a few districts, including Indore, it is dated (2011) and needs to be upgraded in compliance with the latest rules.

Inventories of different waste streams are critical to waste sector emission estimates

BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION

Municipality worker cleaning the road outside Indore airport

5. BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION

5.1. Introduction to budgetary analysis

"The Climate Public Expenditure and Institutional Review (CPEIR)" methodology of UNDP is used to analyse regional expenditure on climate action. The CPEIR is a systematic qualitative and quantitative analysis of public expenditures and how they relate to climate change. Since 2011, CPEIRs have been conducted in many countries in Asia-Pacific, including Bangladesh, Indonesia, Nepal, Thailand and Vietnam, at both national and sub-national levels.

Analysis of select flagship schemes at the district level is presented in this chapter. A total of 39 national schemes were reviewed to identify those with climate resilience and mitigation relevance. Of these, based on the availability of information across districts as well as their relevance to climate actions, four schemes were selected for further analysis.

Annexures 5.1 and 5.2 detail the rationale, methodology and assumptions adopted to conduct district-level analysis.

5.2. Analysis and findings of flagship schemes

5.2.1 Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)[19]

2018-19

- Annual budgetary expenditure: ₹ 3,952.64 lakh
- Allocation to climate action: 18.79%
- Majority of climate action works: Water conservation and water harvesting and rural connectivity.

2019-20

- Annual budgetary expenditure: ₹ 3,834.24 lakh
- Allocation to climate action: 42.05%
- Majority of climate action works: Water conservation and water harvesting and rural connectivity

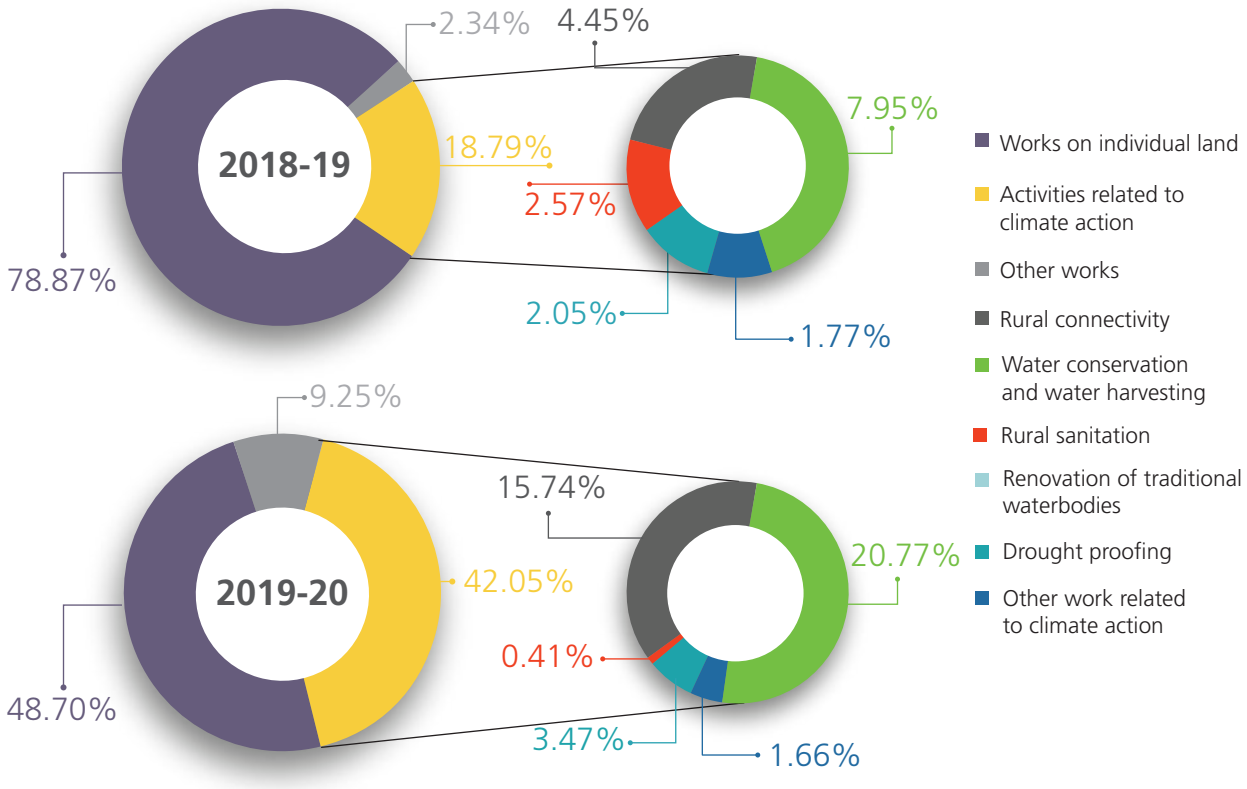


Figure 36: Expenditure distribution under MGNREGS in Indore (2018-19 and 2019-20)

19 Ministry of Rural Development (MoRD) lists 17 major activities under MGNREGS. Out of these, 11 can be assumed to be acting on climate change, categorised as mitigation-specific, resilience-specific or both, refer annexure 5.3 for details.

Annual expenditure (₹ lakh)

	Drought proofing	Rural Sanitation	Rural connectivity	Water conservation and water harvesting	Other works related to climate action
2018-19	81.09	101.58	175.84	314.13	69.99
2019-20	132.98	15.73	603.41	796.45	63.63

Figure 37: Comparing annual expenditure (₹ lakh) under MGNREGS in Indore between 2018-19 and 2019-20

5.2.2 Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

The micro-irrigation techniques employed in the Indore district under this scheme are: 1) Drip irrigation technique and 2) Sprinkler irrigation technique. Other works include building of community ponds, tanks, check dams, and earth dams.

Budget allocation	2016-17	2019-20
Budgetary spending on micro-irrigation activities (₹ lakh)	69.00	560
Budget attributed to climate action (69%) (₹ lakh)	47.61	386.4
State budget for PMKSY micro-irrigation (₹ lakh)	14,000	13,600
% attributed to climate action (micro-irrigation budget under PMKSY) given to district w.r.t state budget	0.34	2.84

5.2.3 Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) and Saubhagya Scheme

Until April 30, 2020, an amount of ₹ 9,131 lakh had been released to carry out the activities under DDUGJY and Saubhagya Scheme. Hence, an amount of ₹ 4,565 lakh can be attributed towards climate action for the district.[20]

5.2.4 Green India Mission (GIM)

For expenditure on the six sub-missions under GIM, the Department of Forests provides a five-year plan for the district. Figure 38 details the fund allocation in the district under GIM. As observed, major activities under the mission have been geared towards enhancing the quality of forest cover and improving ecosystem services, i.e., sub-mission 1 under the GIM.[21]

20 Works under the scheme include New substations, Augmentation substations, LT Lines, Feeder segregation, Consumer metering etc. See Annexures 5.2 and 5.3 for detailed methodology.

21 1) Enhancing quality of forest cover and improving ecosystem service
2) Ecosystem restoration and increase in forest cover
3) Enhancing tree cover in urban and peri-urban areas (including institutional lands)
4) Agro-forestry and social forestry (increasing biomass and creating carbon sink)
5) Restoration of wetlands
6) Promoting alternative fuel energy

Allocation (₹ lakh)

	Enhancing quality of forest cover and improving ecosystem service	Ecosystem restoration and increase in forest cover	Enhancing tree cover in urban and peri-urban areas (including institutional lands)	Agro forestry and social forestry (increasing biomass and creating carbon sink)	Restoration of wetlands	Promoting alternative fuel energy	Activities Cost
2018-19	3.34	0	1.66	0	0	0.37	0
2019-20	24.36	0	0.81	5.29	0	0	0.22

Figure 38: Mission-wise fund allocation (₹ lakh) under GIM in Indore district in 2018-19 and 2019-20

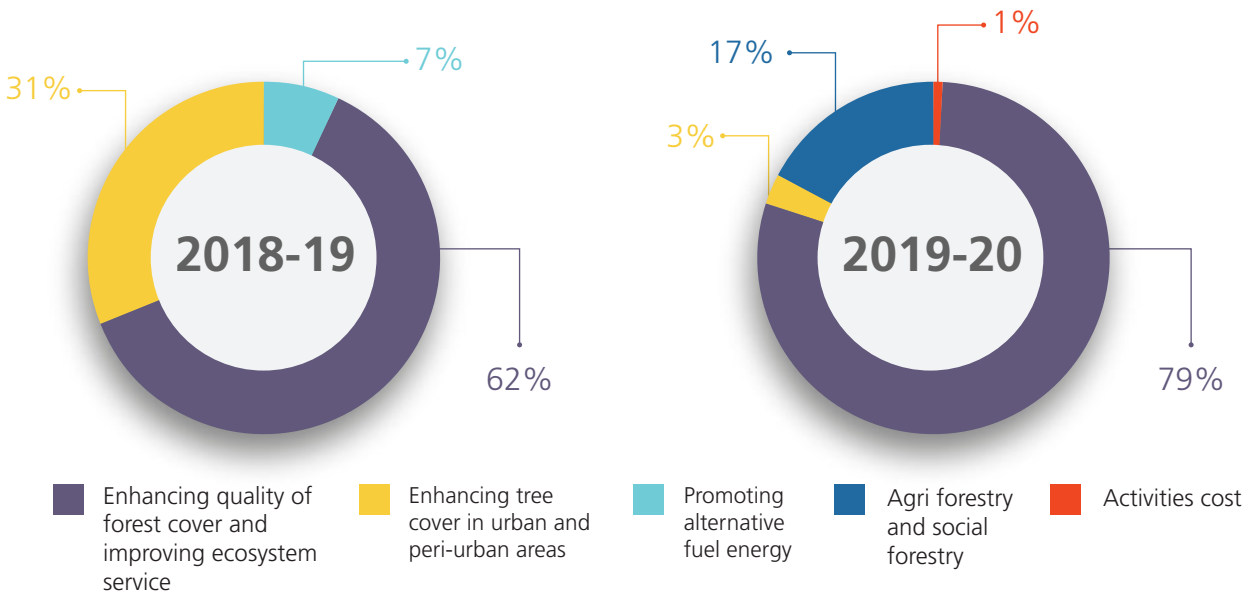


Figure 39: Mission wise fund allocations under GIM in Indore district (2018-19 and 2019-20)

5.2.5 Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

Based on the methodology and assumptions mentioned in Annexure 5.2, amounts of ₹ 129.36 crore, ₹ 160.18 crore and ₹ 191.51 crore can be attributed to climate action for Indore district in FY 2015-16, FY 2016-17 and FY 2017-20 respectively (see Figure 40 for budget expenditure by category).

Budgetary allocation (₹ crore)

	Water supply	Sewage and septage management	Urban transport	Drainage	Green space and parks
2015-16	79.90	41.66	3.76	0	4.04
2016-17	99.06	51.48	4.66	0	4.99
2017-20	118.28	61.67	5.58	0	5.98

Figure 40: Comparison of budgetary expenditure (₹ crore) on climate related activities under AMRUT scheme in Indore for 2015-16, 2016-17 and 2017-20

Further, Figure 41 gives a distribution of budgetary allocations between years 2015 and 2020 in Indore district, with the total allocation during this period being ₹ 917.49 crore.

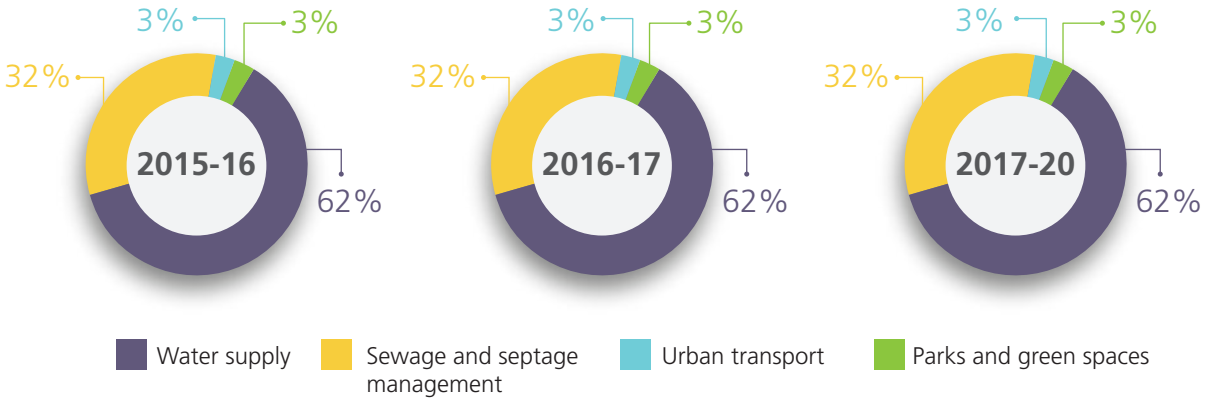


Figure 41: Distribution of climate relevant budgetary expenditure on activities under AMRUT scheme in Indore for 2015-16, 2016-17 and 2017-20


AC Bus
Smart Card

RECOMMENDATIONS

iBus, GPS-enabled Intelligent Transport System (ITS) in Indore

6. RECOMMENDATIONS

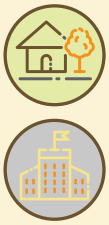
This section provides a comprehensive basket of sector-wise recommendations from a climate perspective, with an aim to complement India's 2030 NDC commitments through a district-level alignment in the form of this District Climate Change and Environment Plan. The salient features of these recommendations are as follows:

- Recommendations are grouped under four broad categories – energy; agriculture, forestry and other land use (AFOLU); waste; and district-specific environmental issues.
- The recommendations in the action plan can potentially mitigate 51,23,069 tCO_2e in Energy sector, 12,31,468 tCO_2e in AFOLU, and 99,613 tCO_2e in Waste sector.
- Actions under each category on which recommendations can be made by the district collector/committee to the relevant state departments as well as inputs on innovative financing have been identified.
- These recommendations are based on district-specific ground realities and situations.
- The state and district vision documents were factored in while developing the recommendations.
- Information provided on timeframe and framework for implementation would enable the district authorities and concerned departments prioritise actions.
- List of existing policies, programmes and schemes that can help streamline actions is provided along with the concerned primary and supporting departments in a separate table following each sectoral recommendation matrix.
- Additionally, this section provides information on SDGs and other co-benefits that can be addressed through the recommendations mentioned in this action plan.
- Further, the cross-sectoral benefits of each recommendation have been identified and indicated using the icons as listed in the table below:

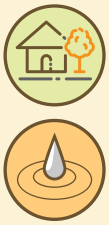
	Energy and electricity		Green space, forestry and allied activities and bio-diversity
	Habitat (residential)		Water resources and water conservation
	Commercial and public infrastructure		Solid waste
	Transport		Wastewater
	Industry		Air pollution
	Agriculture and allied activities		Awareness, communication and capacity building

6.1. Sector-specific recommendations

6.1.1 Electricity and energy: Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Increasing RE share in electricity generation basket				
Increase the share of renewable energy (RE) generation by advancing rooftop and ground-mounted installations, and other RE installations.		Short to medium-term (government. buildings) Medium-term (commercial buildings) Medium to long-term (residential and others)	Policy framework and RE targets exist. (section 6.1.1.1) Need to create awareness in residential sector	India has a target of 40 GW for solar rooftop (2022). However, as of February 28, 2021, only 4.32 GW has been achieved. The state of Madhya Pradesh has a solar rooftop capacity of only 76.91 MW (as of February 2021). Case example calculation: a. If equipped with solar rooftops, the government schools in Indore district alone can generate 56.83 MUs electricity, thereby avoiding $MtCO_2e$ emission annually. b. If 50% of the commercial buildings in Indore district are equipped with solar rooftops (having a potential of 870 MW), 0.91 $MtCO_2e$ emission can be avoided annually. c. Further, if 50% households in the district are equipped with solar rooftops, total potential installed capacity would be 2,304 MW, which can help avoid 2.95 Mt CO_2e emission annually. Meeting the solar rooftop targets can be fast-paced by making it mandatory for hospitality industry/ new construction (having a built-up area greater than 20,000 sq ft) / private health-care infrastructure (above certain bed-capacity). Ground mounted solar: The current installed capacity of ground mounted solar in Madhya Pradesh stands at 2.38 GW (as of February 2021). Indore district has a huge potential for solar power generation (rooftop and ground mounted). In Indore city, which is highly industrialised and urbanised, solar rooftop installation can be promoted, while for the rest of the district, ground-mounted solar installations can be a more viable option.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Battery storage to be promoted aggresively.		Short to medium-term	Additional financial spport can be created	Case example: Maharashtra Energy Development Agency has installed 650 Ah batteries for a few solar projects and has proposed hybrid inverters for RE projects across Maharashtra. Hybrid inverters take power from battery/RE installation up to a particular load, and on increased demand, they switch to the grid supply. Similar initiatives can be taken up in the district.
Encourage captive use of renewable energy, particularly, in rural areas for small industries and creation of local entrepreneurs.		Short to medium-term	Policy framework exists Need to generate awareness	By 2030, the district's electricity demand is expected to be around 7,000 MUs, annually. If all of this is supplied from coal, around 6 $MtCO_2e$ would be emitted, annually. Decentralised renewable energy (DRE) setups can power/boost small/cottage industries and can play an important role in providing livelihoods in rural areas as well as support reverse-migration (that was recently witnessed during the COVID-19 pandemic). Such setups would also create new jobs and empower rural entrepreneurs. Cold storage network across the district can be powered through DRE. Besides storing farm produce, such set-ups can also be useful for storing vaccines.
Energy demand-side management (DSM) and energy efficiency				
Encourage faster penetration of Street Lighting National Programme (SLNP). This would ensure all street and public lighting fixtures are replaced with energy-efficient LED bulbs. Priority must be given to premises and recreational areas of all government / public institutions.		Short-term	Policy framework and schemes exist	Smart streetlighting can reduce electricity use by up to 80%. Around 320 million streetlighting poles are in use globally, but fewer than 3% of these are smart enabled (International Energy Agency, 2021). SLNP had a national target of replacing 1.34 crore conventional street lamps with LED lamps by March 2020, but till date only 1.18 crore LED lamps have been installed. In Indore district, under the SLNP, if 20,000 existing conventional lamps are replaced by LED lamps, about 10,533 tCO_2e emission can be avoided, annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Expedite the installation of smart meters in collaboration with MPPMCL in an effort to develop advanced metering infrastructure (AMI). Smart meters would allow the DISCOM to obtain real time energy consumption data of each consumer for subsequent analysis and will pave the way for initiating various smart measures like: a. Time of day (TOD)/time of use (TOU) billing b. Prediction and managemen t of peak demand c. Providing real time energy consumption data to consumers d. Prepaid billing facility e. Remote connection and disconnection of load f Development and adoption of a differential pricing model to demotivate energy consumption during peak hour, etc.		Short to medium-term	Policy framework and targets exist (section 6.1.1.1) Awareness generation for consumer segment	Implemented by EESL (BEE), Smart Meter National Programme aims to replace 25 crore conventional meters across the country with Smart Meters. MPPKVVCL's smart metering project, commenced in 2019, entailed the installation of about 1,40,000 smart meters in Indore Smart City at a cost of around ₹ 60 crores. The project, one of the biggest in terms of smart metering installations in the country, made Indore the first city in the country to have more than 1 lakh smart meters installed.
Replacement/upgradation of existing inefficient pumping infrastructure by energy-efficient pumps/solar pumps (where possible) for supply of piped drinking water in both rural and urban pockets of Indore district.		Short to medium-term	Relevant schemes and programmes can help achieve this (section 6.1.1.1) Inter-departmental collaboration Is required	MPUVNL has been designated as the nodal agency for the Municipal Energy Efficiency Programme (MEEP) in Madhya Pradesh. This programme aims to save 120 MW through energy efficiency projects in 134 ULBs.
In agriculture sector, promote energy efficient water pumps (provided by EESL), and solar pumps, wherever possible (through PM-KUSUM and CM's Solar Pump Scheme).		Short to medium-term	Policy framework exists (section 6.1.1.1)	According to BEE, 30% to 40% energy savings are possible by adoption of energy-efficient star-labelled pump sets. Conversion of 50% of the existing electricity/diesel operated tube-wells to solar in the district can save 83,144 tCO_2e emissions annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Increase community awareness on and access to energy-efficient appliances and fixtures. Provide additional incentives over and above existing schemes/programmes on energy-efficient appliances. (Other recommendations pertaining to energy efficiency are listed under sections: Habitat, industry and other recommendations that can be made by the collector's office to the state departments)		Medium-term	Additional financial support can be created Creating awareness through dedicated IEC and long-running campaigns	Case example: BSES Yamuna Power Ltd (BYPL) launched an AC replacement scheme in Delhi NCR with the objective of promoting energy efficiency among households. Under the programme, upfront rebate per air conditioner (BEE 5-star rated/ inverter) was offered by BYPL to the consumer in exchange of their old non-star rated air conditioner. MPPKVVCL can implement a similar scheme in its area of supply, with a pilot in Indore district.

