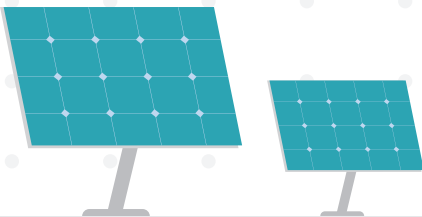


Climate Change and Environment Action Plan of Bhopal District

Executive summary



Prepared By



In Association with



SKMCCC, EPCO, Department of Environment Government of Madhya Pradesh

Supported By



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 Bhopal, 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

Bhopal, Madhya Pradesh

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Cover page images

Top left image:



Rice cultivation in Bhopal (sourced from freepik website)

Bottom right:

Waste to energy plant, Bhopal (sourced from Swachh Bhopal webpage).

Land use map of Bhopal 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



D.O. Letter No.

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

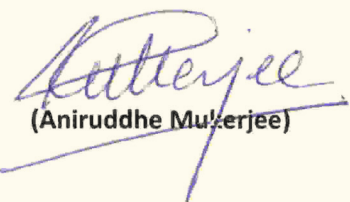
Foreword

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 Bhopal district. I appreciate that a detailed study was undertaken in consultation with various stakeholders to develop the Climate Change Action Plan of Bhopal 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 Bhopal 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 Bhopal 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 Bhopal district, as well as case studies and estimates of mitigation potential.

I applaud the extensive efforts made towards developing this comprehensive DCAP for Bhopal 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, Bhopal District Administration, Vasudha Foundation & Shakti Sustainable Energy Foundation, and appreciate the efforts of all for undertaking this study for Bhopal 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 Bhopal district.

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

We are grateful to Dr. Ashwini Kulkarni from IITM, Pune and Dr. Koteswar 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.