6.1.1.1 Electricity and energy: Policy framework and concerned departments/agencies

Sub-sectors	Policies and programmes[22] that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Increase RE share in the electricity generation basket	1. MP Solar Policy, 2012 2. MP Policy for Decentralised Renewable Energy Systems, 2016 3. Waste to Energy Policy, 2016 4. National Solar Mission 5. i-SMART Project 6. PM KUSUM	1. MPUVNL, GoMP 2. Energy Department, GoMP	1. ALL ULBs 2. Madhya Pradesh Electricity Regulatory Commission (MPERC) 3. Rural Development Department, GoMP 4. Urban Development and Housing Department, GoMP 5. State Knowledge Management Centre on Climate Change (SKMCC) - EPCO 6. Department of Cottage and Rural Industries, GoMP 7. MPPMCL-MPPKVVCL, GoMP 8. Department of Agriculture, GoMP 9. Proposed District-level Committee on Climate Change and Environment
Energy demand-side management (DSM) and energy efficiency	1. Smart Meter National Programme (SMNP) 2. National Smart Grid Mission 3. Streetlight National Programme (SLNP), 2015 4. UJALA Scheme, 2015 5. Standards and Labelling Programme, BEE 6. Sustainable Habitat Mission 7. Smart Cities Mission 8. National Mission for Enhanced Energy Efficiency 9. Municipal Energy Efficiency Programme (MEEP) 10. PM KUSUM 11. MP Solar Policy, 2012 12. MP Policy for Decentralised Renewable Energy Systems, 2016	1. MPUVNL, GoMP 2. BEE (EESL) 3. All ULBs 4. Panchayati Raj Institutions (PRIs) 5. Energy Department, GoMP	1. State Knowledge Management Centre on Climate Change (SKMCC)- EPCO 2. Department of Agriculture, GoMP 3. Urban Development and Housing Department, GoMP 4. Indore Smart City Development Corporation Limited (ISDCL) 5. Proposed District-level Committee on Climate Change and Environment

22 This column enlists information on policies, programmes, rules, schemes and other regulatory provisions pertaining to the sector

6.1.2 Habitat (urban and rural development): Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Energy efficiency in buildings				
Incorporate Energy Conservation Building Code (ECBC) in the building bye-laws and encourage green buildings rating programme.		Medium to long-term	Policy framework exists (section 6.1.2.1) Inter-departmental collaboration required Need for capital incentives over and above the existing provisions from the district administration	The residential and commercial sectors consume around 27% of the total electricity in the district. MPUVNL is working towards incorporating ECBC into building compliance systems in MP. By 2025, if 23% of the existing residential area becomes ECBC compliant, 1.08 $MtCO_2e$ emission can be avoided.
District administration, in collaboration with the ULBs, can implement the India Cooling Action Plan (ICAP) and achieve its objectives. District administration can also explore the possibilities of piloting solar-passive architecture/other renewable energy technologies in a few of its iconic buildings. Implementing this at the district level can help avoid significant GHG emissions.		Medium-term	Policy framework exists (section 6.1.2.1) Needs inter-departmental collaboration Requires capital incentives from the district administration	In September 2018, India became the first country in the world to have a Cooling Action Plan, which seeks to (i) reduce cooling demand across sectors by 20% to 25% by 2037-38, (ii) reduce refrigerant demand by 25% to 30% by 2037-38, (iii) reduce cooling energy requirements by 25% to 40% by 2037-38, (iv) recognise "cooling and related areas" as thrust area for research under national S&T Programme, (v) training and certification of 1,00,000 servicing technicians by 2022-23, in synergy with the Skill India Mission. The plan aims to provide the following benefits (i) Thermal comfort for all – provision for cooling for EWS and LIG housing; (ii) Sustainable cooling – low GHG emissions related to cooling; (iii) Doubling farmers' income through better cold chain infrastructure; (iv) Skilled workforce for better livelihoods and environmental protection; (v) Make in India – domestic manufacturing of air-conditioning and related cooling equipment; among other benefits.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Replace diesel-powered backup with solar-powered or any other RE powered backup in a phased manner. This can essentially be promoted in government / commercial/ institutional buildings with built-up area >20,000 sq ft.		Short to medium-term (government. buildings) Medium to long-term (privately owned, commercial, institutional, and other buildings)	Policy intervention is required Needs inter-departmental collaboration	A diesel generator (DG) of 200 kW (used in industries/huge commercial buildings) operating at full-load consumes approximately 45 litres diesel/hour. This results in usage of around 117 $kgCO_2e$/hour. Replacing DG sets with solar-powered backup can help in avoid these emissions.
Promoting formulation of energy communities in existing RWAs/ other residential committees where residents have ownership over their energy supply. Energy communities can host wind and solar generation installations, or a self-sufficient system functioning as a microgrid/undergrid-minigrid. These committees can make agreements between the community, the private developer and the utility company. Digitalisation can create innovative billing mechanisms and generating data that will provide important investment information to the energy market. Deploying public funding schemes like feed-in tariffs; leverage national and international funds; and providing digital upskilling opportunities to citizens can help promoting the initiative.		Medium-term	Can be pushed forward by aligning with existing policy framework	
Upgrade public transport infrastructure such as bus depots, bus stops, railway stations etc. to include RE and ECBC compliance. Further, roadside advertising near such infrastructure can also be powered through RE. This can eventually be scaled up for hoardings across the district.	 	Short to medium-term	Can be pushed forward by aligning with existing policy framework for solar rooftop (section 6.1.2.1) ECBC compliance of public transport infrastructure to be mandated by building bye-laws	Indore district can adopt and implement initiatives, similar to the one in Lucknow, where the municipal corporation has said it would set up 200 solar-powered bus stops.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Encourage fast penetration of UJALA scheme in every household.		Short to medium-term	Schemes and programmes are available (section 6.1.2.1)	The UJALA scheme provides an LED bulb at a nominal price for replacement of incandescent lamps /conventional bulbs. A projected number of LED bulbs to be used in Indore households by 2030 can potentially avoid 49,392 tCO_2e emissions, annually.
Energy-efficient vertical urban development should be promoted (instead of horizontal development) to conserve green cover.		Medium to long-term	Policy level intervention required	Vertical urban growth not only facilitates settlement of more people per sq m, but also contributes towards the environment. It averts the loss of agricultural land and makes the transport system much more efficient. India has high-rise buildings in Mumbai, Delhi NCR and Bengaluru. Other cities like Kolkata, Chennai, Hyderabad and Ahmedabad are also catching up.
Enhance public awareness for switching to energy-efficient BEE star labelled home appliances.		Short-term and continuous	Needs collaborations and awareness	
Demand-side management				
Promote and subsidise good practices for all ULBs. For instance, installing rainwater harvesting (RWH) in buildings can considerably reduce energy dependence on submersible motors for pumping groundwater.		Short-term	Schemes and programmes exist (section 6.1.2.1) Need to generate awareness	Indore Municipal Corporation (IMC) has mandated RWH in all new buildings with an area of 250 sq m or more. Above this, a rebate of 6% on property tax is provided as an incentive to install RWH. Government of Madhya Pradesh is planning to scale-up the Indore model across the state.

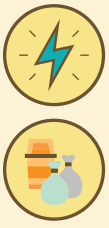
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Implement individual water metering in residential sector to reduce water wastage and introduce other energy efficient measures for drinking water and wastewater plants, thereby, bringing down energy consumption.		Medium-term	Policy intervention is required Need to generate awareness	In many cities, drinking water and wastewater plants are municipally owned and are among the largest municipal energy consumers, often accounting for 30% to 40% of total municipal energy consumption. By incorporating energy efficiency measures into their water and wastewater plants, municipalities can save 15% to 30% of their municipal budgets. To check wastage of drinking water, IMC has linked water distribution to a supervisory control and data acquisition (SCADA) system. IMC has installed water meters in nearly 1,000 houses to record the units of water utilised per house. It is planning to scale-up the practice across the city. Narmada river water supplied to the city is the costliest in the country. It costs IMC ₹ 30/1,000 litres to collect, purify and transport drinking water from Jalud pumping station to houses in Indore.
Encourage residential societies to adopt solar-thermal water heaters.		Short-term and continuous	Schemes and programmes exist (section 6.1.2.1) Inter-departmental collaboration is required Scheme to be implemented as a part of green buildings	As a general rule, for multi-storey residential buildings (up to 12 storeys) community solar water heating systems on the roof (assuming utilisation of 60% of the roof area) can meet around 70% of the annual electricity requirement for heating water (BEE).
Promote installation of automatic/ smart water pumps to control overflowing of tanks.		Short-term	Need to generate awareness	
Water cess/pricing by the municipal corporation to be revised and gradually increased.		Medium-term	Policy framework needs to be updated	
Digital tools, like, GIS, remote sensing can used to identify opportunities to reduce energy demand as well as where energy efficiency interventions hold the most value, and where and how to set up mixed-use zones to flatten demand curves. Energy demands (for cooling) of the district can be mapped, combining weather data with demand data, to identify where efficiency interventions are needed.		Medium to long-term	Needs policy intervention and infrastructural development	Reduced energy demand example: by finding the optimal locations for water features or vegetation to counteract heat islands, or trees to provide shading and reduce cooling demand in buildings

6.1.2.1 Habitat: Policy framework and concerned departments/agencies

Sub-sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Energy efficiency in buildings	1. ECBC, 2017 2. India Cooling Action Plan, 2018 3. UJALA Scheme, 2015 4. MP Solar Power Policy, 2012 5. MP Policy for Decentralised Renewable Energy systems, 2016 6. Smart Cities Mission 7. Sustainable Habitat Mission	1. Urban Development and Housing Department, GoMP 2. All ULBs 3. Indore Smart City Development Corporation (ISDCL) 4. Panchayati Raj Institutions (PRIs)	1. MPUVNL, GoMP 2. State Knowledge Management Centre on Climate Change (SKMCC)-EPCO 3. BEE (EESL) 4. Rural Development Department 5. MP Road Development Corporation Limited (MPDCL) 6. MP Transport Department 7. Proposed District-level Committee on Climate Change and Environment
Demand-side management	1. MP Jal Viniyaman Adhiniyam, 2013 2. ECBC 3. Building Bye-laws 4. Comprehensive General Development Control Regulations – Urban Development and Housing Development	1. Urban Development Housing Department, GoMP 2. All ULBs 3. Rural Development Department 4. Panchayati Raj Institutions (PRIs)	1. MP Jal Nigam. 2. Indore Smart City Development Corporation (ISDCL) 3. MPPCB 4. Proposed District-level Committee on Climate Change and Environment 5. State Knowledge Management Centre on Climate Change (SKMCC)-EPCO

6.1.3 Transport: Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote e-mobility				
Generate awareness to encourage adoption of electric vehicles.		Short-term and continuous	Inter-departmental collaboration and dedicated, long-running campaigns are required	MP EV Policy 2019 plans to declare Indore as model electric mobility (EM) city. Planned awareness campaigns can encourage widespread acceptance of EV in the district.
District should endeavour to increase the modal share of e-vehicles to achieve the target of National Electric Mobility Mission Plan (NEMMP) and FAME II.		Short-term and continuous	Policy framework exists (section 6.1.3.1) and budgetary provisions can be made available through various schemes	The MP Electric Vehicle Policy 2019 aims to increase the modal share of electric vehicles in major cities of Madhya Pradesh, including Indore, through the introduction of electric buses, two-wheelers, three-wheelers and cars in the cities.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Make all public transport (PT) modes low carbon-intensive, such as shifting current fossil fuel-based vehicles to electric-powered or hybrid vehicles.		Medium to long-term	Policy framework (section 6.1.3.1) and budgetary provisions exist	In November 2019, NTPC announced plans to procure and operate 250 electric buses for three cities in MP – Jabalpur, Bhopal and Indore. Atal Indore City Transport Service Limited (AICTSL) procured 40 electric buses in the city as part of its public bus service in 2019. The MP EV Policy 2019 aims to achieve 25% new EV registrations in public transport by 2026. It also targets 100% conversion of current public transport bus fleet into electric buses by 2028. Further, the policy also states that electric buses procured in the first five years will be charged 1% motor tax and will be exempted from vehicle registration fees.
Initiate transition of intermediate public transport (IPT) vehicles to electric by incentivising operators through: a. subsidies, b. separate lanes, c. dedicated parking spaces, d. replacement of lead acid battery powered electric IPT vehicles with more sustainable Li-ion battery e-vehicles in a phased manner.		Medium-term	Policy framework for the recommendation exists (section 6.1.3.1)	Currently, there are more than 1,800 electric rickshaws in Indore. In MP, subsidies are being provided for electric autos and other IPT vehicles under FAME II. The MP EV Policy, 2019 also states that for the first five years, e-rickshaws and e-autos will be charged only 1% motor tax. The vehicle registration fee will also be exempted for the period. Further, these vehicles will not be charged parking fee at ULB-run parking facilities for the initial five years. In addition, the district can provide dedicated parking spaces and plan for separate lanes for electric IPT vehicles.
District administration, ULBs (for office use + solid waste transport activities) and all district-level government offices can adopt e-vehicles. Additionally, all these offices need to install charging infrastructure at the earliest.		Short to medium-term	Needs policy backing	The MP EV Policy, 2019 has recommended all government office buildings to install charging infrastructure. Indore can lead by example and encourage government departments to transition their fleets to EV-based vehicles. Atal Indore City Transport Service Limited (AICTSL) has partnered with EESL and TATA Motors to deploy a fleet of 50 electric cars in the city. Further, in December 2020, the Power Department in Indore announced its plans to transition to electric vehicles. A charging station is also being set-up at Polo Ground to ease this transition.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Develop robust and widespread charging infrastructure. a. Charging infrastructure to be set up at strategic locations, such as commercial hubs, public parking, airports, railway stations etc., preferably RE powered. b. Adoption of relevant policies. c. Prioritise land acquisition for setting up charging infrastructure. d. Dedicated parking spaces for EVs should be introduced with charging facilities. e. Restaurants and commercial spaces on highways can be incentivised to install charging infrastructure for e-vehicles to make long journeys with e-vehicles hassle-free. f. As a cost-effective solution to reduce street clutter and to open access (particularly for those without garages), integrated EV charging points into lampposts can be evaluated as a trial solution for further implementation possibilities.		Medium-term	Policy framework exists (section 6.1.3.1) Inter-departmental collaboration required	Indore city has charging stations at select locations. AICTSL has planned further expansion of charging infrastructure in the city. District authorities can promote EV charging infrastructure installation at key locations such as local markets and recreational areas near lakes where they can collaborate with/incentivise business owners to set up charging points.
The district administration, in collaboration with the ULBs and state officials, may explore options to provide incentives to e-vehicle owners over and above existing programmes through: a. exemptions on road tax, b. exclusive parking, c. additional subsidy scheme for women and students.		Short-term	Enhancing the existing policy frameworks towards holistic integration of EVs	The MP EV Policy, 2019 has a target of increasing the modal share of EVs and has recommended means to promote EV, as listed in the points above. Indore can lead by example by easing transition to EV through these additional incentives.
Promote fast registration of EVs at RTO		Short-term	Need to generate awareness in order to popularise EVs Inter-departmental coordination required	MP EV Policy 2019 has provisions to incentivise adoption of EVs, including exemption from vehicle registration charges and road tax (for the first five years).

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Encourage development of local network of e-vehicle rentals across the district (including cars and bikes) as well as a battery rental network for faster adoption of EVs. Further, this can be integrated with smart cards.		Medium-term	Needs policy backing	The successful rental model of Yulu bikes in Bengaluru can be emulated to develop hour-based electric bike rentals for key routes. These bikes can be a part of an integrated ticketing system that utilise smart cards for payments. MP EV Policy, 2019 also promotes battery swapping stations for ease of transition to EVs.
Encourage and promote adoption of EVs for all delivery operations within the district		Short to medium-term	Policy framework is required	Currently, most delivery partners for food, courier and other kinds of services rely on self-owned, fossil fuel-based two or four-wheelers. In some cities, certain companies are working towards developing an electric vehicle fleet. The district can recommend a transition to electric vehicles for such delivery persons.
Range anxiety is a key barrier to EV adoption. Mobile applications (local app, google map, etc) with real-time data availability of charging points and the cost of charging at various locations will be critical to ensure the popularity of EV by allowing the EV users to plan routes that identify charging points.		Medium to long-term	Needs support for digitalisation	
Smart lampposts can radically improve electrical efficiency and enable a number of new services, like, being equipped with PV modules to harvest and store solar energy during the day to power lighting at night and with sensors and communication technologies that can adjust their output according to ambient light levels, monitor traffic, noise and air pollution, seismic activity and increase coverage of cellular and Wi-Fi networks.		Medium to long-term	Needs technological, infrastructural and policy interventions	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Public transport (PT) and intermediate public transport (IPT)				
Increase reliability, accessibility and enhance last mile connectivity of public transport (PT) and intermediate public transport (IPT) through: a. integrated ticketing and smart cards that work across all transport modes (IPT, cycle hire, etc), b. integrating smart mobility applications with real-time service updates across modes, including car hire, public transit and shared micro-mobility schemes, c. increasing fleet strength, d. increasing frequency, e. adding more stops, f. enhancing reach to low/ non-serviced areas, peri-urban and rural areas, g. developing dedicated parking spaces for IPT.		Medium to long-term	Existing policy framework needs to be enhanced Inter-departmental collaboration required	Public transport services in Indore include AICTSL and Indore Bus Rapid Transport System (IBRTS), called iBus and Skybus, as well as private buses operating on 24 routes. iBus: Route length 12 km, one route, fleet strength 88 buses. Atal City Bus: Route length 277km, >16 routes, fleet strength 110 buses, 120 stops. The option of smart card, called Chalo Card, for PT payments is available. However, it has not been popularised. Further, introducing a smart card that works across all transport modes (IPT, cycle hire etc), entry to tourist sites, payment for rental vehicles among other things can make PT and IPT more popular with increased ease of use. Peri-urban areas are currently connected through MPRTC services. The frequency of services can be enhanced. iBus and Atal City Bus services can also be extended to these areas. The share of IPT by ridership in Indore city is 54% with majority of the population opting for private vehicles for commuting. Currently, IPT sector is largely an informal sector, and is limited to certain routes. The informal IPT modes operating in the peri-urban areas of the district include mini buses, shared autos, omni vans and jeeps. Residents in city outskirts/ peri-urban areas majorly rely on private vehicles or walking. Formalising this mode and transitioning it to a low-carbon regime is essential to reducing GHG emissions from the transport sector in Indore.
District administration can collaborate with ULBs to develop fiscal measures to discourage the use of personal vehicles through measures like variable parking charges for peak hours.		Short-term and continuous	Requires policy framework based on research and inter-departmental cooperation	Indore can adopt recommendations from Delhi Master Plan 2021, which provides a parking district management plan. The action plan suggests that the transport department, municipal corporations, traffic police and other agencies need to collaborate to develop and maintain parking areas. The plan also suggests that variable and time-based parking prices should be introduced.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Implement policy measures to discourage use of private vehicles: a. parking policy for vehicle ownership, b. no car days on certain roads, c. parking allowed only in dedicated areas.		Short to medium-term	Requires proper policy backing based on research and inter-departmental cooperation	For example: 1) Sikkim Parking Policy, 2010, mandates that only houses with parking slots can procure vehicles. 2) In February 2016, Gujarat University had announced that the first and the 15th of each month will be observed as no vehicle days when only public transport and pedestrian movement would be allowed.
Improve enforcement of vehicular pollution control norms to minimise emissions from fossil fuel-based PT and IPT vehicles.		Short-term and continuous	Policy framework exists (section 6.1.3.1) and needs stricter implementation	
Awareness campaigns to popularise PT and IPT modes		Short-term and continuous	Dedicated awareness campaigns required	The Swachh Bharat Abhiyan – Indore campaign has been a success, with the city consistently making it to the top for four consecutive years in the Swachh Survekshan. The campaign design encouraged people's participation in making Indore the cleanest city in India. A similar campaign design – with catchy slogans, road paintings, appropriate messaging on social media, local channels and news – can be adopted to encourage the use of public transport.
Augment non-motorised transport (NMT)				
Improve infrastructure to enhance modal share of NMT transport options in urban areas, by introducing measures such as segregated cycle lanes.		Medium-term	Policy based on research and inter-departmental cooperation required	Current modal split in Indore indicates that the share of NMT is approximately 10%. However, it has been decreasing over the years. Efforts are needed to make NMT a preferred and viable option.
Regular O&M of NMT infrastructure: a. developing and maintaining well-lit, clean and safe pathways for pedestrians and cyclists, b. consulting and engaging local experts and community for development and maintenance, c. removing encroachments.		Short-term and continuous	Policy framework exists Requires inter-departmental cooperation	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote cycle hire service in key locations across the district.		Short-term	Proper policy backing and strategic awareness drives required Further, PPP models can be explored for successful implementation	The iBike initiative, a bicycle rental service, was launched in 2017. However, its popularity is low. Indore can emulate the Bhopal Smart Bike Sharing Service, which was introduced in 2017. In the first phase, 50 locations were chosen to set up rental stations in the city. In the second phase, the network expanded, and users can now register for the bikes through the website or an app. Strategic placement of cycle hiring stations, ease of use and reasonable pricing schemes can help popularise the programme.
Improving traffic flow				
Promote staggered and flexible work timings to limit traffic movement at peak hours to and from key busy routes across the district.		Short-term	Needs policy based on research, along with multi-stakeholder and inter-departmental cooperation	Indore district can adopt the following best practices to minimise congestion at peak hours: In 2019, the Delhi government decided to stagger working hours of its offices during the implementation of the 12-day odd-even scheme, a move aimed at reducing traffic congestion and pollution in the city. Similar shift in work timing is also being planned in Bengaluru.
a. Create additional dedicated parking zones for vehicles in order to deter encroachment of road space and pavements. b. Encourage business/ corporate centres to have mandatory private parking with sufficient parking slots to avoid parking on roads, service lanes and other public spaces.		a. Medium-term b. Short-term and continuous	Policy framework exists Multi stakeholder and inter-departmental cooperation is required.	Indore has multiple parking spaces available. However, since awareness and maintenance of these spaces is poor, usage is also low. The municipal corporations and district authorities need to work towards building awareness and encouraging the use of parking facilities.
Develop dedicated areas for street vendors to deter them from encroaching upon pavements that cause traffic congestion along the roadsides.		Short to medium-term	While the policy framework exists, implementation is irregular and for shorter time-frame. Multi-stakeholder and inter-departmental cooperation are required.	There are regular drives by the IMC and the city police to clear encroachments. However, these affect the livelihoods of street vendors.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Regular maintenance of roads to ensure smooth flow of traffic, since it can help reduce GHG emissions while also extending the life of the road.		Short to medium-term and continuous	While the policy framework exists, implementation is lacking in some areas. Multi-stakeholder and inter-departmental cooperation are required	

6.1.3.1 Transport: Policy framework and concerned departments/agencies

Sub-sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Promoting e-mobility	1. FAME II 2. Madhya Pradesh EV Policy, 2019 3. JNNURM 4. National Electric Mobility Mission Plan 5. Smart Cities Mission 6. AMRUT 7. Proposed e-vehicle Policy (as per 2021-22 Union Budget) 8. National Urban Transport Policy, 2006	1. All ULBs 2. RTOs 3. EESL	1. Urban Development and Housing Department, GoMP 2. MPUVNL 3. Transport Department, GoMP 4. Roads and Buildings Department, GoMP 5. State Knowledge Management Centre on Climate Change 6. Rural Development Department, GoMP 7. Indore Smart City Development Corporation Limited 8. PRIs 9. Airport Authority of India 10. Central Railways – Indore Division 11. Proposed District-level Committee on Climate Change and Environment
Public transport (PT) and intermediate public transport	1. BRTS 2. JNNURM 3. ECBC 4. Smart Cities Mission 5. AMRUT 6. National Urban Transport Policy, 2006	1. All ULBs 2. Indore Smart City Development Corporation Limited 3. MPSRTC	1. Urban Development and Housing Department, GoMP 2. Transport Department, GoMP 3. RTOs 4. Roads and Buildings Department, GoMP 5. State Knowledge Management Centre on Climate Change (SKMCC)- EPCO 6. Rural Development Department, GoMP 7. MPUVNL 8. Proposed District-level Committee on Climate Change and Environment
Augment non-motorised transport	1. Smart Cities Mission 2. AMRUT 3. National Urban Transport Policy, 2006	1. All ULBs 2. Indore Smart City Development Corporation Limited;	1. Urban Development and Housing Department, GoMP 2. Roads and Buildings Department, GoMP 3. State Knowledge Management Centre on Climate Change (SKMCC)- EPCO 4. Rural Development Department, GoMP 5. PRIs 6. MPUVNL 7. Police department, GoMP 8. Proposed District-level Committee on Climate Change and Environment

Sub-sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Improving traffic flow	1. BRTS 2. JNNURM 3. ECBC 4. Smart Cities Mission 5. AMRUT 6. National Urban Transport Policy, 2006	1. All ULBs 2. Indore Smart City Development Corporation Limited; 3. RTOs	1. Urban Development and Housing Department, GoMP 2. Roads and Buildings Department, GoMP 3. Madhya Pradesh Housing and Infrastructure Development Board (MPHIDB) 4. State Knowledge Management Centre on Climate Change (SKMCC)- EPCO 5. Rural Development Department, GoMP (implementation support outside urban areas) 6. Police department 7. Department of Industry Policy and Investment Promotion, GoMP 8. PRIs 9. MPIDC 10. Proposed District-level Committee on Climate Change and Environment

6.1.4 Industry: Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
The district can develop an incentive system, similar to a "cap and trade" system, for enhancing energy efficiency of MSMEs, in coordination with the state energy department.		Medium-term	Requires policy framework based on research and inter-departmental cooperation	
Promote combined heat and power (CHP)/ co-generation for running captive power plants.		Medium-term	Policy framework exists Inter-departmental collaboration required Awareness to popularise the initiative	CHP systems can achieve system efficiencies close to 80% as compared to around 60% by conventional technologies.

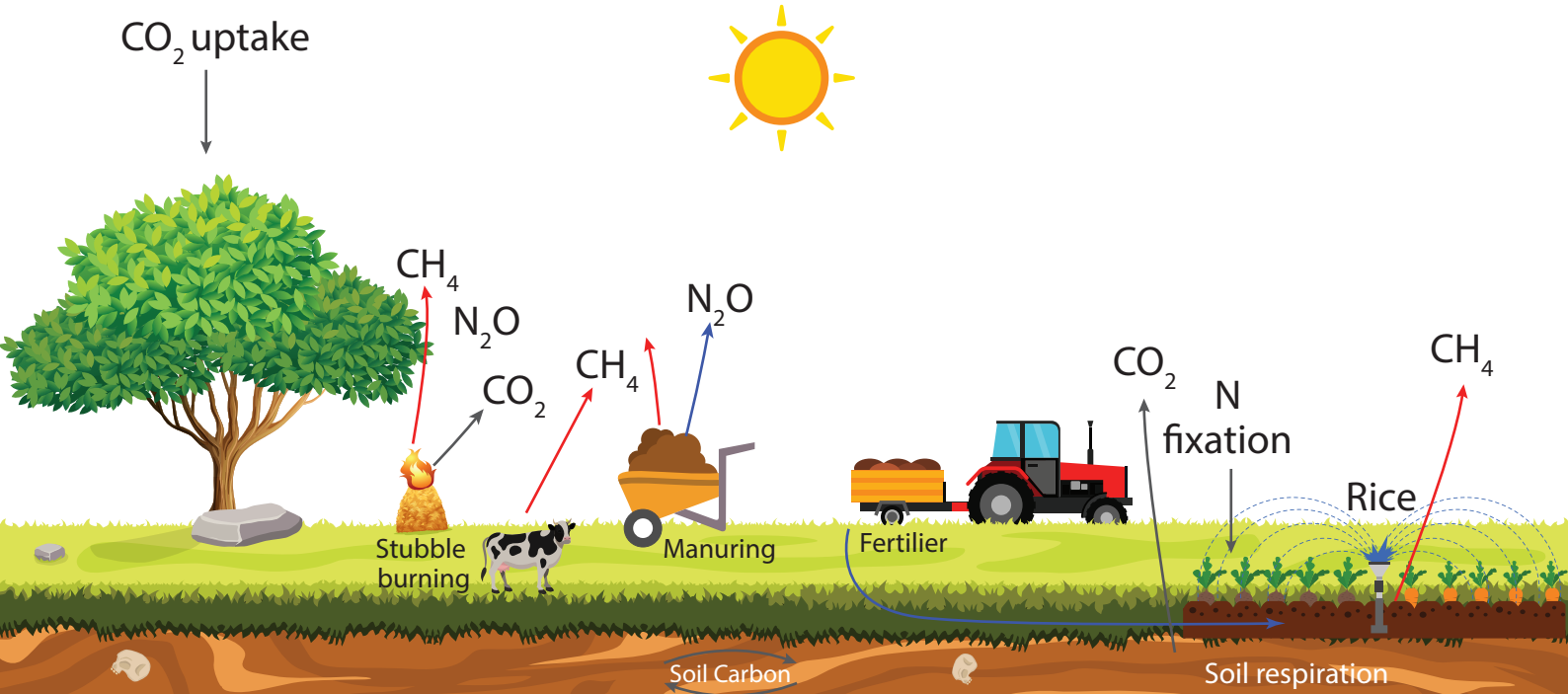
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Optimise equipment efficiency. Equipment that are not usually turned off during downtime, such as heating or cooling equipment, pumps and alarm systems, need to be energy-efficient. Strategies must be developed to switch them off whenever possible.		Medium-term	Policy framework exists (section 6.1.4.1)	MP Industrial Promotion Policy, 2014 undertakes the following measures: 1. Creates a level-playing field for all investors that helps them conduct their business with ease. 2. Strengthens the single-window system to make it more effective under the provisions of the Madhya Pradesh Investment Facilitation Act 2008. 3. Provides competitive fiscal incentives and exemptions to attract investment. 4. Provides support to the investors in making government and private land available for industrial projects across different scales of investments. 5. Upgrades industrial infrastructure in existing industrial growth centres. 6. Promotes the creation of ancillaries to strengthen local vendors. 7. Enhances the employability of youth by focused skill development efforts. 8. Strengthens MSMEs through an attractive package of incentives and concessions. 9. Ensures harmony between private sector investors and local citizens through an enhanced dispute settlement mechanism. 10. Promotes thrust sectors through sector-specific promotion policies; 11. Establishes a 'land bank' keeping in mind future requirements of land for industries. 12. Develops world-class infrastructural facilities for industries with active participation of the private sector. 13. Provisions for the protection of the environment and encourages water conservation measures in the industry through go-green strategies. 14. Promotes industrial parks for cluster development of similar micro and small-scale industries in regions that are rich in the raw material being used by that particular industry.
Invest in green projects – such as plantation drives and afforestation activities – within and around industrial areas in district.		Short-term	Policy framework exists. Improved monitoring and evaluation will give recommendation a further push.	
Target better M&E of energy audits to improve accountability.		Short to medium-term	Policy framework already exists Inter-departmental collaboration is required	
Encourage industries to use recycled water from their plants rather than freshwater.		Short-term	Policy framework exists. However, it needs to be upgraded in collaboration with the responsible agencies and departments	

6.1.4.1 Industry: Policy framework and concerned departments/agencies

Sectors	Policies and programmes which can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Industry	1. MP Industrial Promotion Policy, 2014 2. MP Solar Policy, 2021 3. National Mission on Enhanced Energy Efficiency	1. Department of Industry Policy and Investment Promotion, GoMP	1. MP Audyogik Vikas Nigam (MPIDC) 2. Energy Department, GoMP 3. District Industries Centre 4. BEE 5. MPUVNL, GoMP 6. MPPMCL-MPPKVVCL 7. Proposed District-level Committee on Climate Change and Environment

6.1.5. AFOLU: Recommendations, cross-cutting sectors, qualifying priority and district scenario

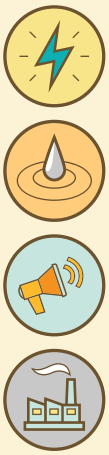
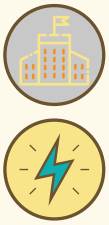
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
AFOLU: Agriculture				
Promote sustainable farming by using non-chemical fertilisers, including programmes like zero budget natural farming in the district.		Short to medium-term	Policy framework exists (section 6.1.5.1) Budget provisions are available	In 2017-18, Indore used approximately 72,521 tonnes of urea (for agriculture). Replacement of 10% of this current urea consumption with non-chemical fertilisers can help avoid 5,300 tonnes of CO_2e emissions/annum. This initiative will also contribute towards: a. cutting down of compostable solid waste from landfilling/dumping and converting it to organic waste, which can further be used to make organic fertilisers, thereby, reducing emission from the waste sector; b. lessening of harmful agricultural run-off, thereby reducing water pollution and eutrophication.



Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote adoption of alternative ways for crop residue management other than burning. Promote adoption of improved harvesting practices, such as land leveller, direct seeding, nutrition management, etc. through agricultural extension programme and financial assistance/ formation of cooperatives, etc. Stubble can be used as feedstock for different industries to make products including paper, cardboard, furniture, organic fertiliser and animal feed, which will also act as an alternative source of income for farmers.		Short to medium-term	Policy framework required Collaboration required Farmers to have easy access to markets/industries that would take crop residue/ stubble Helps meet the following targets: -- SDG#8 8.2; -- SDG#12 12.5, 12. a	Improve harvesting practices through means such as the use of happy seeder, which has the capacity to eliminate 78% of GHG emissions (from crop residue burning). It can potentially add to farmers' profits by at least 10%. Feasibility studies for a cost-benefit analysis of such improved harvesting machines and practices need to be undertaken. Direct sowing of rice reduces soil disturbance, enabling it to retain more nutrients, moisture and organic content. It also, removes the need for stubble-burning, thereby reducing air pollution. Other feasibility studies or projects can be initiated. Such as the development of biofuel pellets from crop residue.
Farmers should be encouraged to follow the recommendation given in the soil health cards.		Short to medium-term	Awareness generation required	According to Soil Health Card Portal, 23,15,844 samples have been tested in Cycle-II in MP. In Indore, 11%, and 1% of all the samples tested reported very low nitrogen and phosphorus, respectively. However, micronutrients were found to be sufficient (as per information provided by the Department of Agriculture Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, GoI).
Promote micro-irrigation (MI) to improve water use efficiency. It saves water, energy and fertiliser consumption.		Short to medium-term	Policy framework is available (section 6.1.5.1) Enable swift procedures and subsidy disbursement for adoption of micro-irrigation District may consider providing additional subsidies	Currently, MP holds 4.99% of the total area under micro-irrigation in India.[23] Under the prevailing subsidy regime in the state, the extent of subsidy varies between 70% and 80% of the cost of the drip system. While the central government provides for 50% of the equipment cost as subsidy in the case of small and marginal farmers (belonging to both general category as well as SC/ST category), the extent of subsidy is 40% in the case of other category of farmers. The state government additionally provides between 20% to 30% of the cost as subsidy.[24] MI helps attain greater water-use efficiency, thereby reducing the pressure on groundwater sources with reduced GHG emissions. Drip systems have 95% water use efficiency. According to PMKSY Achievement Report, 601.30 ha of land was covered under MI in Indore during 2019-20, which should have led to avoidance of approximately 508.33 tonnes of CO_2 emissions. (w.r.t to conventional irrigation through groundwater).

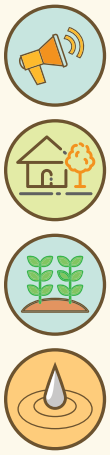
23 Suresh A. and Samuel M. P., 2020, Micro-irrigation development in India: challenges and strategies

24 Towards Accelerating Adoption of Drip Irrigation in Madhya Pradesh, International Water Management Institute Centre for Environment and Development Studies, Jaipur

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Encourage adoption of latest technologies, such as: a. Solar pumps (under PM KUSUM Yojana and CM's Solar Pump Scheme) b. Star-rated energy efficient pump system (EEPS) c. Smart control panels and internet of things (IoT) based systems for optimum resource utilisation (water, energy)		Short to medium-term	Policy framework is available (section 6.1.5.1) Support in capital investment over and above the existing policy can be considered	According to MNRE, Madhya Pradesh has achieved 92.4% of the target of installing solar pumps under PM-Gramin Kalyan Yojana (as on January 21, 2021 MP has installed 3,224 solar pumps). Replacement of 1 lakh diesel pumps with solar pumps over a period of 5 years can cut 900 million litres of diesel consumption over the life cycle of solar pumps, which can potentially save ₹ 840 crore of diesel subsidy and 2.53 million tonnes CO_2 emissions. Under PM KUSUM Yojana and CM Solar Pumps Yojana, the government provides subsidy ranging from 83% to 65% for various pumps and about 50% for cowsheds (gaushalas). If 50% of tube-wells in Indore are converted to solar then 3,10,000 tonnes of CO_2e emissions can be saved. These initiatives will increase farmer income, provide reliable source for irrigation and reduce dependence on diesel in the farm sector.
Enhance the efficiency/ network of cold storage systems and wherever possible, power them with renewable energy.		Medium to long-term	Policy framework exists and can be enhanced (section 6.1.5.1.) Capital investment required Align with solar rooftop policies and ECBC	
AFOLU: Livestock				
Promote grasslands and cultivation of cattle feedstock for good quality forage and to manage fodder scarcity.		Short to medium-term	Policy framework exists (section 6.1.5.1) Research inputs required Collaboration between different communities (farming and pastoral) are needed	Straws from millets, corn and maize have better feeding quality than straws from rice, barley and wheat. This change in quality of forage specie leads to better productivity and an estimated reduction of 30% in emissions. ICAR-NIANP has recently developed a feed supplement - Harit Dhara and Tamarin Plus, for cattle, buffalo and sheep. It is found effective in cutting down methane emissions by 20%. Use of this feed supplement can be encouraged by Indore at the district level.[25]
Promote cattle breeds with higher productivity. Moreover, productivity of indigenous cattle should also be improved (for instance, through the provision of Nand Ghars) However, it's essential to maintain the balance between resilience and productivity. Currently, in most areas, flock sizes are negatively impacting the climate and ecology.		Medium to long-term	Policy framework exists (section 6.1.5.1) Research collaboration required (to ensure biodiversity of the region is not impacted) Generate awareness Provide monetary support to the pastoral community	These initiatives will help meet growing demand of milk while keeping the livestock headcount low. In Indore, if there is a 10% decrease in the number of indigenous cattle over a period of five years, the loss in milk production will be 13 lakh litres and 81,179 tonnes of CO_2e emission can be avoided. To compensate for this loss in milk production, a total of 81,973 new crossbreed cattle need to be introduced, resulting in 74,036 tonnes CO_2e emissions. The net emissions avoided per year in the district will be 7,168 tonnes CO_2e.

25 http://nianp.res.in/harit-dhara-tamarin-plus

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote the use of waste from livestock and poultry as an important source of organic manure for crops. Poultry manure is rich in nitrogen and can be used for various crops like sugarcane, potato etc. for enhancing crop production.		Short to medium-term	Collaboration between different communities (farming and pastoral) is needed; Policy framework is available (section 6.1.5.1)	Poultry manure fertiliser is rich in nitrogen and contains all the 13 essentials nutrients required for crop production. In comparison to cow manure, it is two to three times richer in inorganic fertiliser content.
AFOLU: Forestry and Green Spaces				
Ensure minimum diversion of forest land for any activity or project and promote compensatory afforestation (of the same species) from the funds given by the user agency. Funds for continuous tree improvement and tree breeding programmes can be ensured through Compensatory Afforestation Fund Management and Planning Authority (CAMPA).		Short to medium-term	Policy framework and budget provisions exist (section 6.1.5.1) Policy implementation required Stringent monitoring and evaluation	As per India State of Forest Report, 2019, during the period January 2015- February 2019, a total of 12,785 hectares of forest land of MP was diverted for non-forestry purposes under the Forest Conservation Act, 1980. In 2019, Madhya Pradesh received Rs 5,196.69 crore from the CAMPA, which aims to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses. As per Parivesh Part-II Report (with state serial proposal number MP-079/2016), 397.235 ha of total forest area in Indore has been diverted since 1980.
Measures to increase trees outside forest (TOF) area and green spaces in Indore a. Set up of urban parks b. Adopt Miyawaki Urban Forestry method c. Transplant trees with the help of tree transplanter machines d. Set up floating gardens, butterfly gardens etc. e. Initiate afforestation activities on wastelands and fallow lands f. Plantation along village roads can be taken up under MGNREGS. g. Develop green belt along the major terrain roads, and surrounding the industrial areas h. Tree census should be conducted periodically.		Medium to long-term	Policy framework is available (section 6.1.5.1) Capital investment, research collaboration and inter-departmental cooperation are required	According to the 2019 FSI assessment report, the extent of TOF for Madhya Pradesh is 21,069 sq km. Dominant tree species in TOF are *Butea frondose, Acacia arabica, Azadirachta indica, Zizyphus jujuba* and many more. Miyawaki urban forestry method has reported 15% faster growth rate per year compared to other reforestation methods. Example: AIIMS Bhopal developed the state's first Miyawaki forest on 24,000 sq ft of land. Similar, pilot projects can be adopted in Indore as well. Green belts help mitigate air pollution, increase urban green cover, thereby leading to carbon sequestration.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Enhance forest cover by promoting agro-forestry and social forestry to increase forest biomass and soil moisture. a. Control illegal timber trade. b. Carry out mapping of agroforestry area to monitor the coverage. c. Create provisions of financial instruments/ relaxation in other taxes (over and above the existing schemes) to encourage farming community to adopt agroforestry.		Medium to long-term	Policy framework and budget is available; implementation is required Stringent monitoring and evaluation are necessary	Currently, the forest area in Indore district is only 17.41% of its total geographical area. If 25% of the geographical area of Indore (equivalent to state average forest cover) is converted to green cover, over a period of 10 years, 7.13 Mt of CO_2 emissions can be avoided. According to 2019 FSI Assessment Report, the tree cover of Madhya Pradesh is 8,339 sq. km.
Ensure ULBs carry out regular monitoring of survival of the trees under plantation a. A thorough study needs to be done on suitability of the site and survival ratio of species (majorly native species) before initiating any plantation drive. b. Prepare an audit every year on the number of saplings surviving after plantation drives. c. Ensure geo-tagging of trees (along with site and species) for proper monitoring.		Short to medium-term	Monitoring and evaluation required Collaboration among different stakeholders required	
Promote regeneration of degraded and open forest areas by developing awareness among locals regarding the importance of green spaces.		Long-term	Strengthen the existing policy framework Collaboration among different stakeholders	According to 2019 Forest Survey of India report, there is a decrease in forest cover by 0.27 sq km in Indore from 2017 assessment.

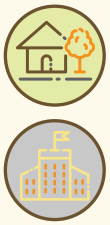
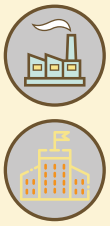
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Various aspects of Joint Forest Management need to be promoted: a. Capacity building and skill development of joint forest management committees in tribal and non-tribal areas through workshops and training. b. Initiate participatory forest management programmes at micro scale.		Short to medium-term	Exclusive communication strategy and IEC material to be developed and used Provisions of monetary support	According to 2015 ENVIS Database, total area under JFM in Madhya Pradesh is 66,87,390 ha. There are about 15,228 joint forest management committees.
Prevent invasion of non-indigenous species a. Develop a database and update information on invasive species and their management. b. Raise awareness at regional levels. c. Strengthen and maintain institutions to coordinate invasive species programmes.		Medium to long-term	Research studies of flora specific to the region. Provisions of monetary support Exclusive communication strategy and IEC material to be developed and used Requires funding, monitoring and evaluation, stakeholder collaboration	*Lantana camara, Cassia tora, Ageratina Adenophora, Ageratum conyzoides* and *Senna occidentalis* are some major invasive species in Madhya Pradesh. Preventing seed production helps in managing spread of invasive species. Removing flower heads prior to seed set will reduce the number of seeds available for spread by birds or other animals. (Solanki, 2018).
Develop participatory forest fire management strategies such as: a. Collecting baseline forest fire data with respect to perceptions, beliefs, expectations and behaviour of local people with regard to forest fires. b. Training local communities to tackle forest fires. c. Organising awareness programmes in local schools. d. Capacity building to develop an early warning system.		Medium to long-term	Provisions of monetary support Exclusive communication strategy and IEC material to be developed and used Monitoring and evaluation required Needs collaboration among different stakeholders	According to FSI report 2019, about 0.14%, 19.36% and 64.84% of the total forest cover area of Madhya Pradesh is under extreme, moderate and least fire prone area, respectively.
Ensure implementation of Sanjay Gandhi Paryavaran Mission		Medium to long-term	Policy implementation required	According to the targets of this mission, five eco-smart villages/ blocks need to be established in the district, and five crore saplings are to be planted (as a collective effort by all the district departments) by 2025.

6.1.5.1 AFOLU: Policy framework and concerned departments/agencies

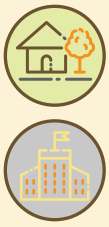
Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Agriculture	1. Pradhan Mantri Krishi Vikas Yojana 2. National Mission for Sustainable Agriculture 3. Pradhan Mantri Krishi Sinchayee Yojana 4. PM KUSUM Yojana 5. Soil Health Card 6. National Mission on Food Security 7. National Mission on Micro-irrigation 8. CM Solar Pump Scheme 9. Dinkar Yojana 10. Price Support Scheme 11. CM Farmer Promotion Scheme 12. MP Kisan Anudan Yojana 13. Pradhan Mantri Garib Kalyan Yojana	1. Farmers' Welfare and Agricultural Development Department, GoMP	1. Panchayat and Rural Development Department, GoMP 2. Water Resources Department, Madhya Pradesh 3. Energy Department, GoMP 4. Department of Animal Husbandry, GoMP 5. State Knowledge Management Centre on Climate Change (SKMCCC): EPCO – for monitoring 6. Forests Department, GoMP 7. Madhya Pradesh State Agro Industries Development Corporation 8. Madhya Pradesh State Agriculture Marketing Board 9. APMCs 10. MPIDC 11. Proposed District level Committee on Climate Change and Environment
Livestock	1. National Livestock Mission 2. Rastriya Gokul Mission 3. Kisan Credit Cards to Livestock farmers 4. National Programme for Dairy Development 5. Livestock Health and Disease Control 6. National Programme for Dairy Development 7. Intensive Cattle Development Programme 8. Nandi Shala Yojana 9. Upgraded Animal Breeding Scheme 10. Supply of (10 + 1) goat unit on bank loans and grants 11. Acharya Vidyasagar Cow Promotion Scheme 12. VAT observance promotion scheme	1. Department of Animal Husbandry, GoMP	1. Forests Department, GoMP 2. Farmers' Welfare and Agricultural Development Department, GoMP 3. State Knowledge Management Centre on Climate Change (SKMCCC) 4. Proposed District-level Committee on Climate Change and Environment
Forestry and green spaces	1. National Afforestation Programme (NAP) 2. Project Tiger 3. Compensatory Afforestation Fund Management and Planning Authority (CAMPA) 4. Green India Mission (GIM) 5. Integrated Development of Wildlife Habitat (IDWH) 6. Intensification of Forest Management Scheme (IFMS) 7. Pradhan Mantri Ujjwala Yojana	1. Forest Department, GoMP	1. Farmers' Welfare and Agricultural Development Department, GoMP 2. State Knowledge Management Centre on Climate Change (SKMCCC) 3. All ULBs (IMC + other Municipalities) 4. Mineral Resources Department, GoMP 5. Urban Development Department, GoMP 6. Rural Development Department, GoMP 7. Proposed District level Committee on Climate Change and Environment 8. All PRIs

6.1.6 Waste management: Recommendations, cross-cutting sectors, qualifying priority and district scenario

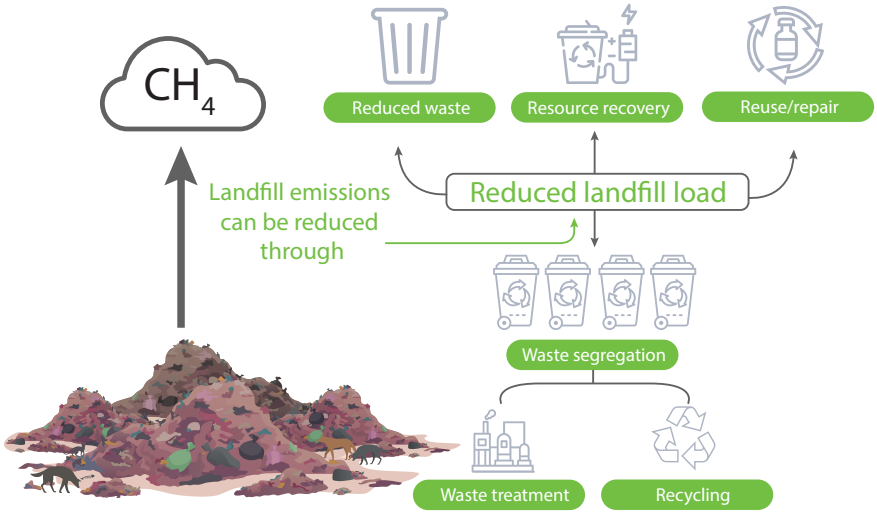
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Solid waste				
Waste prevention: Reducing landfilling				
Minimising landfill waste disposal by: a. promoting reduction of waste at source through product reuse, extending lifetime (maximum use of resources) and right to repair, b. ensuring efficient and 100% segregated waste collection from across the district (both urban and rural) by distributing colour-coded bins, monitoring waste collected from household and penalising households not practicing segregation, c. ensuring and maximising recycling, recovery, optimum resource utilisation throughout product lifecycle and treatment, d. promoting resource efficiency and circular economy practices across sectors.		a. Medium to long-term b. Short to medium-term c. Medium-term d. Long-term	a. Need policy intervention, awareness generation, incentivisation b. Policy framework exists (section 6.1.6.1) c. and d) Need policy intervention and execution (Resource Efficiency Policy has been drafted by NITI Aayog, but has not been implemented)	Landfills are considered to be one of the largest anthropogenic sources of methane emissions contributing to 11% of all global CH_4 emissions. Hence, reducing landfill load and emission is critical in achieving India's NDCs. Following are the initiatives adopted in Indore (mostly the city area) which will eventually reduce emissions from landfill and can be planned for the district as well: For the fifth consecutive year, Indore has been declared as the 'cleanest city' in India by Swachh Survekshan 2021 (cleanliness, hygiene and sanitation survey). Madhya Pradesh has 94% waste collection efficiency and 76% waste treatment rate. Indore has 100% waste segregation and collection efficiency in all the ULBs of the district. IMC has 100% door-to-door waste collection efficiency through partitioned vehicles for collecting wet, dry and domestic hazardous waste separately in all its 85 wards. MP has adopted a 'cluster-based model of ULBs for effective integrated solid waste management (ISWM) based on the concepts of regional landfill and implementation through the public private partnership (PPP) mode. Indore has one of the 26 clusters of the state having eight ULBs – Betma, Depalpur, Hatod, Indore, Manpur, Mhowgaon, Rau, Runji-Gautampura. Indore cluster ISWM facility and landfill site is located at Devguradiya. MP has a target of 80% resource recovery out of the total solid waste generated. Indore cluster reportedly generates 1,010 TPD MSW and has one waste to energy (W2E) plant under implementation. All the wet waste from the bulk generators (50 kg and above) within IMC is processed at their premises. Wet waste from the garbage transfer stations (from households) and semi-bulk collection is transported to a central wet waste processing plant for composting.

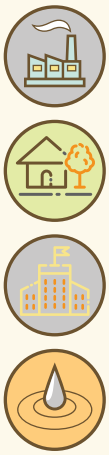
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Minimising single use plastic (SUP): Detailed information and recommendations are given in section 6.1.6.2.		Short to medium-term	Policy framework exists (section 6.1.6.2)	Disposable SW take-back has not been implemented in Madhya Pradesh as of now. About 31% of the total waste generated in Indore is inert waste. Paper waste is 8.6%, much of which can be treated/recycled. Within IMC, 500 TPD waste is treated at MRF. Plastic waste is collected at plastic waste collection centres and is sold to a cement plant at Neemuch and to MP Rural Road Development Board for construction of roads. The plastic waste has been used for construction of 10 roads within IMC.
Implement producers (manufacturer/brand owner) take-back mechanism (SWM Rules, 2016) either through financial assistance by the producers or a defined collection system facilitated by the producers for disposables, such as tin, glass, plastics packaging, sanitary napkins and diapers, for efficient management of these waste materials, thereby reducing landfill inert waste load.		Short to medium-term	Mandated by the SWM Rules, 2016 Needs regional policy formulation and interventions	
Ensure 100% recycling of recyclables at landfill through material recycling facilities (MRFs), refuse derived fuel (RDF), waste to energy (W2E), etc. Encourage use of LDPE and HDPE plastic waste in road construction.[26]		Short to medium-term	Capacity enhancement of existing facilities required	
Management of construction and demolition (C&D) waste: a. Ensure segregation, collection, transport and proper management. b. Facilitate processing and recycling. c. Incentivise initiatives for C&D waste reuse in non-structural concrete, paving blocks, lower layers of road pavements, colony and rural roads. d. Mandatory procurement of C&D materials (10% to 20%) in municipal and government contracts (subject to quality control).		Short to medium-term	Mandated by the rules, CPCB guidelines exist (section 6.1.6.1) Needs state-level policy formulation Strict implementation and enforcement Capital investment in infrastrcture required	

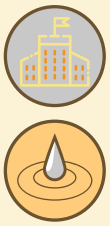
26 Guidelines given by Indian Roads Congress in this regard can be followed. https://pib.gov.in/PressReleasePage.aspx?PRID=1736774

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Increasing consumer awareness and access to recycling facilities and repair options within the district.		Short to medium term	Dedicated awareness campaign required	About 10% to 15% of global GHG emissions can be reduced through improved waste management following a lifecycle assessment approach (Global Waste Management Outlook - UNEP/ISWA, 2015). Prevention and recovery of waste (as secondary material or energy) can significantly save GHG emissions from across the sectors of the economy including energy, forestry, agriculture, mining, transport and manufacturing sectors.
Conduct education and awareness drives to ensure 100% at source segregation of biodegradable waste, non-biodegradable waste, domestic hazardous waste and household biomedical waste.		Short-term	Dedicated awareness campaign required	
Introduce fiscal instruments to encourage waste reduction, such as, mandatory carry bag charges, pay-per-bin schemes (charging residents for each community refuse bin).		Short-term	Needs district-level scheme/notification and community participation	
Conduct behavioural change communication workshops targeting corporates, educational institutes, PSUs, government offices to influence behaviour at both individual and organisational level to better manage resource and reduce waste generated. For example, conducting weekly workshops at all public schools for waste reduction and recovery. These workshops can also address issues such as energy efficiency and water conservation.		Short-term and continuous	Needs sustained campaign for the target groups	
Consumer awareness for demand-side management of product choices with: a. sustainable packaging, b. displayed higher product lifespan, c. displayed recycling/ resource recovery efforts and information.		Short-term and continuous	Dedicated campaign required	
Conduct waste audits at household level, corporate offices, institutes, etc. to identify scope of waste minimisation and promote the same as an evidence-based practice.		Short to medium-term	Needs research collaboration	

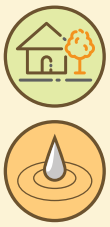
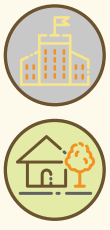
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Ensure segregation, collection and treatment of sanitary waste (sanitary napkins and diapers) to reduce landfill load.		Short to medium term	Mandated by SWM Rules, 2016 Capital investment in infrastructure development (for treatment) is required, which can be obtained from producers	Sanitary waste is being collected separately in IMC as part of domestic hazardous waste, and is segregated before being sent for incineration to the common bio-medical waste treatment facility (CBWTF).
Transitioning the district to a green market approach: a. promoting local circular business models, and b. mainstreaming of alternative sustainable business models for consumers to have a basket of choice.		Medium-term and continuous	Needs alternative business models, collaborations and awareness	
a) Waste transportation emission reduction: Encourage shifting to electric or zero emission vehicles (ZEVs) for all kinds of waste transportation, including municipal solid waste (in all ULBs), bio-medical waste in all common bio-medical waste treatment facilities (CBWTFs) and hazardous waste in all treatment, storage and disposal facilities (TSDFs), b) Installation of waste bins with sensors to monitor volume and optimise the routes of collection vehicles to reduce consumption of fuels for waste transport and related emissions.		Medium to long-term	Needs capital investments	The current common cluster-based landfill site for eight ULBs in Indore requires long-distance waste transportation from several ULBs in the cluster. Petrol or diesel-driven trippers/ trucks are used for waste collection and transportation, with significant transport emission potential. These can be avoided by transitioning to ZEVs. Though there are several specifications for CBWTF vehicles to ensure efficient management and monitoring of BMW, they do not consider the mitigation part from transport.



Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Waste treatment: Composting				
Encourage 100% conversion of organic waste to biological waste through processing (composting, bio-gas, etc.).		Short to medium-term	Policy framework exists (section 6.1.6.1) Needs awareness and infrastructure development	Organic treatment of compostable waste might initially lead to emissions, but reduces GHG emissions in the long-run, when compared to emissions from landfill. It takes at least three decades of landfill emissions to balance with those from aerobic composting. In Indore, 58% of solid waste is biodegradable and is entirely processed by composting. Composting emission potential is 19,377 tCO_2e/year. Currently, no gas management system is installed at composting units. A state-of-the-art waste management plant is being set up in association with IMC which proposes to convert a traditional 500 TPD (input feedstock) aerobic composting process to an output of 15.3 TPD bio-CNG and 105 TPD composts. The project – South Asia's largest bio-CNG based on urban organic waste – aims to run over 400 vehicles on bio-CNG and market 50% of the bioCNG produced by GAIL. With an annual GHG footprint of over 1,30,000 tCO_2e per year, the project is estimated to have a net carbon sequestration impact equivalent to that of a rainforest spread over 50,000 acres, making it one of the most climate positive projects in the world. No PRI level SWM data or detailed treatment type-wise data is available. Composting with gas management of 100% of the organic waste going to landfill can reduce emission by 17,659 tCO_2e/year in Indore district. Fruit and vegetable waste generated at the Choitram Mandi (the largest mandi in central India) is now collected and processed in a decentralised bio-methanation (bio-CNG) plant of 20 TPD capacity. The plant generates 800 kg of purified and compressed bio-CNG daily, which is used as fuel to operate 15 city buses. The digested slurry is converted into organic compost.
Develop composting facilities at ULB level in addition to cluster-level to avoid: a. loss of carbon content in long-route organic waste transportation; and b. reduce waste transport emissions.		Medium-term	Needs land and infrastructural investment at ULB level	
a. Equip new composting units and upgrade/convert existing ones with gas management systems for gas capture after conducting feasibility studies. b. Biomethane produced from wastewater and solid waste processing can be used as a fuel for industrial production, to provide energy services in buildings or as a transport fuel. A benefit of biomethane is that existing gas infrastructure can be utilised for transport and distribution. As a local, sustainable source of power and heat, biomethane offers communities and municipalities a flexible option that can contribute to lowering emissions.		Long-term	Needs policy intervention District-level capital investment and research collaboration required	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Emission profiling and reduction				
Facilitating research and documentation on characteristics and percentage share of waste, moisture content, localised BODs for domestic wastewater and industrial wastewater, is important for accurate city or district-level emission estimations from the waste sector.		Short-term	Needs research collaboration	
Ensure better compliance to waste management rules in terms of maintaining segregated waste collection and treatment data (solid waste, bio-medical waste, e-waste and hazardous waste) in the public domain (annual reports/websites), particularly at the district level.		Short-term and continuous	Policy framework exists (section 6.1.6.1)	
Bio-medical waste and hazardous waste				
a. Promote installation of modern incinerators with energy-recovery facilities (such as, use of recovered heat for preheating of waste to be burnt or use of incinerator steam to generate electricity) for new common bio-medical waste treatment facility (CBWTFs) and upgradation of the existing ones. b. Using smart controls, waste treatment plants equipped with energy recovery incineration facilities can be integrated as distributed energy sources into the electricity grid and as heat sources into the district energy network.		Long-term	Needs policy formulation and investment in infrastructure	Though not a recommended treatment due to its emission potential, incineration prevents manual scavenging and further contamination for certain kinds of infectious waste (particularly, the anatomical, contaminated waste, discarded medicines and chemical waste). Incineration is the best available and recommended practice right now in India. Current annual BMW incineration emission in the district is 651 tCO_2e./ year. Energy recovery incineration is not practiced. District-level HW generation/ incineration data is not available.
Strict monitoring of adherence to recommended incineration technologies and practices through regular monitoring by the District Bio-medical Waste Management Monitoring Committee.		Short-term and continuous	Mandated by the BMWM Rules, 2016 (section 6.1.6.1) Needs monitoring by district-level BMWM committee	
Ensure 100% segregation, collection and treatment of bio-medical waste through coverage and registration of all healthcare facilities to CBWTFs.		Short-term and continuous	Mandated by the rules (section 6.1.6.1)	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Waste electrical and electronic equipment (WEEE)				
As per the provisions of E-waste Management Rules, 2016, a state level e-waste inventory with district-level category wise e-waste generation information needs to be developed. The inventory must include all sources of generation and consider all WEEE categories as per the rules.		Short to medium-term	Mandated by the rules (section 6.1.6.1), Needs research collaboration	About 95% of the e-waste in India is processed informally (including rudimentary operations like open burning, acid wash, open smelting, etc.). City-based studies show that efficient management and recycling of electrical and electronic equipment waste (WEEE) can significantly contribute to emission reduction targets. A 2011 e-waste inventory for Bhopal, Indore, Gwalior and Jabalpur projects 99,031.42 Mt/year WEEE generation in 2020 in Indore. However, only 534.43 Mt/year WEEE was collected (formally reported by MPPCB) during 2018-19 in the entire state, which indicates informal routing of most of the e-waste generated.
Ensure stringent policy implementation -- trace informal routing, restrict informal processing of e-waste (open burning, metal smelting, etc.), ensure proper disposal of mercury containing lamps.		Short-term and continuous	Policy framework exists (section 6.1.6.1)	
Tapping into the informal e-waste collection network and formalisation of the same to channelise e-waste disposal to the formal sector.		Short to medium-term	Can be achieved through producers, recyclers and/ or producer responsibility organisation (PROs)	
Ensure proper collection and disposal of electrical waste (lighting infrastructure) and strict monitoring to stop landfilling of the same.		Short to medium-term	Mandated by the rules (section 6.1.6.1) Multi-stakeholder collaboration required Need to create awareness	
Improve consumer awareness of responsible e-waste disposal and provide readily available information on aspects like e-waste collection points, recyclers, producers (manufacturer), producer responsibility organisations or local e-waste collection drives at the district level.		Short-term and continuous	Mandated by the rules for the producers (section 6.1.6.1). Dedicated campaign required, can be achieved by collaborating with producers	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Formulation of district-level e-waste management programmes		Short to medium-term	Needs state and district collaboration	
Wastewater: Domestic and industrial				
Achieve 100% domestic wastewater treatment through the following measures: a. In both urban and rural areas of the district, set up 100% closed and underground sewer collection network. b. Shift 100% domestic wastewater treatment to aerobic setups by having only aerobic STPs for new constructions and transition old anaerobic STPs to aerobic set up. c. Operation and regular maintenance of periodical sludge removal facilities of all STPs. The sludge can be reused for the bio-methanation of compost.		Medium to long-term	Policy intervention and capital investment required	Wastewater, if treated anaerobically, can be a huge source of methane and even nitrous oxide emissions. Being stagnant and subject to heating (anaerobic conditions), open sewers emit CH_4. Closed underground sewers, on the other hand, are considered to be an insignificant source of CH_4. The STPs in Indore (90 MLD capacity) are currently anaerobic. IMC generates 8.03 MLD sewerage at present, and is projected to generate 9.56 MLD by 2035 and 10.13 MLD by 2050. Based on the projections, Asian Development Bank's water supply and sewerage project has proposed a 10 MLD STP with SBR technology (aerobic) having inbuilt nitrification, de-nitrification and biological phosphorous removal mechanism at Shekhar Nagar. This is an ideal technology to reduce GHG emissions from sewerage treatment. No information is available on the rural sewerage coverage and treatment. Fully (100%) closed and underground sewer connection with centralised aerobic STPs can potentially reduce the current 81,954 tCO_2e emission from STPs to negligible in Indore district. MP introduced a state-level policy for wastewater recycle and reuse and feacal sludge management in 2017, which encourages reuse of treated wastewater in industries. Case example: Ahmedabad Municipal Corporation has set up the first sewage sludge hygienisation plant in the country at Pirana (operational since 2019), which can convert 100 tonnes of dry sludge into fertiliser per day. A similar plant can be developed for Indore.
Development of rural wastewater disposal and treatment plan for the district.		Medium to long-term	Requires capital investment and inter-departmental collaboration.	
Create appropriate connecting infrastructure for industries to utilise treated industrial and domestic wastewater. Provide subsidy/tax rebate to industries, healthcare, hospitality sectors for implementation of smart recycled water investments.		Medium to long-term	Policy framework exists Needs capital investment in infrastructure and technology upgradation	
Implement and operationalise the guidelines and regulations of National Policy on Faecal Sludge and Septage Management, 2017 to reduce emissions from faecal sludge. Regular collection and appropriate disposal of sludge needs to be ensured.		Medium to long-term	Needs ULB level implementation and capital investment in infrastructure	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Develop a policy mandate for data transparency and availability of waste and wastewater generation, treatment and discharge information for industrial sector, including CETPs.		Short to medium-term	Needs policy intervention Inter-departmental collaboration required	Data transparency on wastewater by industries is key to reducing water pollution, which can be achieved through rating of industries based on their emission and effluent discharge and treatment. For example, under its star rating programme, the Odisha State Pollution Control Board gives star rating to industries and presents it through their website. This can help in environmental compliance and encourages public participation.
Encourage data transparency by the industries for wastewater generation, treatment and discharge information including those of CETPs.		Short to medium-term	Needs collaborative efforts	

6.1.6.2 Waste management: Policy framework and concerned departments/agencies

Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/ agencies
Solid waste	1. Solid Waste Management Rules, 2016 & Amendment 2018 2. Plastic Waste Management Rules, 2016 3. Construction & Demolition Waste Management Rules, 2016 4. Integrated Solid Waste Management Project 5. Swachh Bharat Mission - Urban & Rural 6. Indore Master Plan, 2021 7. Indore Smart Cities Mission 8. National Resource Efficiency Policy (draft) 9. Guidelines on Environmental Management of C&D Waste Management in India, CPCB 10. MP State Level Policy for Waste Water Recycle and Reuse and Faecal Sludge Management, 2017 11. MPPCB Annual Reports (for data availability)	1. Urban Development and Housing Department, GoMP 2. All ULBs 3. Panchayats and Rural Development Department, GoMP 4. All gram panchayats 5. Department of Housing and Environment, GoMP	1. Indore district administration and the proposed District-level Climate Change & Environment Committee 2. Madhya Pradesh Urban Development Company Limited (MPUDCL) 3. Indore Development Authority (IDA) 4. Madhya Pradesh Pollution Control Board (MPPCB) 5. Community or Residential Associations 6. State Knowledge Management Centre on Climate Change, EPCO, GoMP
Bio-medical waste and hazardous waste	1. Bio-medical Waste Management Rules, 2016 2. Hazardous and Other Waste (Management & Transboundary Movement) Rules, 2016 3. Batteries (Management & Handling) Rules, 2001 4. Revised Guidelines for Common Bio-medical Waste Treatment and Disposal Facilities, 2016, CPCB	Research funding can be obtained from Department of Environment, GoMP, SKMCC, MPPCB, etc.[27]	1. MPPCB 2. Indore District Administration and the proposed District Level Climate Change & Environment Committee 3. Healthcare facilities 4. CBWTF
Waste-electrical and electronic equipment (WEEE)	1. E-waste Management Rules, 2016 2. Implementation Guidelines for E-Waste (Management) Rules, 2016, CPCB	Only implementation monitoring and research needs resources, which can be obtained from the Department of Environment, GoMP, SKMCC, MPPCB, etc.[28]	1. MPPCB 2. Indore District Administration and the proposed District Level Climate Change & Environment Committee 3. Electronic and Electrical Producer Manufacturers/ Producers/Brand owners, Producer Responsibility Organisations

27 Bio-medical and Hazardous waste management is profitable and not funded by Govt except for providing the land, which generally are the Industrial Development Corporation lands

28 E-waste management (collection, transport, disposal, treatment – dismantling or recycling) is profitable and is the responsibility of the producers, recyclers, producer responsibility organisations (PROs).

Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/ agencies
Wastewater: Domestic	1. Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 2. Jawaharlal Nehru National Urban Renewal Mission on Urban Infrastructure and Governance (JNNURM) 3. National River Conservation Plan 4. Integrated Urban Sanitation Programme 5. Swachh Bharat Mission (Urban) – MP 6. Swachh Bharat Mission (Rural) – MP 7. Indore Smart City Mission 8. Indore Master Plan, 2021	1. Urban Development and Housing Department, GoMP 2. All ULBs 3. Panchayats and Rural Development Department, GoMP 4. MP Jal Nigam	1. Indore Development Authority 2. MPUDCL 3. Indore Smart City Development Corporation 4. All Gram Panchayats 5. Indore District Administration and the proposed District Level Climate Change & Environment Committee
Wastewater: Industrial	1. Common Effluent Treatment Plant System 2. Online Continuous Emission Monitoring System 3. MPPCB Annual Report	1. Department of Housing & Environment, GoMP	1. Madhya Pradesh Pollution Control Board (MPPCB) 2. Indore District Administration and the proposed District Level Climate Change & Environment Committee

6.1.6.3 Single use plastics (SUPs) – critical to replace

Definition

- SUPs are often referred to as disposable plastics and are commonly used for plastic packaging. They include items intended to be used only once before they are thrown away or recycled, such as grocery bags, food packaging, bottles, straws, containers, cups and cutlery (UNEP).

Concerns

- Since SUPs are made for single use, they increase waste load and are resource-intensive.
- SUPs often get out of the collection and treatment network and (a) are one of the biggest ocean polluters and ingested by aquatic animals, (b) stay in the environment for forever, leading to microplastic pollution, and (c) block waterways and intensify natural disasters.
- They have high carbon footprint and cost for collection, transport and treatment/recycling requirement.
- SUPs release harmful toxic chemical additives at their end-of-life disposal (unscientific) and further contaminate soil, water and food chain.

Easily replaceable SUP, their alternatives and key user industries

SUPs	Type of plastic majorly used	Key user industries	Alternatives	Pros and cons of various alternatives
Polythene bags	Low density polyethylene (LDPE)	Fast-moving consumer Goods (FMCG)	Cotton bags, jute bags, bio-plastics	**Cloth (cotton)** • Pros: Natural fibre, durable, reusable, biodegradable, profitable and non-food crop • Cons: High consumption of chemical fertilisers and pesticides in cotton farming; high cost, water intensive crop; not moisture resistant; needs to be reused many times to offset high degradation/recycling carbon footprint **Jute** • Pros: Natural fibre, durable, reusable and biodegradable, high carbon assimilation rate • Cons: Expensive, water-intensive crop, highly dependent on rainfall, product not moisture resistant **Bio-plastics** • Pros: Bio-degradable, moisture resistant, inexpensive, light weight • Cons: Most contain significant number of plastic polymers leading to microplastic pollution; needs commercial composting facility to degrade; can inadvertently be mixed with plastic recyclables in municipal solid waste; needs quality check and control **Paper** • Pros: Bio-degradable, low manufacturing cost, can be made from recycled paper • Cons: Water-intensive, high carbon footprint, not durable, not moisture resistant **Glass** • Pros: Inert, infinitely recyclable, no toxic chemical additives, low manufacturing carbon footprint • Cons: Fragile, higher cost, injury and health risk, weight **Metal** • Pros: Renewable resource, durable, can be recovered and infinitely recycled • Cons: Expensive, higher transportation carbon footprint, tin- coated steel can leach into food & contaminate, heat conductor
Plastic packaging a. Food packaging b. Insulated food packaging, fragile item protective packaging c. Multi-layered packaging (chips, biscuits, noodle, etc) d. Packaging for online delivery	a. LDPE b. Expanded polystyrene (EPS) c. Paper + foil + LDPE/ PE + foil + paper/ polyethylene terephthalate (PET) + foil + LDPE, etc. d. LDPE	FMCG (food & beverages), hospitality, e-commerce	Bio-plastics, recycled paper	
Plastic bottles, tubes for household, personal care & cosmetics, sanitisers, toiletries, etc.	High density polyethylene (HDPE)	FMCG (personal care and cosmetics Products / PCCP, food, household and toiletries), beauty, hospitality	Glass, metal (tin-plated steel, aluminium), bamboo, pottery and other ceramics	
Plastic sachet	LDPE	FMCG (food and beverages, PCCP), hospitality	Cellophane/ another bio- degradable alternative	
Styrofoam products (plates, tray, cups)	Expanded polystyrene (EPS)	--	Bio-plastic, recycled paper, leaf, bamboo	
Biscuit tray, plastic box, air seal for food, etc.	Polypropylene (PP)	FMCG (food and beverages), hospitality	Bio-plastic	
Plastic water and other drink bottle	Polyethylene Terephthalate (PET)	Hospitality, FMCG (food and beverages)	Glass, metal, ceramics, bulk vending	
Plastic cutlery, plates, cups and stirrers	Polystyrene (PS)	Hospitality	Bio-plastic, recycled paper, steel	
Plastic use and throw Pens	Polypropylene (PP)	FMCG (stationary)	Paper, bamboo, refillable pens	
Straws, stirrers, balloon sticks	Polypropylene (PP)	FMCG (stationary)	Bamboo, recycled paper	
Milk packets	LDPE	FMCG (food and beverages), hospitality	Tetra pack, bottling and bulk vending	
Face shields	Polycarbonate and polyester (PET)	Healthcare	Compostable/bio-degradable face shield	
Sticks of cotton buds	--	FMCG (PCCP)	Recycled paper, other eco- designed materials, bamboo	
Cigarette butts	Cellulose acetate	Tobacco industry		
Freezer bags	LDPE	Hospitality, healthcare, R&D	Glass container, sealable stainless steel	

Microplastics

- Definition: Microplastics are defined by UNEP as solid phase materials, particulates < 5mm, water insoluble, non-degradable and made of plastic. European Commission defines them as consisting of man-made, conventional plastics including bio-degradable plastics, bio-based analogue plastics and bio-based alternative plastics with a particle size below 5 mm and include nanometer sized plastics as well (nanoparticles).
- Major sources: a) vehicle tyres, b) fishing gear, rope, painting and maintenance of ships and boats, c) loss from plastic manufacturing industry, d) painting, construction and road marking, e) fibres from synthetic textile, f) microbeads in personal care and cosmetic products, g) breakdown of plastic products
- Out of all the sources, intentionally-added microbeads in cosmetics and personal care products are 'designed to drain' SUPs. Replacement of microbeads in PCCPs comes under central regulation, however, at a district level, consumer awareness can make a change through shifting of demand to sustainable alternatives.

Regulatory provisions in India for Single Use Plastics

- Plastic Waste Management (Amendment) Rules, 2021 (announced on March 11, 2021): a) The manufacture, import, stocking, distribution, sale and use of the SUP commodities – such as earbuds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks and polystyrene (thermocol) for decoration – shall be prohibited from January 1, 2022, b) The manufacture, import, stocking, distribution, sale and use of the SUP (including polystyrene and expanded polystyrene) items – such as plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping/packing films around sweet boxes; invitation cards; and cigarette packets, plastic/PVC banners less than 100 micron and stirrers – shall be prohibited from July 1, 2022.
- Plastic Waste Management Rules, 2016 and Amendment Rules, 2018: a) Puts the onus on the producers, through extended producer responsibility (EPR), to collect plastic waste either individually or through the concerned local body, b) The primary responsibility is on producers, importers and brand owners (who introduce the products in the market) to collect used multi-layered plastic sachet, pouches and other packaging, c) Manufacturing and use of multi-layered plastic, which is non-recyclable or non-energy recoverable or with no alternate use, should be phased out in two years.
- Solid Waste Management Rules, 2016: a) Introduces EPR for manufacturers or brand owners of disposable products (including plastic packaging, sanitary napkins and diapers) to provide financial assistance to local authorities for waste management system and to set up a collection/take back system for packaging waste.
- Different policy frameworks for single use plastic ban or restrictions (of different kind) exist in at least 23 states and five union territories of India. Madhya Pradesh does not have any policy directive at state level as of now.

Recommendations[29]

- Implement the ban (as specified by the Plastic Waste Management Amendment Rules, 2021) on manufacture, import, stocking, distribution, sale and use of the single use plastic, such as on a) commodities: Ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene (thermocol) for decoration by January 1, 2022; and b) on items -- such as plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping/packing films around sweet boxes; invitation cards; and cigarette packets, plastic/PVC banners – less than 100 micron by July, 1 2022.
- Formulate policies with provisions to: a) Mandate producers to put labels on products and create awareness on disposal, clean-up, collection and treatment of SUP products/packaging, b) Mandate collection target (can be a differential target for different products) for SUP producers as part of extended producer responsibility (EPR), c) Penalise consumers for accepting banned SUP carrier bags or products, d) Strict and random monitoring for implementation of bans in supermarkets, street vendors, shopping malls, large organised markets, etc., e) Gradual phasing out (giving the transition time) of other selected categories of SUP products; can be achieved by sensitising for voluntary action/targeting for elimination of identified groups of key industries/sectors.

29 Note: A sustainable solution to SUP products needs both state and district-level collaborations at all levels including policy formulations and implementations
UNEP. 2018. Single use plastics: A roadmap for sustainability. Available at http://www.indiaenvironmentportal.org.in/files/file/singleUsePlastic_sustainability.pdf
Toxics Link. 2020. Single use plastic, the last straw: A watershed moment in the anthropogenic era.
MoEF&CC. 2016. Solid Waste Management Rules, 2016.
MoEF&CC. 2018. Plastic Waste Management (Amendment) Rules, 2018

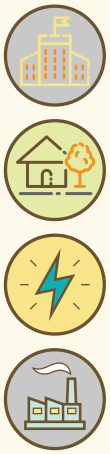
- Promote eco-friendly alternatives to SUPs through: a) Identifying alternative sustainable products, b) Identifying micro-enterprise and cottage industries for the products, c) Integrating them into the mainstream business models through connecting/cross-cutting policies, d) Providing financial incentives for alternative industries and for integrating sustainable products into mainstream business models, such as in the hospitality industry, e) Strict quality control and certification requirement for plastic-free alternatives, such as mandating that no resin or plastic powder is mixed product in the name of alternative.
- Promote extended lifespan and reuse of products, even for the sustainable alternatives, through continued and lasting campaign for 'no single use' to ensure public participation. Replacing the concept of 'single use' is critical as biodegradability or recyclability have 'time' and 'conditions' (energy and water footprint, transport requirement, etc.) attached to them.
- Introduce economic incentives/support: a) Invest in R&D of alternatives to different SUP products, b) Support technology incubation and stimulate creation of micro-enterprises to drive job creation, c) Introduce livelihood support schemes or have special provisions in the existing schemes to accommodate the job loss from plastic industry, d) Grant tax rebate to alternative models, public-private partnerships, etc., e) Incentivise plastic industries to shift to sustainable alternatives.

6.2. Innovative financing

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote green municipal bonds to mobilise untapped investments towards green projects, such as RE infrastructure development, waste management etc.		Medium to long-term	Needs policy formulation Collaboration among various stakeholders required Create specific financial instruments	In 2018, Indore Municipal Corporation raised ₹ 140 crore through municipal bonds. The funds raised were to be used for infrastructure development in the district.
Voluntary carbon market mechanism can be developed for the district to motivate industries, ULBs and other sectors to lower their emission levels through monetary incentives.	All sectors	Medium-term	Need feasibility studies, research and inter-departmental and multi-stakeholder collaboration Institutional structure needs to be established for the same	In 2020, Smart City Indore collected carbon credit of around ₹ 50 lakh through its two bio-methanisation plants. Since 2019, the smart city has avoided emissions of 1,70,000 tCO_2e to generate credits. The gas generated from these plants is used in the city buses – City Bus and iBus.

6.3. Recommendations based on district-specific environmental problems: Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommendation	Framework for implementation	
Water scarcity and water pollution				
Conduct zone-wise assessment and mapping of water challenges in the district.		Short-term	Multi-stakeholder collaboration required Research collaboration required	Madhya Pradesh has provided aquifer vulnerability index (AVI) information to Central Ground Water Board and identified areas for mapping, giving the list of assessment units under critical and overexploited category and their respective change in the water table level.
Prepare a comprehensive district action plan for integrated water resource management (IWRM), for a bottom-up approach in addressing water stress. Establish sustainable and inclusive water governance in the district to develop, implement, evaluate as well as share information on programmes for water resource management and efficient water use in a transparent and inclusive manner with mandatory stakeholder engagement and public participation.		Medium-term	Policy intervention required Stakeholder and research collaboration required	According to the Composite Water Resource Management Index (2019) prepared by the NITI Aayog, MP is one of the top performing states in water resource management. This can be complemented by a district level IWRM.
Promote net zero water (NZW) construction and infrastructure upgradation in urban areas in alignment with ECBC norms.		Medium-term	Policy-level interventions required	

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommendation	Framework for implementation	
Promote rainwater harvesting (RWH): a. Renovation of existing rainwater harvesting structures, b. Implementation of artificial recharge developed by Central Ground Water Board for Indore district in the Gambhir and Kshipra river basins, c. Ensure rainwater harvesting structures in new construction of residential buildings, institutions, commercial centres and industries in the district as per building the bye-laws, d. Efficiently plan storm water drainage. Storm water can also be used for recharging activities.		Short to medium-term	Policy framework exists Align with existing regulations	Indore Municipal Corporation (IMC) has mandated RWH in all new buildings with an area of 250 sqm or more. Added to this, a rebate of 6% on property tax is provided as an incentive to install RWH system. Indore has 126.10 km of underground storm water drainage network against the total existing road length of 1912.2 km (i.e., 6.59% coverage). There is a gap of 93.41% in coverage of storm water drainage network. There is no underground storm water drainage in ABD area. And eventually, storm water ends up in roadside open drains, nallahs and rivers.
Ensuring minimum non-revenue water (NRW), i.e., technical loss due to leakage, seepage or unauthorised use.		Medium-term	Research collaboration required	According to a water balance study (UN-HABITAT) of four cities of Madhya Pradesh, NRW is between 33% and 60% in Bhopal, Gwalior, Jabalpur and Indore – indicating that more than one-third of water is lost in distribution. Reducing NRW through repairs (of leakages) can help the district meet the national average of 20% NRW.
Improve the condition of local surface water sources (Yashwant Sagar Dam) to reduce dependence on Narmada (thereby leading to less energy consumption due to less pumping, less water loss due to leakages, and lower cost of water – the cost of water from local source is ₹ 4 to 5/kl as compared to ₹ 50-70/ kl for water from Narmada). Base water billing on water metering rather than fixed charges. Penalisation for over-consumption should be encouraged.		Medium to long-term	Need to create awareness and collaboration	Indore receives 75% of its water supply from Narmada, which flows at a distance of about 70 km from the city, making it one of the most energy-intensive and costliest water supply in the country (@₹ 30/1,000 litres) To check wastage of drinking water, IMC has linked the water distribution to Supervisory Control and Data Acquisition (SCADA) system. IMC has installed water meters in nearly 1,000 households to record the units of water utilised per house. Installation of meters in remaining households is underway.
Promote dual-flush systems to reduce water consumption, energy consumption and wastewater generation.		Short to medium-term	Align with the existing policies Can be aligned with green buildings	

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommendation	Framework for implementation	
Revive local lakes/ponds and rejuvenate polluted river stretches through desilting, aquifer recharging, and river rejuvenation projects.		Medium-term and continuous	Requires long-term planning and financial investment Multi-stakeholder collaboration required Inter-departmental cooperation required	MPPCB has proposed river rejuvenation action plans for the rivers Kanh, Chambal and Kshipra. The entire stretch of river Kanh is reportedly polluted due to the city sewage of Indore. The Kanh river meets river Kshipra at Triveni Sangam, Ujjain, thus polluting the same. Example: Revival of Kaveri (a tributary of Narmada River) in the Khandwa district of MP, has made it a perennial river from a 'monsoon river' and has increased irrigation area by around 1,000 ha, thereby helping overcome water shortage. Similar initiatives can be undertaken for the other rivers (Chambal, Kshipra, Kahn, Gambhir) in Indore.
Identify and map all wastewater sources to the rivers and waterbodies. Ensure proper functioning of STPs and ETPs to prevent direct release of untreated wastewater from industries, commercial and residential sectors to surface water sources.		Medium-term	Policy framework exists Strict monitoring and reporting required	Sewage disposal at some places within the city is connected with storm network or disposed of in natural drains or in open street drains. Mapping of these sources can help in implementation of measures to extend sewerage network coverage and ensure treatment of wastewater. MP has introduced a state level policy – Waste Water Recycle and Reuse and Feacal Sludge Management in 2017 – which encourages reuse of treated wastewater in industries. Indore city has been declared the first "water plus" city of India under the Swachh Survekshan 2021. IMC has tapped 1,746 public and 5,624 domestic sewer outfalls in 25 small and big drains freeing the city's Kanh and Saraswati rivers from sewer lines. About 110 MLD water is being treated through 7 STPs constructed from these sewers. Example: In Gujarat, Re-use of Treated Wastewater Policy, 2018 mandates that all power plants and large industries within 50 km of a sewage treatment plant must use recycled wastewater to relieve the burden on groundwater and surface water. Similar policy initiatives in MP can help overcome the water challenges in Indore.

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommendation	Framework for implementation	
Managing air pollution				
Facilitate source apportionment studies to identify the sources and develop specific containment measures.		Short to medium-term	Research collaboration required	Indore is categorised as one of the 124 non-attainment cities in India under the National Clean Air Programme (NCAP) for managing particulate matter concentration (PM_{10} and PM_{25}) in alignment with the existing CPCB norms. Indore has one CAQMS at Pologround Industrial Area and three manual stations operated as per CPCB guidelines under National Ambient Air Quality Monitoring Programme (NAMP), installed at Vijay Nagar, Kothari Market and Sanwer Road. Major sources for air pollution in Indore include vehicular emission, road dust, construction activities, biomass and garbage burning, industrial emission, etc. MPPCB already has an action plan to control air pollution in Indore. No recent source apportionment study is available for Indore. IMC has multi-level parking facilities at five locations currently, and 12 more are proposed. Indore had a target of opening 300 vehicular pollution check centres (Action Plan), of which 61 opened to issue PUCs. India's first greenfield SEZ in Pithampur (Madhya Pradesh), located 35 km from Indore, covers a total area of 1,114 hectare.
Increase the number of Continuous Air Quality Monitoring Stations (CAQMS) to statistically, spatially, and temporally, represent the mix of sources and the range of pollution in the city. Also increase the number of air quality display facilities in public places.		Short to medium-term	Policy framework and budgetary provisions exist	
Increase the modal share of public and non-motorised transportation (detailed recommendation under transport sector). Further, promote e-vehicles.	 	Medium to long-term	Policy framework available Need to create awareness Capital investment required Inter-departmental coordination required	
Better traffic management, re-direction of traffic movement, development of multi-layered parking and ban on-street parking within specific perimeters of the multi-layered parking to ensure parking inside the facility.		Short to medium-term	Feasibility studies needed Implementation of existing rules/policies Capital investment required	
Increase/create green cover or green buffers along the major traffic corridors, circles and industrial areas (Pithampur SEZ).	  	Medium to long-term	Inter-departmental coordination Efficient maintenance and monitoring of plantation sites	
Enforce environmental standards set by CPCB for emissions from industries.		Short-term and continuous	Robust M&E required	

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommendation	Framework for implementation	
Sprinkling of water (preferably, recycled grey water) for road dust suspension during peak pollution episodes.		Short-term and continuous	Inter-departmental cooperation required	
Open waste burning (of solid waste, biomass, plastic, horticulture waste, etc.) should be regulated by the municipal corporation/nagar panchayats.		Short to medium-term	Implementation of existing rules/ regulations required	
Implementation of action plan for construction and demolition waste (as per CPCB guidelines).		Short to medium-term	Implementation of existing rules/ regulations required	
Ensure installation and operation of air pollution control devices in industries and adherence to emission standards.		Medium to long-term	Implementation of existing rules/ regulations required Robust M&E required	

6.3.1 Recommendations based on district-specific environmental problems: Policy framework and concerned departments/agencies

Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Water scarcity (decline of groundwater) and water pollution	1. Model Bill for the Conservation, Protection, Regulation, Management of Ground Water, 2016 2. Water Prevention and Control of Pollution Act, 1974 3. National Water Mission 4. MP State Level Policy for Waste Water Recycle and Reuse and Feacal Sludge Management, 2017 5. Comprehensive State Water Policy, 2015	1. MP Water Resources Department, GoMP 2. MP Pubic Health Engineering Department, GoMP 3. MPPCB	1. Proposed District Level Climate Change & Environment Committee 2. All ULBs 3. Indore Development Authority (IDA) 4. Urban Development and Housing Department, GoMP 5. Panchayat and Rural Development Department, GoMP 6. Dept of Industry Policy and Investment Promotion, GoMP 7. MPIDC 8. CGWB
Managing air pollution	9. Air (Prevention and Control of Pollution) Act- 1981; 10. Environment (Protection) Act, 1986; 11. National Clean Air Programme 12. Solid Waste Management Rules, 2016 & Amendment 2018 13. Construction & Demolition Waste Management Rules, 2016	1. Department of Housing and Environment, GoMP 2. MPPCB	1. District Administration and the proposed District Level Climate Change & Environment Committee 2. Department of Housing and Environment, GoMP 3. Department of Forest, GoMP 4. Department of Transport, GoMP 5. RTO 6. All ULBs

Carbon neutrality for Indore

The Smart Cities Mission was launched by the Government of India in June 2015 with the objective of promoting cities that provide core infrastructure, clean and sustainable environment through the application of 'smart solutions' (Ministry of Housing and Urban Affairs, 2021). Indore was one of the first 20 cities selected under the mission in 2016. The same year, Indore Smart City Development Limited (ISCDL), a special purpose vehicle, was established for this purpose.

Indore is the only smart city in India to trade carbon offset in the international market. ISCDL has generated revenue of ₹ 50 lakh by selling credits against 1.7 lakh tonnes CO_2 under the Verified Carbon Services Programme. This was achieved through three projects undertaken by the Indore Municipal Corporation (IMC):

- 600 tonne/day composting plant;
- 35 tonne/day bio-methanation plant;
- 1.5MW solar plant.

Indore is the only Indian smart city to trade carbon offset in international market generating ₹ 50 lakh revenue against 1.7 lakh tonnes of CO_2

Carbon neutrality denotes achieving a balance between emitting and absorbing carbon emissions from the atmosphere. Numerous cities across the globe have committed to attaining carbon neutrality within a certain timeframe. These include New York (by 2050), London (by 2050), Helsinki (by 2035), Copenhagen (by 2025), and Bangalore (by 2050). Various consortiums of cities have been organised across the globe to achieve this target. One such consortium is the C40 Cities, which defines the criteria for a carbon neutral city as follows:

1. Net zero GHG emissions from fuel use in buildings, transport and industry
2. Net zero GHG emissions from grid supplied energy
3. Net zero GHG emissions from treatment of waste generated within the city boundary
4. Net zero GHG emissions from additional sectoral emissions in the city's GHG accounting boundary

Smart City Indore can further enhance its ambition of sustainability and become a carbon neutral city by adopting the following measures:

1. Enhancing urban energy infrastructure
    a. Transitioning the current fossil fuel-based energy regime to renewable and waste-based energy regime
        i. Government schools in Indore district, if equipped with solar rooftops, can generate 56.83 MUs electricity, thereby avoiding 40,000 tCO_2e annually.
        ii. If 50 percent of the commercial buildings in Indore city (having a potential of 870 MW and) install solar rooftops, 9,10,000 tCO_2e can be avoided annually.
    b. Modernising grids and moving to a demand-based energy supply structure.
    c. Transitioning towards climate neutral buildings by (a) retrofitting old buildings to become energy and water efficient in compliance with the ECBC norms; and (b) ensuring new buildings are compliant with 'net zero' or 'plus energy' standards. These measures would lead to considerable drop in emissions (given below):
        i. By 2025, if 23 percent of the existing residential areas in Indore become ECBC compliant, 10,80,000 tCO_2e can be avoided.
        ii. During the same period, if 30 percent of the commercial area in the district becomes ECBC compliant, around 3,00,000 tCO_2e can be avoided.
    d. Design energy tariffs, incentive packages and taxes in a manner that encourage investment in energy-efficient infrastructure and eliminate energy imbalances in the residential, commercial, and industrial sectors.
2. Urban planning and spatial strategies
    a. Limit horizontal urban sprawl by achieving appropriate building density.
    b. Limit car dependency by enhancing public transport facilities.
    c. Promote sustainable and low carbon transport modes.
    d. Encourage eco-towns and sustainable settlements.
3. Low carbon mobility
    a. Developing a comprehensive network of bicycle routes and bicycle hire facilities across the city.
    b. Ensuring safe and convenient cycling and walking infrastructure, particularly for the elderly, children and those with reduced mobility.
    c. Making public transport attractive, convenient, and affordable.
    d. Developing no-vehicle pedestrian friendly zones.
    e. Encouraging a transition to electric fuel-based public and intermediate transport and installing RE-based charging infrastructure for the same.
4. Enhancing lung spaces
    a. Green spaces should represent a considerable portion of land use while being integrated into the city design in a manner to protect the city infrastructure from natural disasters, mitigate urban heat island effect and to provide ample recreation space.
    b. Enhance trees outside forest and urban forestry initiatives.
        i. Table 16 gives the CO_2 sequestration potential by a single tree of common tree species.
    c. Installing green roofs and converting brownfield sites into green areas.
    d. Green spaces also reduce the risks of floods, droughts and heat waves.
5. Waste and wastewater management:
    a. Promoting recycle and reuse to minimise waste generation.
    b. Ensuring 100 percent waste segregation from residential, commercial and industrial sectors.
    c. Treating waste as valuable feedstock for energy generation and developing infrastructure for material recycling, 100 percent organic waste treatment (by composting with a methane capturing facility), waste-to-energy generation, heat recovery of incinerators.
    d. Achieving 100 percent underground sewerage network coverage with aerobic sewerage treatment.
    e. Promote reuse of treated wastewater in industrial sector and for landscaping and gardening.

6. Building urban resilience
    a. Undertaking a climate risk assessment exercise to investigate exposure and impacts of climate, energy and environmental risks.
    b. Identifying vulnerable groups and locations through social impact assessment.
7. Awareness
    a. Well-designed awareness campaigns with widespread reach through social media, radio, newspapers and other local media, ***nukkad nataks***, wall paintings and school programmes. This will help ensure people's participation for advancing towards carbon neutrality that is based on the principles of social inclusion.

Table 16: Indicative CO_2 sequestration potential of different plant species[30]

Species	Girth class (cm)/age class (year)	Carbon sequestered by one tree (kg/tree)	CO_2 sequestered by one tree (kg/tree)
Mangifera indica (Aam/Mango)	10 to 30 cm	11.3	41.4
	31- 60 cm	40.5	148.5
	61 – 90 cm	83.3	305.43
	91 – 200 cm	727.4	2,665.67
	> 200 cm	810.7	2,972.57
Ficus benghalensis (Banyan)	10 to 30 cm	21.4	78.47
	31- 60 cm	54.2	198.74
	61 – 90 cm	197.9	725.64
	91 – 200 cm	283.6	1,039.87
	> 200 cm	706.9	2,591.97
Delonix regia (Gulmohar)	10 to 30 cm	8.38	30.72
	31- 60 cm	44.48	163.09
	61 – 90 cm	89.32	327.5
	91 – 200 cm	330.39	1,211.43
	> 200 cm	602.34	2,208.58
Emblica officinalis (Amla)	10 to 30 cm	4.82	17.67
	31- 60 cm	28.4	104.13
	61 – 90 cm	112.9	413.97
	91 – 200 cm	176.9	648.64
	> 200 cm	340.89	1,249.93
Tectona grandis (Teak)	10 to 30 cm	73.44	269.28
	31- 60 cm	134.34	492.58
	61 – 90 cm	352.48	1292.42
	91 – 200 cm	775.17	2842.29
	> 200 cm	2413.68	8850.16
Tamarindus indica (Khati Imli)	10 to 30 cm	21.33	78.21
	31- 60 cm	42.38	155.4
	61 – 90 cm	310.9	1139.97
	91 – 200 cm	705.3	2586.1
	> 200 cm	1111.8	4076.6

30 CO_2 sequestration potential is calculated using species wise information provided in "Carbon Stock Assessment of Selected Tree Species in Urban and Sub Urban Areas of Gujarat (Report-II)" published in 2013 by the Forest Department, Gujarat State in collaboration with GEER Foundation. MP specific CO_2 sequestration potential can be calculated if species wise carbon stock assessment/carbon stock density of MP is available.

Species	Girth class (cm)/age class (year)	Carbon sequestered by one tree (kg/tree)	CO_2 sequestered by one tree (kg/tree)
Polyalthia longifolia (Ashopalav)	10 to 30 cm	7.4	27.1
	31- 60 cm	100.2	367.4
	61 – 90 cm	130.9	479.97
	91 – 200 cm	497.4	1823.8
	> 200 cm	1590	5830
Ficus religiosa (Peepul)	10 to 30 cm	7.1	26.03
	31- 60 cm	49.5	181.5
	61 – 90 cm	71.5	262.17
	91 – 200 cm	189.5	694.83
	> 200 cm	679.2	2,490.4
Azadirachta indica (Neem)	10 to 30 cm	11.7	42.9
	31- 60 cm	56.2	206.06
	61 – 90 cm	248.5	911.17
Dendrocalamus strictus (Bamboo)	1 year	2.67	9.8
	2 year	3.23	11.84
	3 year	3.30	12.1
	4 year	3.49	12.8
	5 year	3.50	12.84

6.4. Actions district authorities can recommend to state departments

Recommendations that can be pursued by the district collector/committee at the state level	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
POWER SECTOR: Upgrade DISCOM infrastructure and their supply network to reduce AT&C losses, billing inefficiencies etc. Furthermore, introduction of smart billing system would help curtail power thefts, and increase billing efficiency, helping the DISCOM generate more revenue.		Short to medium-term.	Policy framework and targets exist (section 6.4.1)	• The current AT&C losses of MPPKVVCL are 25.8%, which is higher than the international standard range of 6 to 8%. • MPPKVVCL needs to upgrade its infrastructure, expand smart metering, smart billing, etc. to increase its efficiency. • For example, EESL has signed an MoU with Uttar Haryana Bijli Vitran Nigam and Dakshin Haryana Bijli Vitran Nigam for 10 lakh smart meters. The deployment of smart meters in the country has led to a 20% increase in monthly revenue per customer for DISCOMs, a 5% (average) reduction in AT&C losses and has enabled remote disconnection of defaulters. Smart meters have also completely eliminated the need for manual reading of meters, thereby reducing the cost of operations (as per EESL).

Recommendations that can be pursued by the district collector/committee at the state level	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
HABITAT: Provide subsidies/ tax rebates to builders/ building owners to encourage adoption of ECBC or IGBC (e.g., property tax/water cess/IT rebate).		Medium to long-term	Policy framework exists (section 6.4.1), but targets need to be set Needs inter-departmental collaboration	ECBC buildings deliver 20-25% of energy savings, in different climates, when compared with the conventional buildings (BEE, 2017). By 2025, If 30% of the commercial area in the district becomes ECBC-compliant, around 0.3 $MtCO_2e$ emissions can be avoided.
TRANSPORT: Energy efficiency of infrastructure in railways can be enhanced through the following measures: a. Installation of solar panels along electrified tracks and on railway station rooftops b. Installation of optimal light control systems and appliances, smart sensors and building management systems at station buildings c. Ensuring regeneration of energy (through rolling stock) parallel to the grid.		Medium-term	Needs inter-departmental collaboration	Rail Land Development Authority and National Building Construction Corporation have signed an MoU for redevelopment of 10 railway stations across India as 'smart railway stations'. Railway stations in Indore district can also be developed along those lines.
TRANSPORT: Use fiscal instruments to discourage the use of personal vehicles. Here are some examples: a. Increase charges on registration of internal combustion engines (ICE) vehicles b. Levy congestion charges and other green tax c. Phase out older, more polluting vehicles.		Short-term and continuous	Proper policy backing based on research and inter-departmental cooperation is needed	In January 2021, the Ministry of Road Transport and Highways announced 'green taxes' in the form of additional taxes on old vehicles that are unfit for roads.
TRANSPORT: Identify and plan shifting of key commercial / business centres from all the ULBs to outside city limits to reduce traffic load.		Long-term	Proper policy backing based on research and inter-departmental cooperation is needed	There is need to develop areas outside of IMC limits to accommodate the shifting of industries, business centres, IT parks etc.
TRANSPORT: District authorities while gradually rolling out EV infrastructure, can advocate to state and national governments for standardised EV cables and infrastructures for easier integration and interoperability for implementation of smart charging on a large scale.		Medium to long-term	Needs policy intervention	

Recommendations that can be pursued by the district collector/committee at the state level	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
INDUSTRY: a) Ensure regular PAT compliance of DISCOMs and other designated consumers (DCs) in the district b) Increase the number of DCs for PAT scheme in the district, and ensure the compliance of targets.		a) Short-term and continuous b) Medium to long-term	Policy framework exists (section 6.4.1), but targets need to be revised gradually Ensure M&E Collaboration required	Until PAT Cycle VI (2020-21), only four[31] DCs had volunteered under the scheme in Indore district. Over the years, these DCs from Indore district have helped avoid around 7.11 $MtCO_2e$[32] by improving their systemic energy efficiency, under the PAT scheme. Under the BEE-SME Programme, Indore was among the four pilot MSME clusters across the nation to adopt energy efficiency measures to reduce energy consumption in forging, textile, food and brick industries. Seven industries out of the Indore food cluster participated in the programme. Under the project, several interventions such as optimisation of the combustion efficiency, compressed air system energy efficiency etc. were carried out in the cluster. Up to March 2017, implementations carried out in these industries led to energy savings of 220 tCO_2e.
INDUSTRY/ENERGY: Ensure compliance to renewable purchase obligations (RPO) and increase the RPO targets gradually.		Medium to long-term	Policy framework exists (section 6.4.1)	For FY 2021-22, the RPO target for industries is 17%.
AGRICULTURE: Encourage millet cultivation (requires less water to grow, shows good productivity under extreme climate conditions and is nutritionally rich).		Medium to long-term	Needs creation of appropriate financial mechanisms to encourage farmers to grow millets Requires research collaboration This would also help meet the following targets of SDG#2: 2.1, 2.3, 2.4	In Indore, jowar production has continuously decreased (230 MT in 2017-18 to 12 MT in 2018-19).

31 Names of Designated Consumers- MPPKVVCL, STI India Limited, Pratibha Syntex Limited, Raddisson Blu.

32 It may be noted that the DISCOM Is not situated within Indore district, and the emissions savings depicted here are calculated on the basis of population share of the district in DISCOM's supply network.

Recommendations that can be pursued by the district collector/committee at the state level	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
AGRICULTURE: To compensate for predicted decrease in crop productivity, initiate research on high yield, drought and temperature resilient genotypes of various food and cash crops, in association with agricultural institutes/universities.		Medium to long-term	Needs research collaboration and capital investment This would also help meet the following targets of SDG#2: Targets 2.1, 2.3, 2.4, 2.a.	Rainfed area (for agriculture) of Indore decreased from 2.81 lakh ha (in 2010-11) to 2.52 lakh ha (2015-16). However, the irrigated area increased from 1.79 lakh ha (2010-11) to 2.16 lakh ha (2015-16). Area under wheat cultivation in the district increased from 1.10 lakh ha to 1.26 lakh ha (between 2017-18 and 2018-19) and production improved from 4.65 lakh MT to 5.21 lakh MT (between 2017-18 and 2018-19). However, the yield reduced by 2.01 %. In order to meet the future food demand, climate-smart agriculture will be the key to reducing crop failures.
AGRICULTURE: For overall reduction in electricity consumption and water savings in the agriculture sector, subsidies can be reduced by some percentage points in a phased manner.		Medium to long-term	Policy intervention needed Requires awareness generation and collaboration with the farming communities	Tariffs are levied based on the consumption slabs as well as the capacity of the pump being used. As per Madhya Pradesh Electricity Regulatory Commission's Aggregate Revenue Requirement and Retail Supply Tariff Order for FY 2020-21, the electricity cost is 645 paise/unit and 469 paisa/unit for domestic sector and agriculture & allied activities sector, respectively, upon utilisation of 300 units. - both state and central Electricity tariff policies, in conjunction with large subsidies for agricultural power, have caused rapid groundwater depletion in many regions and led to massive financial losses for power utilities and (state and central) governments.
FORESTRY/GREEN SPACES: Promote regeneration of degraded and open forest areas through CSR (or similar mandates) and encourage corporates to dedicate some percent of their profit for greening the spaces around their units/ factories.		Long-term	Needs strengthening of the existing policy framework Needs different stakeholder collaboration	Green belt on the boundaries of industries helps in maintaining the green cover of the area. Moreover, it absorbs the pollution emitted from the industries (i.e., helps in carbon sequestration).
E-WASTE: Adopting 'green marketing' approach by: a. Promoting green products, b. Displaying product lifespan as a label on e-products to influence purchase decisions, thereby, using the labels as behavioural intervention.		Medium to long-term	Needs policy intervention, collaborations and awareness	

6.4.1 Actions district authorities can recommend to state departments: Policy framework and departments

Sub-sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Associated departments/agencies
Power sector	1. National Smart Grid Mission 2. Smart Metering National Programme 3. Integrated Power Development Scheme (IPDS); 4. Restructured Accelerated Power Development and Reforms Programme (R-APDRP) 5. UDAY Scheme, 2015 6. National Mission on energy Efficiency, specifically PAT (Perform, Achieve and Trade) Scheme 7. MP Solar Power Policy, 2012 8. Policy for Decentralised Renewable Projects, 2016 9. Standards and Labelling Programme	1. MPPMCL-MPPKVVCL, GoMP 2. MPUVNL, GoMP 3. BEE (EESL)	1. State Knowledge Management Centre on Climate Change (SKMCCC)- EPCO 2. West Central Railways – Indore Division 3. Proposed District Level Climate Change and Environment Committee
Habitat	1. ECBC	1. Urban Development and Housing Department, GoMP 2. All ULBs 3. Indore Smart City Development Corporation Limited (ISDCL).	1. Proposed District Level Climate Change and Environment Committee 2. MPUVNL
Transport	1. ECBC 2. JNNURM 3. Smart Cities Mission 4. AMRUT	1. Ports and Transport Department 2. All RTOs 3. ALL ULBs	1. MPSRTC 2. MPUVNL 3. Indore Smart City Development Corporation Limited 4. West Central Railways - Indore Division
Industry	1. PAT Scheme 2. Industrial Promotion Policy, 2014 3. BEE-SME Program	1. Department of Industry Policy and Investment Promotion, GoMP	1. Industries Commissionerate 2. District Industries Centre 3. Proposed District Level Climate Change and Environment Committee
AFOLU	1. National Mission on Food Security 2. Pradhan Mantri Krishi Vikas Yojana 3. National Mission for Sustainable Agriculture 4. Price Support Scheme 5. National Afforestation Programme (NAP) 6. Green India Mission 7. CSR Act, 2013	1. Farmers' Welfare and Agricultural Development Department, Government of Madhya Pradesh 2. Forest Department, Government of Madhya Pradesh	1. APMCs 2. MPIDC 3. Energy Department, GoMP 4. Madhya Pradesh State Agro Industries Development Corporation 5. Mineral Resources Department, GoMP 6. Madhya Pradesh State Agriculture Marketing Board 7. Proposed District level Committee on Climate Change and Environment
Waste	1. E-waste Management Rules, 2016	1. Science and Technology Department, GoMP	1. Proposed District Level Climate Change and Environment Committee

6.5. Sustainable Development Goals being addressed

SDGs	Targets	Sector (sub-sectors) addressing the recommendation
SDG 1: No Poverty 	Target 1.4: Ensure that all men and women, in particular the poor and the vulnerable, have access to basic services.	Waste; water
SDG 2: Zero Hunger 	Target 2.1: End hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants to safe, nutritious and sufficient food all year round.	AFOLU (agricultural)
	Target 2.3: Double Agricultural Productivity.	AFOLU (agricultural)
	Target 2.4: Implement resilient agricultural practices that increase productivity and production.	AFOLU (agricultural)
	Target 2.a: Increase investment, including through enhanced international cooperation, in rural infrastructure and agricultural research.	AFOLU (agricultural)
	Target 2.a; Article 10.3.e: Development of sustainable irrigation programmes for both crops and livestock.	AFOLU (agricultural and livestock)
SDG 3: Good Health and Well-being 	Target 3.3: End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.	Water pollution; co-benefits from waste (through cleaner neighbourhood, better access to sanitation)
	Target 3.4: Reduce by one third premature mortality from non-communicable diseases through prevention.	Co-benefits from waste (by reducing pollution and providing better hygiene)
	Target 3.9: Substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination.	Waste; water scarcity and pollution; air pollution
SDG 6: Clean Water & Sanitation 	Target 6.1: Achieve universal and equitable access to drinking water.	Water scarcity and water pollution
	Target 6.3: Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.	Waste; energy (industry); water pollution
	Targe 6.4: Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals.	Energy (habitat – demand-side management, by-laws for new construction & industry); AFOLU (agricultural and green spaces); water scarcity
	Target 6.5: Implement integrated water resources management at all levels.	AFOLU (agricultural and green spaces/ forestry); water scarcity and pollution
	Target 6.8: Support and strengthen the participation of local communities.	Waste; AFOLU; transport
	Target 6.a: Expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including wastewater treatment, recycling and reuse technologies.	Waste; AFOLU; transport

SDGs	Targets	Sector (sub-sectors) addressing the recommendation
SDG 7: Affordable & Clean Energy 	Target 7.1: Ensure universal access to affordable, reliable and modern energy services.	Energy (power & habitat); AFOLU (agricultural)
	Target 7.2: Increase share of renewable energy in energy mix.	Energy (power, transport, habitat – energy efficiency in building and bye-laws for new construction & industry)
	Target 7.3: Double the global rate of improvement in energy efficiency.	Energy (power, habitat & industry)
	Target 7.a: Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.	Energy (power)
	Target 7.b: Expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries in accordance with their respective programmes of support.	Energy (power); AFOLU
SDG 8: Decent Work and Economic Growth 	Target 8.2: Achieve higher levels of economic production through diversification, upgradation, and innovation.	Energy; AFOLU (agricultural & livestock)
	Target 8.4: Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production.	Waste
SDG 9: Industry, Innovation and Infrastructure 	Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure.	Energy (habitat – energy efficiency in building); waste; transport
	Target 9.2: Promote inclusive and sustainable industrialization.	Energy (industry)
	Target 9.3: Improving access and connectivity to industries/other enterprises.	Energy (transport)
	Target 9.4: Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.	AFOLU (agricultural); waste, energy (industry); water scarcity
	Target 9.5: Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.	Energy (power); waste
	Target 9.b: Research and innovation in developing countries, including by ensuring a conducive policy environment.	Waste; energy (power & industry); air pollution

SDGs	Targets	Sector (sub-sectors) addressing the recommendation
SDG 11: Sustainable Cities and Communities	Target 11.1: Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.	Waste; habitat; water
	Target 11.2: Safe, affordable, accessible and sustainable transport systems for all.	Energy (transport); habitat; air pollution
	Target 11.3: Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management.	Waste; energy (power; habitat – energy-efficient building), all district-specific inputs
	Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage.	AFOLU (forestry); water scarcity
	Target 11.6: Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.	Waste, energy (power, transport, habitat industry) and air pollution
	Target 11.a: Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening regional development planning	Energy (transport and industry)
	Target 11.b: Substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change,	Energy; AFOLU; waste
SDG 12: Responsible Consumption and Production	Target 12.1: Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries.	Energy; waste
	Target 12.2: Achieve the sustainable management and efficient use of natural resources.	Energy; AFOLU; waste; air pollution and water pollution
	Target 12.3: Halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.	AFOLU; waste
	Target 12.4: Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil.	AFOLU; waste; air pollution and water pollution
	Target 12.5: Substantially reduce waste generation through prevention, reduction, recycling and reuse.	Waste; energy (habitat and industry)
	Target 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.	Waste; industry
	Target 12.8: Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.	Individual action and behavioural change communication (BCC)
	Target 12.a: Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.	Waste; AFOLU (agriculture and livestock)
SDG 13: Climate Action	All targets	All sectors
SDG 14: Life under Water	Prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.	Waste (Single use plastic)

SDGs	Targets	Sector (sub-sectors) addressing the recommendation
SDG 15: Life on Land	Target 15.1: Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.	AFOLU; waste; water pollution
	Target 15.2: Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation.	AFOLU (forestry/ green spaces)
	Target 15.3: Combat desertification, restore degraded land and soil.	AFOLU (forestry/ green spaces)
	Target 15.9: Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies.	AFOLU and water scarcity
	Target 15.a and 15.b: Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity, ecosystems and sustainable forest management.	AFOLU and water scarcity
SDG 17: Partnerships for the Goals	Target 17.7: Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries.	Energy; AFOLU; waste; BCC; individual action
	Target 17.16: Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.	Energy; AFOLU; waste

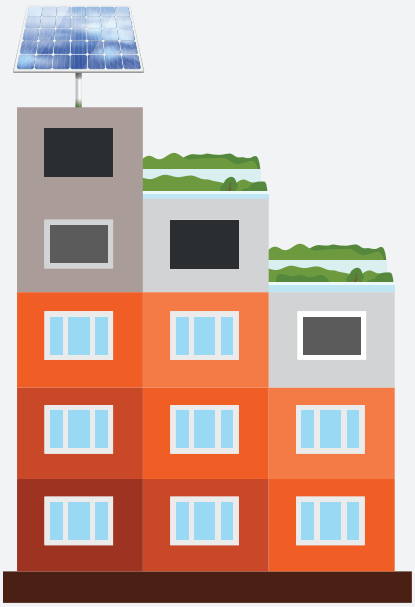
6.6. Promoting voluntary individual climate action

Waste management

1. Practice source segregation and handover segregated waste: biodegradable, non-biodegradable, domestic hazardous waste and household clinical waste.
2. Go for sustainable tourism/eco-tourism or tourism efforts for lowered waste footprint.
3. Electronic brand website gives information on e-waste collection points, ensure formal recycling of your electronic products by going through the collection points.
4. Responsibly dispose your e-waste: send them to a recycler, producer (manufacturer), producer responsibility organisation or dispose during local e-waste collection drives.
5. Say no to personal care products using microplastics/microbeads, read the labels before buying.
6. Say no to easily avoidable single use plastic products, like, plastic cutlery, straws, plastic carry bags, pouch products, food wraps, multi-layered packaging products.
7. Choose products with: a) less packaging waste, b) sustainable packaging, c) displayed higher product lifespan, d) displayed recycling/resource recovery efforts and information.

Housing

1. Insulate the building as much as possible, ensure proper sealing of doors and windows to avoid cooling/heating leakage
2. Develop and maintain provision for rainwater harvesting
3. Install solar rooftop panels, if feasible
4. Adopt wastewater recycling and reuse
5. Rooftop gardens can considerably reduce space cooling requirement



Lighting

1. Switch off lights and fans when not required
2. Replace incandescent bulbs with LEDs
3. De-dust lighting fixtures to maintain illumination
4. Smart LEDs are even more convenient – they can be controlled even when the person is not at home

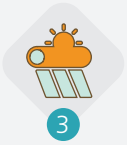
Kitchen

1. While cooking on gas stove, use moderate flame setting to conserve LPG
2. Prefer the use of pressure cookers
3. Keep the burner clean
4. Use lids to cover the pan while cooking
5. Use flat bottomed pan on electric stove
6. Turn off electric stove several minutes before the specified cooking time

Daily use appliance

1. Purchase BEE star-rated energy efficient appliances

2. Shift consumption to off-peak hours (i.e. other than 10 am to 8 pm)



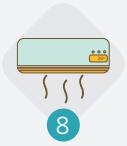
3. Replace electric water heater with a solar water heater, if feasible

4. Unplug idle devices/appliances.

5. A power strip can be used to reduce plug load. Devices such as desktops, TVs, microwaves, etc. use standby power even when off. Switching off the power strip has the same effect as unplugging all devices

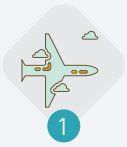
6. Proper maintenance of air conditioners helps to increase efficiency

7. Do not overload the refrigerator



8. Set the AC thermostat at 25°C to 26°C, for optimum cooling

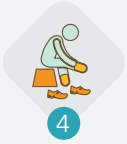
Transport



1. Choose direct flights to reduce carbon footprint

2. Travel light to reduce carbon emissions

3. Strictly abide by pollution norms



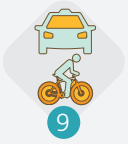
4. Put on your shoes for short trips

5. Ensure regular maintenance of vehicles

6. Choose inter-modal transport (private + public)

7. Reduce demand for vehicle travel by expanding personal mobility choices such as car-sharing and bike-sharing

8. Shift to clean, non-petroleum fuels such as electricity (through RE) to power vehicles



9. Car pool to work, Use bicycles park and ride

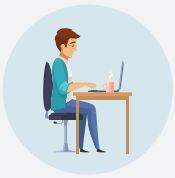
10. Swicth off the ignition at traffic signals

Other climate-conscious precepts

Be mindful of water consumption. Use bucket instead of shower. Use bucket instead of hose for cleaning cars/ porch/back-yard. Opt for dual-flush toilets. Close the tap while brushing. Reuse RO reject water.

Carry your own bottled water, adopt minimalist lifestyle to reduce overconsumption of resource, purchase only when necessary.

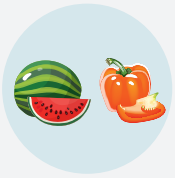
Go for climate conscious producers/ manufacturers. Develop a knowledge and preference for locally available and sustainably produced and designed products.



If possible, opt for work from home option for a few days in a week.

Encourage elected representatives and policy makers to opt for green choices/deals/decisions.

Choose standard shipping while ordering online.



Buy locally available produces, especially food, items vegetables and other perishable products.

Invest time and effort in greening local areas through collective community action.

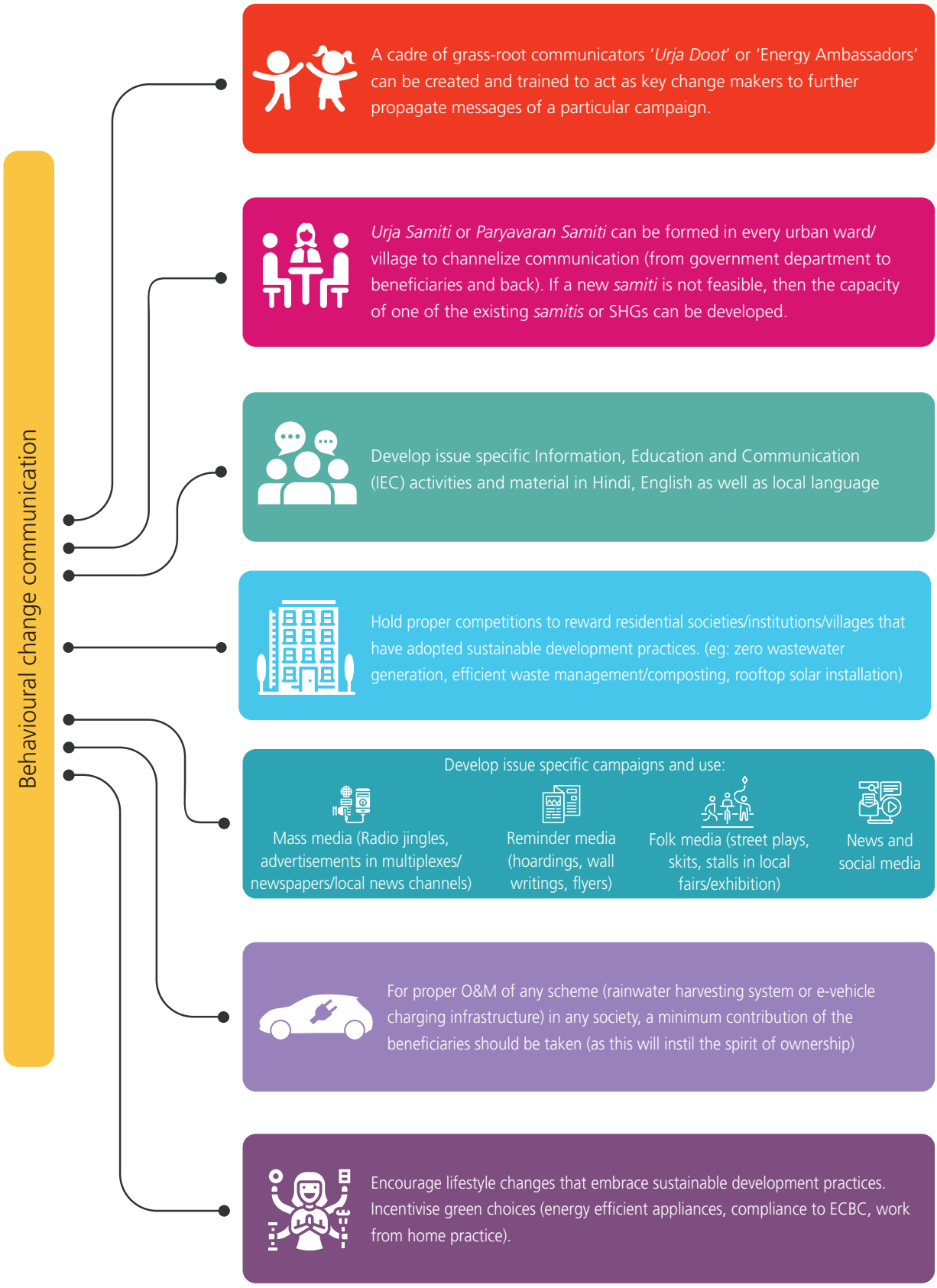
Develop a habit of repair and reusing appliances and products at home instead of buying new ones. Follow reduce, reuse and recycle principles in the household to reduce footprint.

Include more meat-free meals and limit food wastage.

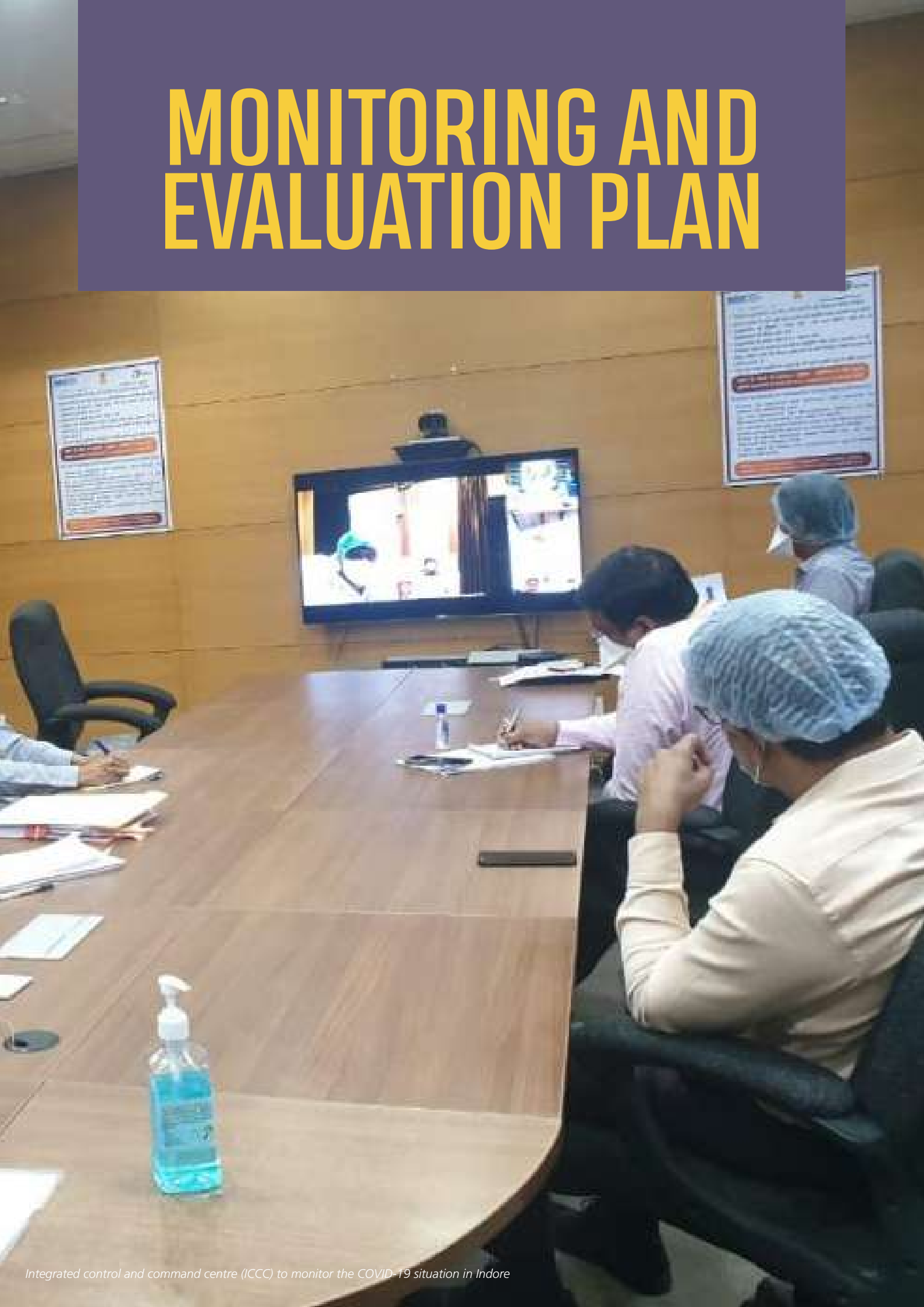
Buy local and organic food items not only for health but also to cut down emissions from transport and chemical fertilisers.

Opt for water saving fittings and fix any leakages in the house.

6.7. Behavioural change communication (BCC) techniques



MONITORING AND EVALUATION PLAN

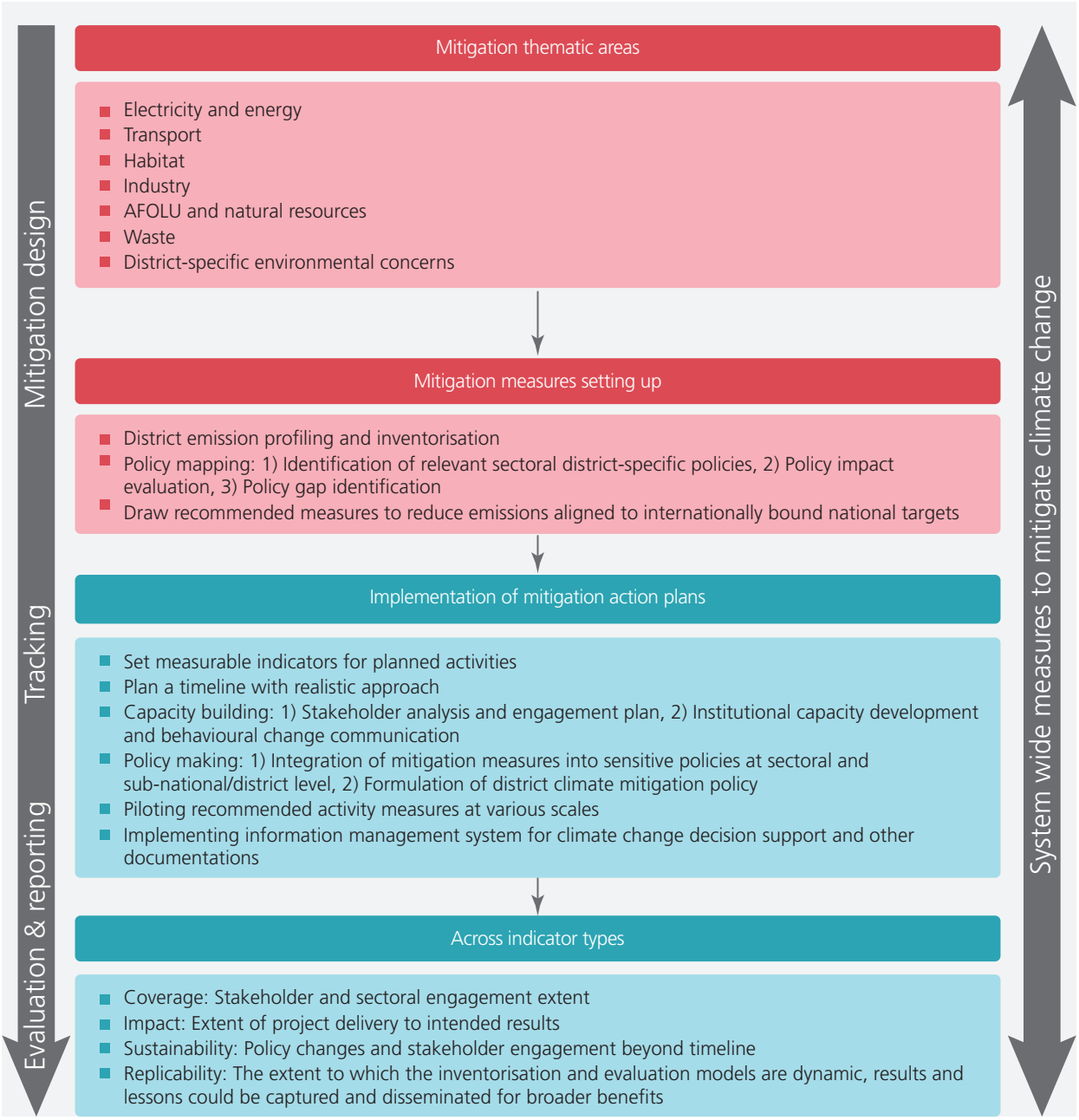


Integrated control and command centre (ICCC) to monitor the COVID-19 situation in Indore

7. MONITORING AND EVALUATION PLAN

7.1. Framework for monitoring and evaluation

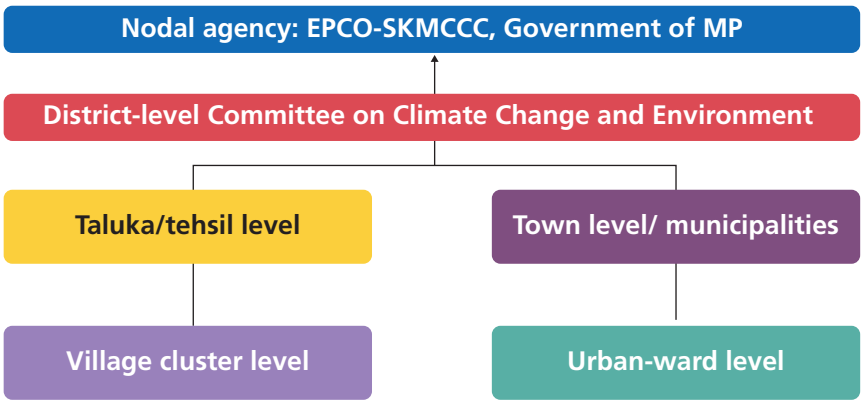
This section describes the planning for monitoring and evaluation of the climate change mitigation measures that the district may adopt for the sectors identified in the report to realise the achievement and track the effectiveness of results envisaged, in order to compliment the national endeavours to attain nationally determined contributions. The framework proposes to incorporate: a) district-level mitigation profiling; b) planning for mitigation measures; c) tracking of implementation and integration to the national mitigation response, and d) evaluation of relevance and effectivity.[33]



33 Activities that are already covered in the current CCEAP for Indore District are in red colour. Activities that are 1) to be based on the CCEAP findings and recommendations or 2) potentially mapped out through the CCEAP report, like the stakeholder mapping or behavioural change communication plan, etc. are given in the blue colour.

7.2. Proposed institutional set-up

As a central authority or body to steer the wheels of climate mitigation, it is recommended to formulate a district climate cell/committee or include the perspective of climate change in the existing District Environment Committee.[34] The Committee shall assign tasks according to stakeholder analysis and engagement as outlined in the model given below. This committee shall comprise of representatives from concerned administrative bodies, sectoral experts, civil society organisations and civic/other associations (as applicable) and shall similarly be formed at block, ULB, cluster and ward level. The committee shall oversee implementation of deliverables following the prescribed recommendations/ framework and the outputs. A proposed set-up of the committee at each of the levels is as follows:



District level committee

Chairman: District Collector

Members: Municipal Corporation Commissioner, District Development Officer (DDO), Superintendent of Police, Deputy Collector, district Level officers/representatives of Pollution Control Board, MSMEs, Agriculture & Animal Husbandry, department of Statistics and Planning, District Urban Development Agency, Industry Department, Urban Development Department (UDD), water supply, Rural Development Department (RDD), health care department, Regional Transport Office (RTO) etc

Taluka level

Chairman: Mamlatdar/Taluka Development Officer

Members: Taluka Level Members of: Rural Development Department, Department of Irrigation, Water Supply Department, Agriculture & Animal Husbandry and other departments mentioned in the district committee

Town level/municipalities

Chairman: Head of Municipality/Nagarpalika

Members: Town-level representatives of the departments mentioned above

Village cluster level

Chairman: Deputy Mamlatdar

Members: Sarpanch and other PRI members, SHG members, head of women committee, village water and sanitation committee, grassroot communicators

Urban-ward level

Chairman: Ward Representatives

Members: President of RWAs, grassroot communicators, civil societies, members of *samittee*

34 as per the Hon'ble NGT order in O.A. No. 710-713/2017 dated 15.07.2019


इन्दौर नगर पालिक
केवल
घर एवं दुकान का
डालना प्रतिबंधित
गीला
इन्दौर नगर पालिक निगम
केवल राहगीरों के उपयोग
घर एवं दुकान का कचर
डालना प्रतिबंधित
सूखा कचर
सर्वेक्षण

IMPACT OF COVID-19 VIS-À-VIS CLIMATE ACTION

A street vendor wearing mask to prevent corona virus and the bins on the roadside for waste management in Indore

8. IMPACT OF COVID-19 VIS-À-VIS CLIMATE ACTION

8.1. Introduction

The ongoing COVID-19 pandemic situation has gravely affected almost every corner and sector of the country. Indore district too did not go unaffected and reported 1,53,154 cases (September 30, 2021), making up for 19.35 percent of the state's total cases (Covid19India, 2021). This affected management of climate crisis in the backdrop of an already vulnerable governance, poor emergency response and warning system and an over-stretched public health infrastructure. The economic and social costs (both direct and indirect) of a pandemic like COVID-19 may take priority over the global climate goals and national climate commitments in both the short and the long run.

Positive impacts: Lockdowns have had several positive impacts on the environment. For the first time in nearly four decades, India has seen reduction in CO_2 emissions by 30 million tonnes CO_2 (1.4 percent) in FY 2019-20 due to a slowdown and restrictions on economic and other activities (Lauri & Dahiya, 2020). In April 2020, aerosol levels were at a 20-year low in north India, one of the most polluted regions in the world (NASA, 2020). Improved water quality and biodiversity sightings were also reported from different parts of the country during the lockdown period of mid-March to June 2020 (India Today, 2020).

Following are some likely impacts of COVID-19 on climate mitigation measures in the district of Indore.

8.2. Energy consumption

8.2.1 Electricity demand

Coal-based power generation reduced by 26 percent in just two weeks after the lockdown, a significantly larger drop as compared to 6 percent globally (Pillay, 2020). In April, India's power consumption shrank by 22.75 percent, but increased by 14.16 percent in May with relaxations in the lockdown restrictions (EconomicTimes, 2020). Furthermore, at the national level, during the strict lockdown period, the fuel consumption took a dip of around 70 percent and electricity demand fell by 20 to 25 percent as compared to pre-COVID levels.

Though the domestic sector energy consumption increased during the lockdown, the overall energy demand was reduced due to decreased service and industry sectors demands (International Energy Agency, 2020). However, in Madhya Pradesh, the overall power demand has gone up by 6.4 percent due to an increase in consumption of agricultural power (The Financial Express, 2020). In the long run, India's electricity demand is projected to be 7 to 17 percent lower by 2025 due to the downward revision of its GDP growth, partly due to the COVID-19 economic shock (Spencer, 2020).[35]

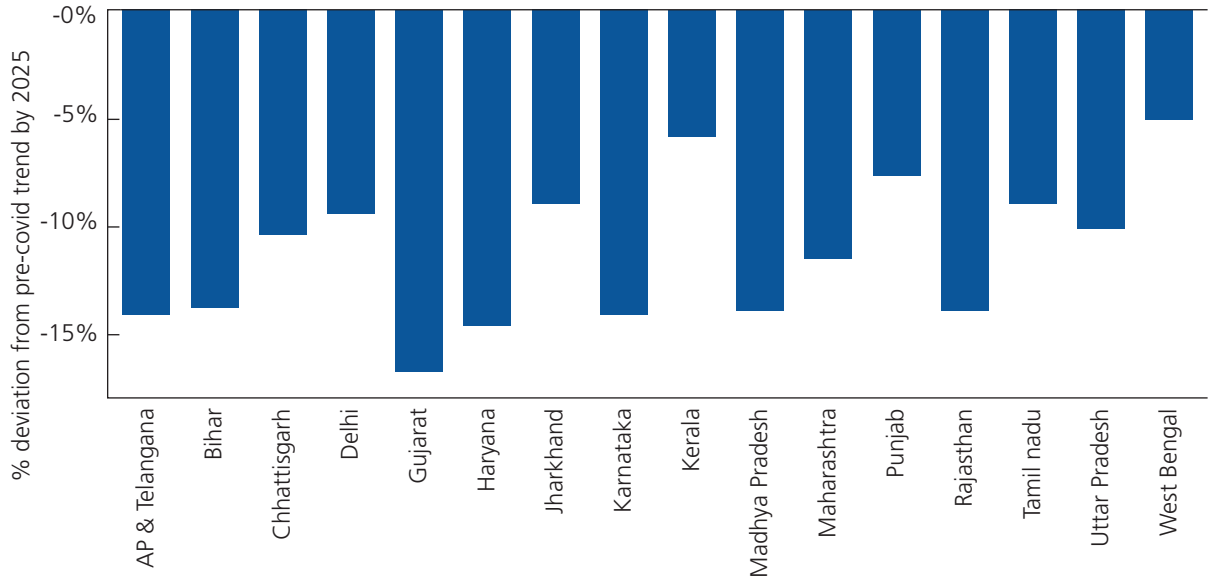


Figure 42: 2025 deviation of electricity demand from pre-COVID trends projected from major Indian states

35 However, as per Central Electricity Authority's Power Supply Report, the national energy requirement in August, 2021 was 1,28,519 MU, recording a 14 percent rise in comparison to the same month in 2019.

Outlook for Indore

Due to lower demand, some states have reduced coal power generation. Contribution of coal in total power generation in India reduced from an average of 72.5 percent in March 2020, to 65.6 percent in April 2020. This can be attributed to the fact that renewable energy sources have a 'must run' status and the running cost of renewable power plants is lower as compared to thermal power plants (Surya, 2020). This only underscores the need to increase focus on renewable energy and strengthen its integration into the grid. Indore district can contribute to Madhya Pradesh's RE generation capacity by encouraging projects such as solar rooftops, biogas and solar pumps for agriculture.

8.2.2 Fuel consumption

India's fuel consumption fell 45.8 percent to 9.93 million tonnes in April, down from 18.32 million tonnes fuel consumed in the same month a year back (Business Standard, 2020). In July, diesel consumption declined by 12.7 percent compared to the previous month – from 6.3 million tonnes to 5.5 million tonnes. Overall consumption of petroleum products dropped by 3.7 percent to 15.7 million tonnes in July, as compared to 16.3 million tonnes in June (The Hindustan Times, 2020). The only fuel that showed growth was LPG, as the government dole of free cooking gas cylinders to poor households fired up consumption by 12.2 percent, to 2.13 million tonnes in April. With gradual unlocking, moderately progressing economic recovery, restricted movement, and industries mostly operating at 70 to 80 percent capacity due to subdued demand and restrictions, the demand for fuel has also reduced.

Outlook for Indore

In June 2020, the Madhya Pradesh government revised the price of fuel by levying a Corona tax of Re 1. Overall, there is uncertainty around fossil fuel prices. In such a scenario, the paradigm shift of the transport system towards e-mobility needs to be better planned and implemented in a phased manner.

8.3. Agriculture

COVID-19 caused disruption to agriculture and supply chains. Non-availability of migrant labour and farmers' inability to hire harvesters and other machines interrupted harvesting activities for wheat and pulses. The demand for milk went down due to the closure of hotels, restaurants, sweet shops etc. Faced with the double-whammy of the lockdown and misinformation on social media, poultry farmers were hit badly.

In Madhya Pradesh, the government began importing maize. Coupled with the lockdown, this led to a price crash that further hurt the farmers, and they were forced to sell their produce at half the MSP ensured by the Central Government in 2019 (Pandey, 2020).

On the flip side, reverse migration proved to be fruitful for *kharif* (monsoon) crops. As on July 17, 2020, total *kharif* crops had been sown on 691.86 lakh ha area against 570.86 lakh ha area during the corresponding period of 2019 – an increase in area coverage by 21.20 percent in the country (WBCSD, 2020) (PIB, 2020).

Outlook for Indore

To prevent loss of yield, the district administration must ensure availability of irrigation facilities, composts, seeds, farming machines during sowing and harvesting periods. Small farmers must be prioritised while provisioning facilities.

8.4. Migration

India has seen a national migrant crisis resulting from halted economic activity, leading to widespread loss of jobs, particularly for wage labourers during the nationwide lockdown. This influx to the districts certainly adds stress to their energy, food and water resources, and increases the waste footprint. By June 2020, Madhya Pradesh saw an influx of 7.3 lakh migrants returning from various parts of the country.

Outlook for Indore

With unlocking and renewed opportunities of employment, some migrants may return to their city of employment. The district administrator must understand the migration pattern in Indore and plan accordingly for resource allocation and management. Agriculture sector schemes, MGNREGS and state employment guarantee programmes can be used to fast-track incorporation of these migrants into the state roll, while also increasing employment opportunities.

8.5. Waste management

The COVID-19 pandemic has had a tremendous impact on the waste sector that calls for rapid overhaul of the waste management systems. Grappled with an already burdened healthcare and municipal waste management system, Indian states and district-level administrations are going to face serious environmental governance challenges leading to a risk of higher emission from this sector. Here are some challenges confronting administrations:

- Use of disposable PPEs, masks, single-use plastic containers for sanitisers, online shopping packaging waste and double layered bags (two bags) for collection of COVID-19 waste in the hospitals, etc. are leading to huge amount of additional waste that's different in both composition and density of municipal solid waste and hospital waste.
- All COVID-19 medical waste from hospitals treating COVID-19 patients is categorised as yellow waste, which is to be incinerated as per the Bio-medical Waste Management Rules, 2016. Similarly, biomedical waste generated from quarantine camps/homes is to be treated as 'domestic hazardous waste' under the Solid Waste Management Rules, 2016. This increases emissions from waste incineration manifold (CPCB, 2020).
- The CPCB guideline mandates immediate disposal of COVID-19 bio-medical waste and permits operation of incineration facilities for extra hours at the CBWTF, if required, causing further increase in emissions.
- For rural areas not having CBWTF facilities, COVID-19 waste shall be disposed of in the existing captive facilities, which would have more emission potential (equal to landfilling) than that of incineration. It is to be noted that most of rural India is not connected to CBWTFs and is already impacted by COVID-19.
- Use of hazardous waste treatment facilities (TSDF) for incinerating COVID-19 waste from solid waste stream leads to increased emissions from TSDFs

8.6. Air pollution[36]

Comparisons of 24-hour average of $PM_{2.5}$ over Indore district between Jan to May for the years 2019 and 2020 show that $PM_{2.5}$ concentration has reduced significantly during the lockdown months (Figure 43).

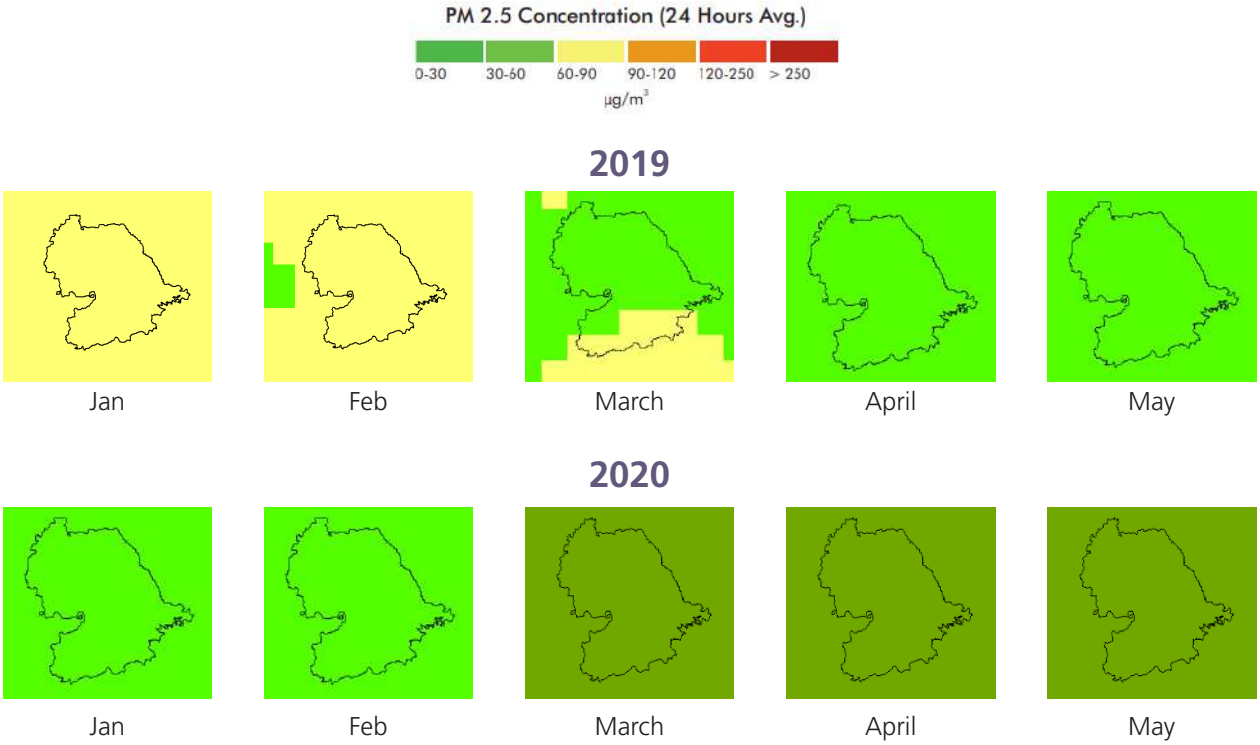


Figure 43: $PM_{2.5}$ concentration over Indore for January to May, 2019 vs. 2020

36 The PM 2.5 and PM 10 modal forecast data obtained from European Centre for Medium-Range Weather Forecasts (ECMWF) and analysed at GIS platform for mapping of monthly mean values. The data can be accessed from https://apps.ecmwf.int/datasets/data/cams-nrealtime/levtype=sfc/

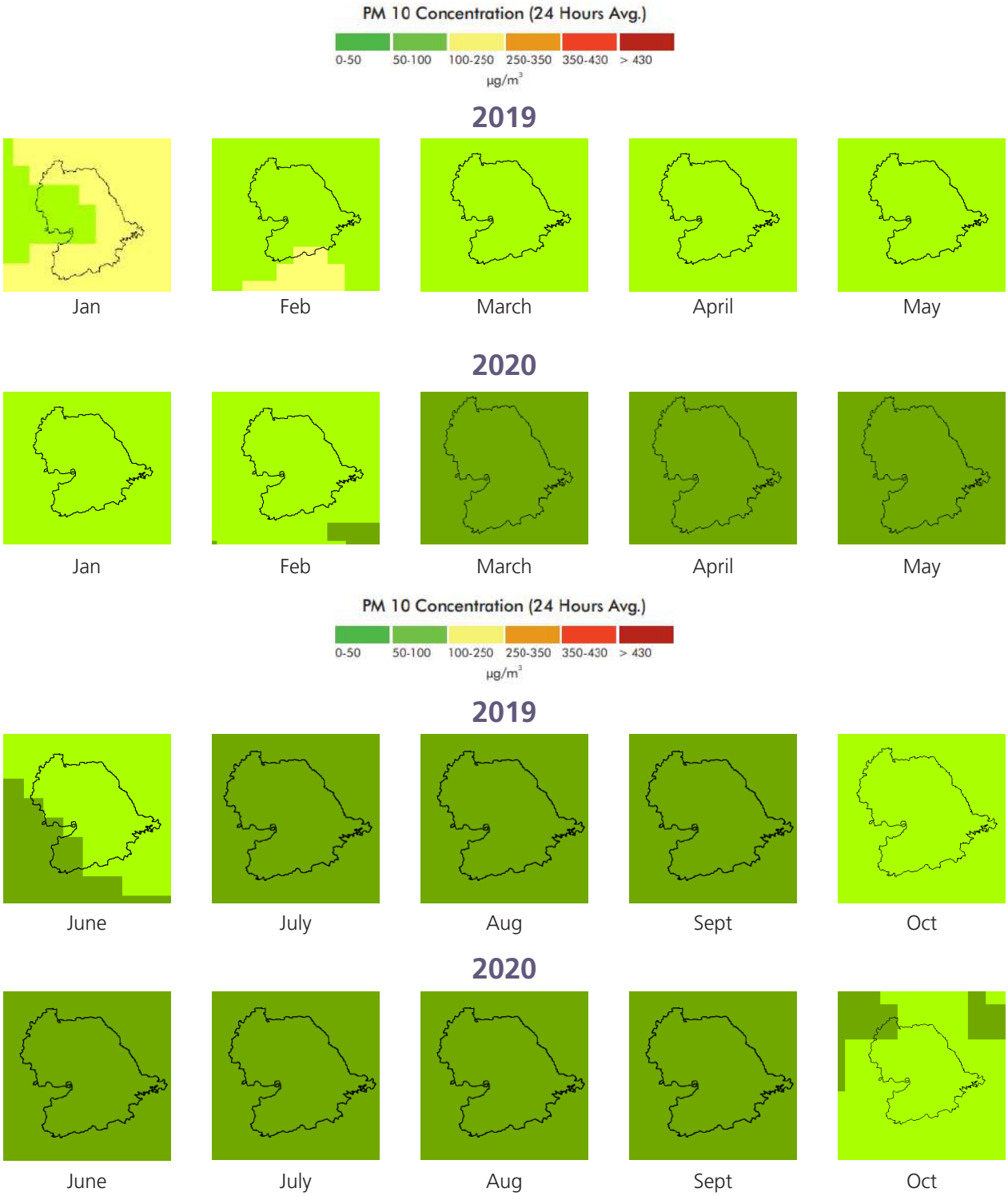


Figure 44: PM_{10} concentration over Indore for January to October, 2019 vs. 2020

Concentration of PM_{10} has also reduced significantly during the lockdown months in Indore as compared to the previous year. The concentration remained below 0-100 µg/m² (Figure 44).[37]

37 The term "PM" refers to particulate matter i.e., tiny particles suspended in air in the form of either solid or liquid droplets. They comprise of various organic and inorganic components including acids, ammonia, black carbon, water, mineral dust, etc. Major sources of particulate matter are vehicular, industrial, domestic fuel burning, construction, natural sources including soil dust (re-suspended) and other anthropogenic sources. PM can be primary (i.e. mechanically generated including carbonaceous fly-ash particles produced from high temperature combustion of fossil fuels in coal power plants) and secondary (formed in the atmosphere through reactions of primary gaseous pollutants such as NO_2, NH_3, SO_2 and non-methane volatile organic compounds). The size of these particles is critical in defining their potential for causing health problems. Particles less than 10µm in diameter penetrate deep into the lungs causing serious health concerns and reduce visibility (cause haze). Of this, particles having diameter less than 2.5µm (PM_{25}) pose greater risk to respiratory and cardiovascular mobility and increase mortality over the long-term.

The large-scale emissions of NO_2 occur due to the anthropogenic activities such as fossil fuel combustion and biomass burning. Owing to restricted vehicular and industrial activities during the lockdown, NO_2 concentration over the city area of Indore started reducing significantly from March till May 2020 in comparison to 2019. From a range of 57-85 µmole/m² in 2019, the concentration decreased to the range of 0-57 µmole/m² in 2020 (Figure 45).

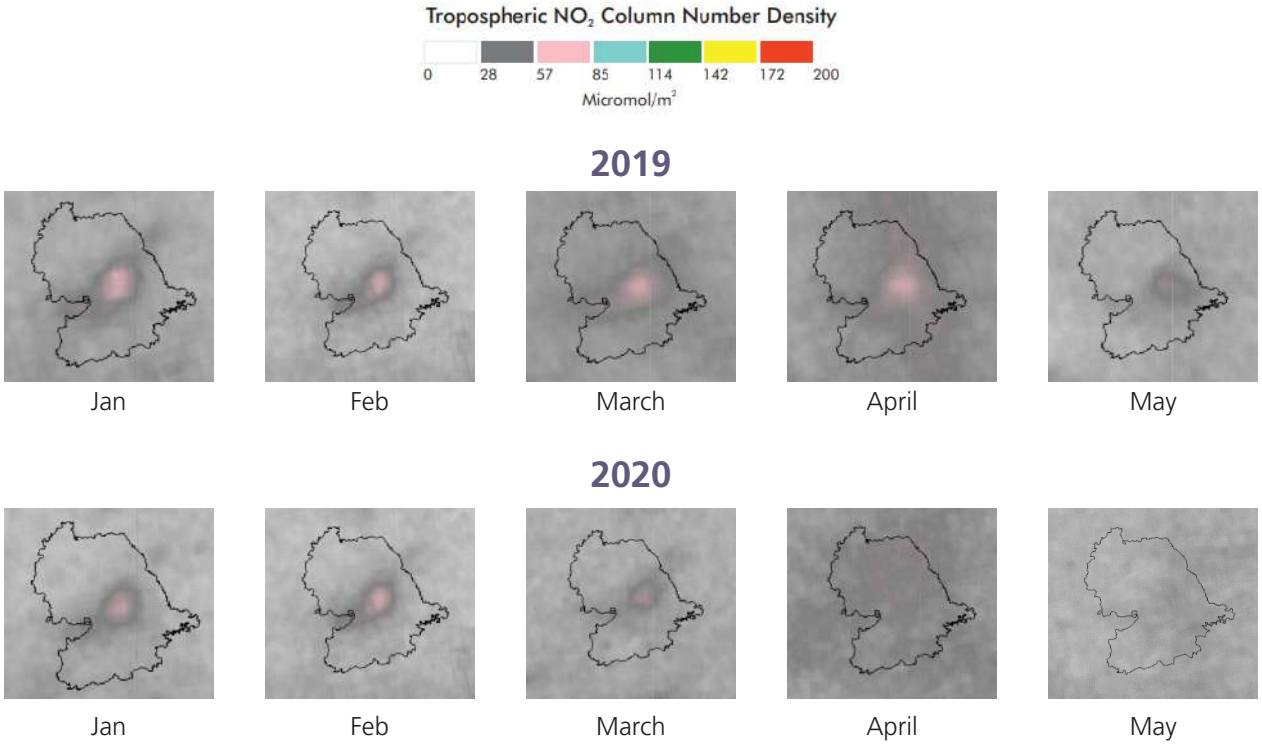


Figure 45: NO_2 concentration over Indore for January to May, 2019 vs. 2020

Majority of SO_2 emissions are of anthropogenic origin. Higher SO_2 concentration adversely affects human health, worsens air quality and impacts climate through radiative forcing. The concentration of SO_2 over Indore district also shows a sharp decline during April and May 2020 from its usual high 350-420 µmole/m² to 0-280 µmole/m² (Figure 46).

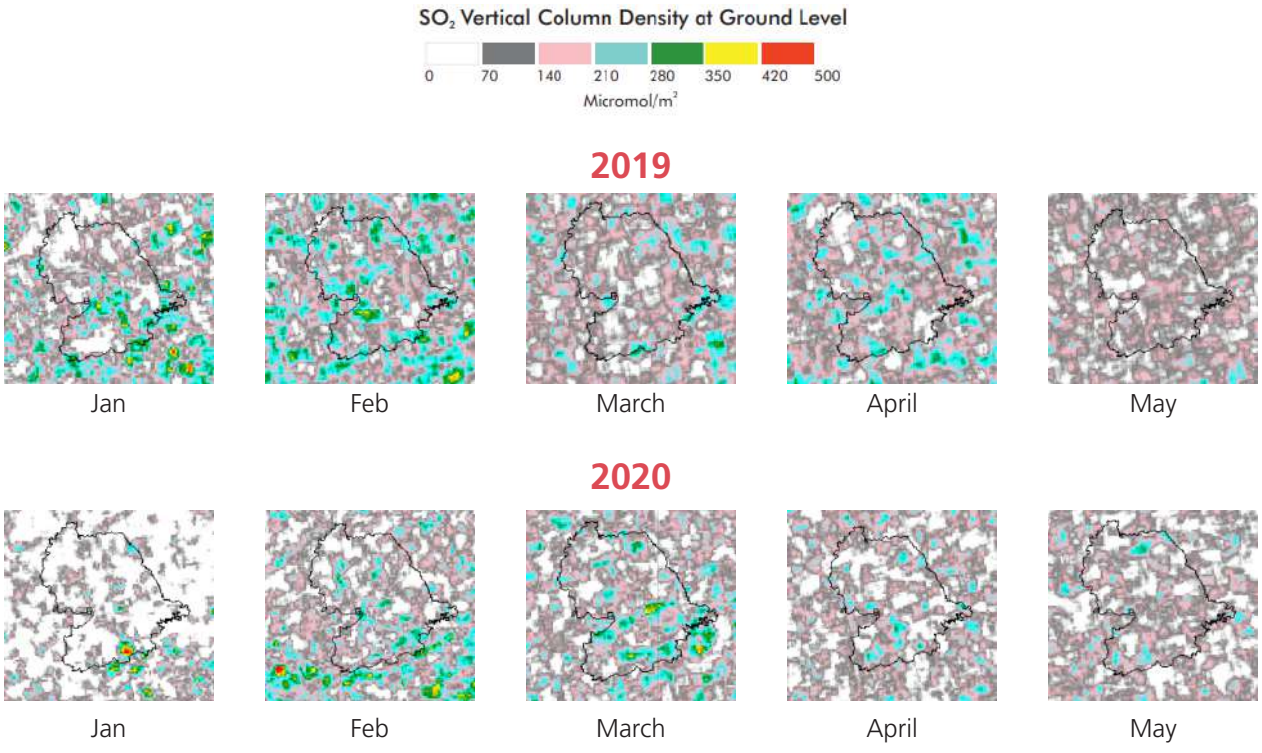


Figure 46: SO_2 concentration over Indore for January to May, 2019 vs. 2020

Outlook for Indore

The COVID-19 lockdown provided a temporary relief from air pollution in most Indian cities. However, once the unlock process started and the restrictions were relaxed, air pollution levels increased gradually with the levels reaching pre-Covid levels post-October as normal life resumed. Source apportionment studies can help identify air pollution hotspots in the district. Authorities in Indore can focus on measures to minimise and/or optimise industrial processes to reduce atmospheric emissions. Further, authorities must also work towards reducing traffic during peak hours and encouraging use of public transport to minimise vehicular emissions.

THE WAY FORWARD

Arial view of Rewa Solar power plant, Madhya Pradesh - one of the largest in the country

THE WAY FORWARD

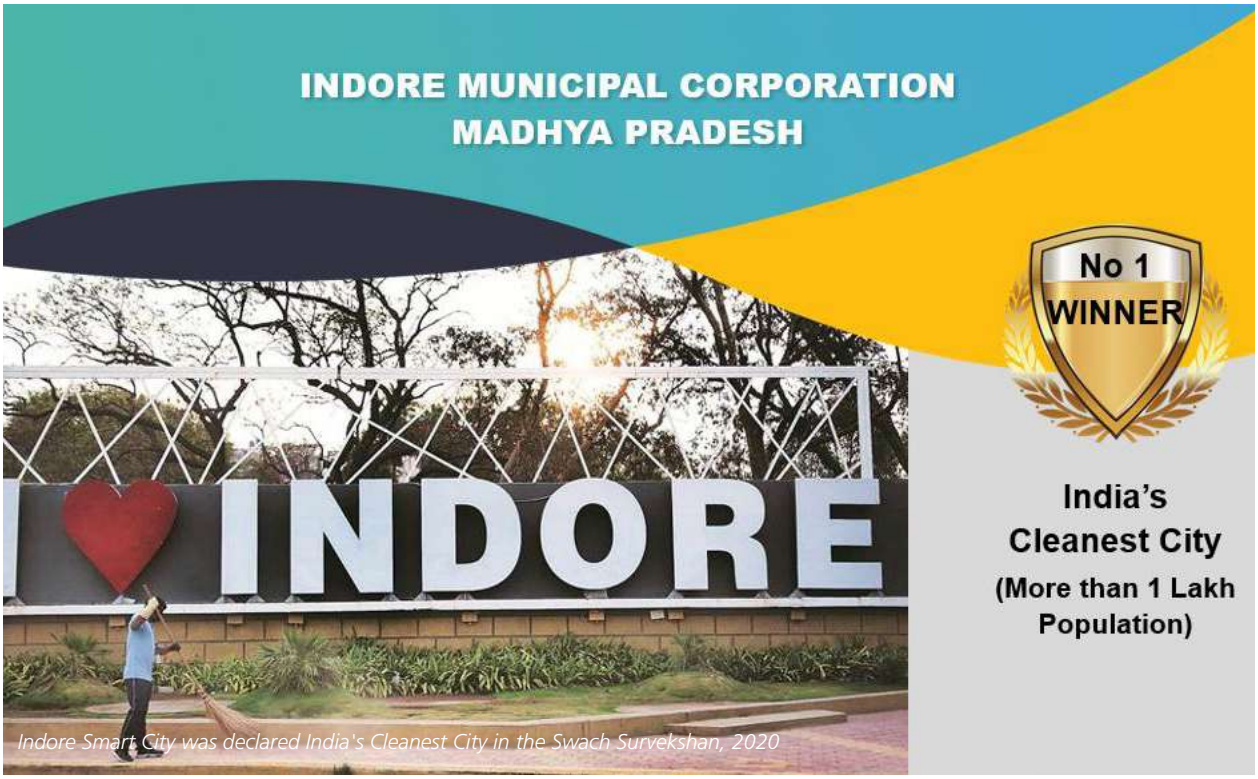
India has set a target to meet its 50% of energy demand through RE by 2030 at COP26/Glasgow, 2021. It is important to break that overall plan into smaller action plans for each district and involve various stakeholders to work towards meeting the targets.

When it comes to mitigating climate change, the district of Indore has accomplished many feats – it is the only smart city in India that trades carbon credits in the international market and has generated a revenue of INR 50 lakh against 0.17 million tonnes of CO_2. The district has 100 percent waste segregation and collection efficiency. Indore city is also segregating and treating sanitary waste and domestic hazardous waste. Such measures have helped Indore achieve the distinction of being the 'cleanest city' in India for the fourth consecutive year, as per the Swachh Survekshan 2020. Moreover, Madhya Pradesh has introduced a state-level policy – Wastewater Recycle and Reuse and Feacal Sludge Management – in 2017 that encourages reuse of treated wastewater in industries.

In the field of energy, Indore is the first city in India to have more than 1 lakh smart meters installed under smart metering project implemented by MPPKVVCL's. The Indore Municipal Corporation has also mandated rainwater harvesting for buildings with area greater than 250 square metres.

The district can select recommendations from the comprehensive list provided in Chapter 6 and develop a detailed implementation plan for pilot projects that can be rolled out in the short-, medium- and the long-term.

With the availability of a district-level policy and scheme-wise budgetary allocation, a detailed budgetary analysis with respect to climate action can be carried out for Indore as an add-on to this action plan. However, this must be treated as a dynamic document and the action plan can be updated regularly with the latest emissions profile and mitigation potential of the district. Organising periodic stakeholder consultations would help strengthen the action plan, as per the changing requirements of the district.



Indore Smart City was declared India's Cleanest City in the Swach Survekshan, 2020

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Shakti Sustainable Energy Foundation (SSEF) seeks to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies in the following sectors: clean power, energy efficiency, sustainable urban transport, climate policy and clean energy finance.

Vasudha Foundation is a not for profit organization set up in April 2010 with the belief in conservation of Vasudha, which in Sanskrit means the Earth, the giver of wealth and with the objective of promoting sustainable consumption of its bounties.

The core mission is to promote environment -friendly, socially just and sustainable models of energy by focusing on renewable energy and energy efficient technologies and lifestyle solutions. Climate change mitigation is one of the key verticals of the organization. The focus is to bring about reduction in greenhouse gas emissions in the environment and ensure energy efficiency, energy security, energy independence, and sustainable development as well as simultaneously, promoting the concept of “Low Carbon Solutions” and “Green Economies'.

SKMCCC, EPCO, Department of Environment
Government of Madhya Pradesh

The Environmental Planning & Coordination Organisation (EPCO), state's premier organisation in the field of environmental matters, was established by the Housing and Environment Department of the Government of Madhya Pradesh in 1981 and is presently under the Urban Development and Environment Department of the Government of Madhya Pradesh. It works closely with the State Government, despite having established its own identity as an autonomous organisation.

Vasudha Foundation

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