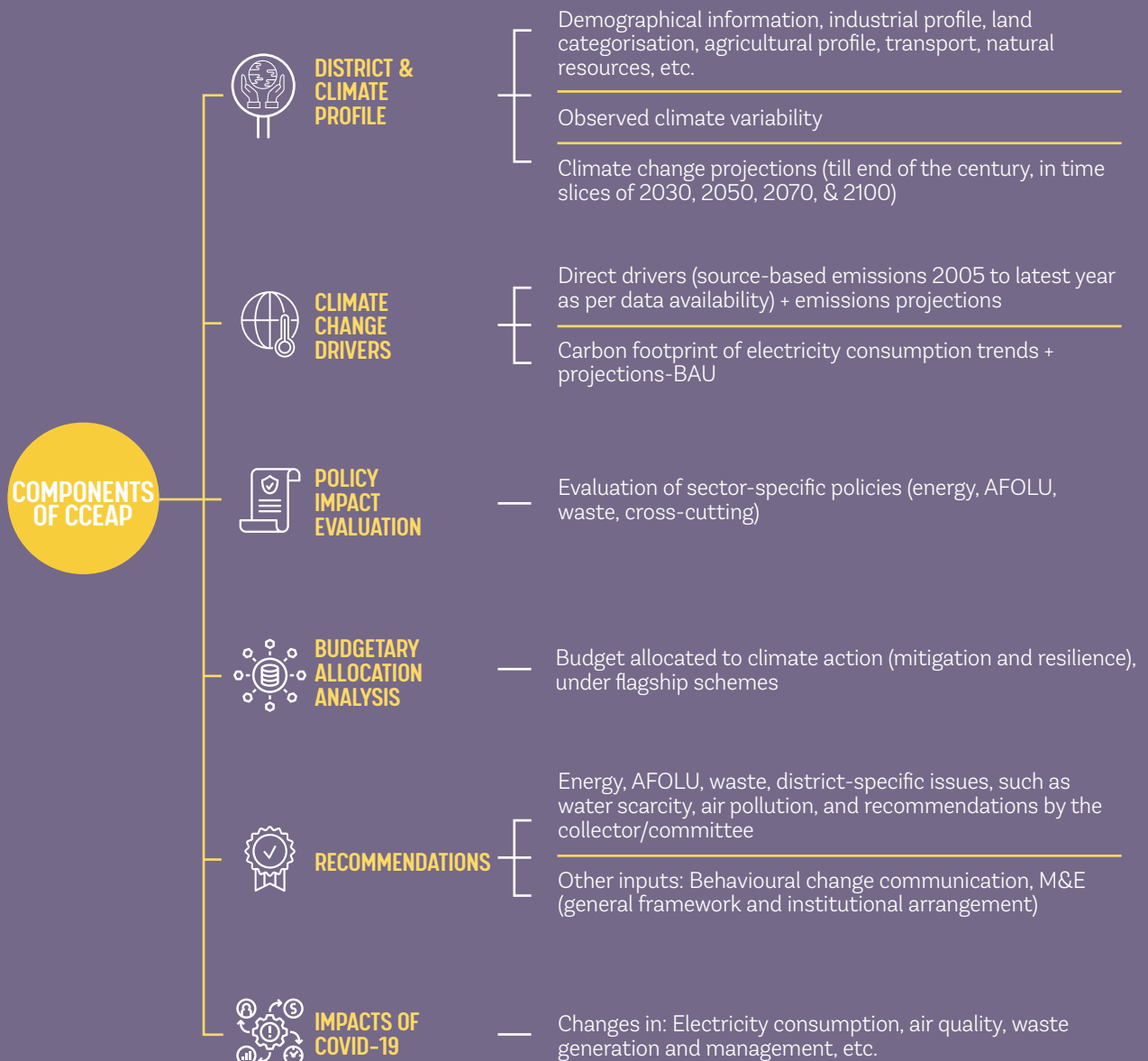
EXECUTIVE SUMMARY

This Climate Change and Environment Action Plan studies the past, present and the future of the district of Bhopal 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 chart below:



CLIMATE PROFILE AND PROJECTIONS

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

- **Warm days have gone up by 10 percent:** The maximum temperature has been observed to show a significant increasing trend in April and May. This trend has accelerated over the last two decades. The mean percentage of warm days is more pronounced in the recent years, having increased by 10 percent. Warm days may go up by 35 percent of the present climate – Bhopal district is projected to experience a warming of 2°C to 3°C under RCP4.5 and a warming of 2°C to 5°C under RCP8.5.¹ The percentage of warm days is also projected to increase by more than 35 percent in the future.
- **Cold days are decreasing:** The minimum temperature also projects an increasing trend and the cold days (in percentage) may decrease in all the epochs under changing climate conditions.
- **Rainy days are projected to increase:** The monsoon rainfall does not show any significant trend. July and August months are the principle rainy months for the district. The variability in rainy days is higher and shows a slight decreasing trend in monsoon months for the period 1951-2018. The seasonal rainfall of the district is projected to increase by five to 21 percent under RCP4.5 and by 17 to 39 percent under RCP8.5 emission scenarios. The number of rainy days is also projected to increase during the monsoon season, particularly during July and August.

SECTORAL GREENHOUSE GAS EMISSIONS PROFILE: CLIMATE CHANGE DRIVERS

- **Greenhouse gases have increased three-folds since 2005:** Between 2005 and 2019, the total greenhouse gas (GHG) emissions of Bhopal district increased by 291.80 percent (from 0.57 million tonnes CO₂e in 2005 to 2.21 million tonnes CO₂e in 2019) with a CAGR of 10.25 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 GHG emissions. Although energy emissions of Bhopal district increased at a CAGR of 5.31 percent, its share has decreased from 84 percent in 2005 to 52 percent in 2019 due to increase in AFOLU emissions. There are no emissions from the industrial product use and processes (IPPU) sector because the district does not have any large-scale industries that fall under the IPPU industries, as per the IPCC guidelines.
- **From a net sink in 2011, AFOLU sector is now witnessing high GHG emissions:** The agriculture, forestry and other land use (AFOLU) sector has witnessed very high growth in GHG emission due to constant reduction of forest cover. Its CAGR between 2012 and 2015 (between positive values) was 9.66 percent. It may be noted that AFOLU sector was a net sink until 2011.
- **Waste sector's contribution to GHG emissions is decreasing:** Emissions from the waste sector have grown at a slow rate (CAGR of 2.89 percent) and its contribution has dropped from 16 percent (in 2005) to 7 percent (in 2019).
- **Business-as-usual scenario will be disastrous:** In business-as-usual scenario (i.e. no actions/policies are put in place to mitigate emissions), the total emissions of Bhopal by 2030 are likely to increase over three-folds – or by 342 percent –with respect to 2015 levels.

ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE

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

1 Representative concentration pathways (RCPs) are concentration pathways used by the IPCC. They are prescribed pathways for greenhouse gas and aerosol concentrations, together with land use change, that are consistent with a set of broad climate outcomes used by the climate modelling community. The pathways are characterised by the radiative forcing produced by the end of the 21st century. Radiative forcing is the extra heat the lower atmosphere will retain as a result of additional greenhouse gases, measured in Watts per square metre (W/m²). There are four RCPs, RCP2.5 (low pathway where radiative forcing peaks at approximately 3 W m⁻² before 2100), RCP4.5 and RCP6.0 (two intermediate stabilisation pathways in which radiative forcing is stabilised at approximately 4.5 W m⁻² and 6.0 W m⁻² after 2100) and RCP8.5 (high pathway for which radiative forcing reaches greater than 8.5 W m⁻² by 2100).

- **Power and energy:** For this sector 12 policies/programmes were evaluated (UDAY and PAT schemes are the biggest contributors to GHG mitigation)
 - ◀ Policies related to clean energy generation mitigated 2,11,113 tCO₂e emissions.
 - ◀ Policies pertaining to energy-efficient buildings and processes helped avoid 7,45,727 tCO₂e emissions.
 - ◀ Transportation interventions have led to an emission avoidance of 1,17,345 tCO₂e.
- **AFOLU and cross-cutting:** Nine policies were assessed.
 - ◀ Forestry policies alone led to a mitigation of 1,79,78,321 tCO₂e (as per scenario 1)², and 11,156 tonnes of CO₂e (as per scenario 2)³.
 - ◀ Policies pertaining to livestock, proved to be beneficial for climate action by avoiding 4,326 tonnes of CO₂e.
 - ◀ Under the agricultural sub-sector, emissions from the National Food Security Mission (NFSM) were estimated to be 20,432 tonnes of CO₂e.
 - ◀ The cross-cutting sector: The National Mission on Micro Irrigation resulted in avoiding 911 tonnes of CO₂e emissions (from reducing use of urea alone). The Pradhan Mantri Ujjwala Yojana has helped mitigate 8,47,722 tonnes of CO₂e (as per scenario 1), and 87,891 tonnes of CO₂e (as per scenario 2).
- **Waste:** Sixteen policies were assessed.
 - ◀ Policies pertaining to sanitation added 88,846 tCO₂e emissions.
 - ◀ Composting as a part of solid waste management practices has mitigated 60,923 tCO₂e.
 - ◀ Domestic wastewater treatment interventions have led to 44,228 tCO₂e emissions.

BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION

This section analyses the regional expenditure to estimate spending on climate action. A total of 39 flagship 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 the relevance to climate actions, five schemes were selected for further analysis.

Table 1: Summary of flagship schemes budgetary analysis for Bhopal 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 were 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	4,084	322	8
		2019-20	1,194	233	*20
PMKSY	Micro-irrigation activities	2016-17	1,766	1,218	*69
GIM	Enhancing forest cover, ecosystem restoration, agro-forestry, social forestry, wetland restoration, promoting alternative fuels	2018-19	13,21	13,21	*100
		2019-20	10,30	10,30	
AMRUT	Water supply, sewage and septage management, urban transport, drainage, green spaces	2015-16	25,502	13,906	*54.5
		2016-17	31,438	17,139	
		2017-20	37,658	20,529	
DDUGJY + Saubhagya	New and upgradation of substations, LT lines, feeder segregation, consumer metering, DTR metering, etc	Upto April 2020	4,481	2,2405	*50

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

2 Scenario 1- Carbon Stock density of MP (89.79 tonnes/ha) is used (as given in the FSI Reports for MP).

3 Scenario 2 - Carbon stock density 10 tonnes/ha is used (Bhopal specific carbon stock density was suggested by MP Forest Officials)

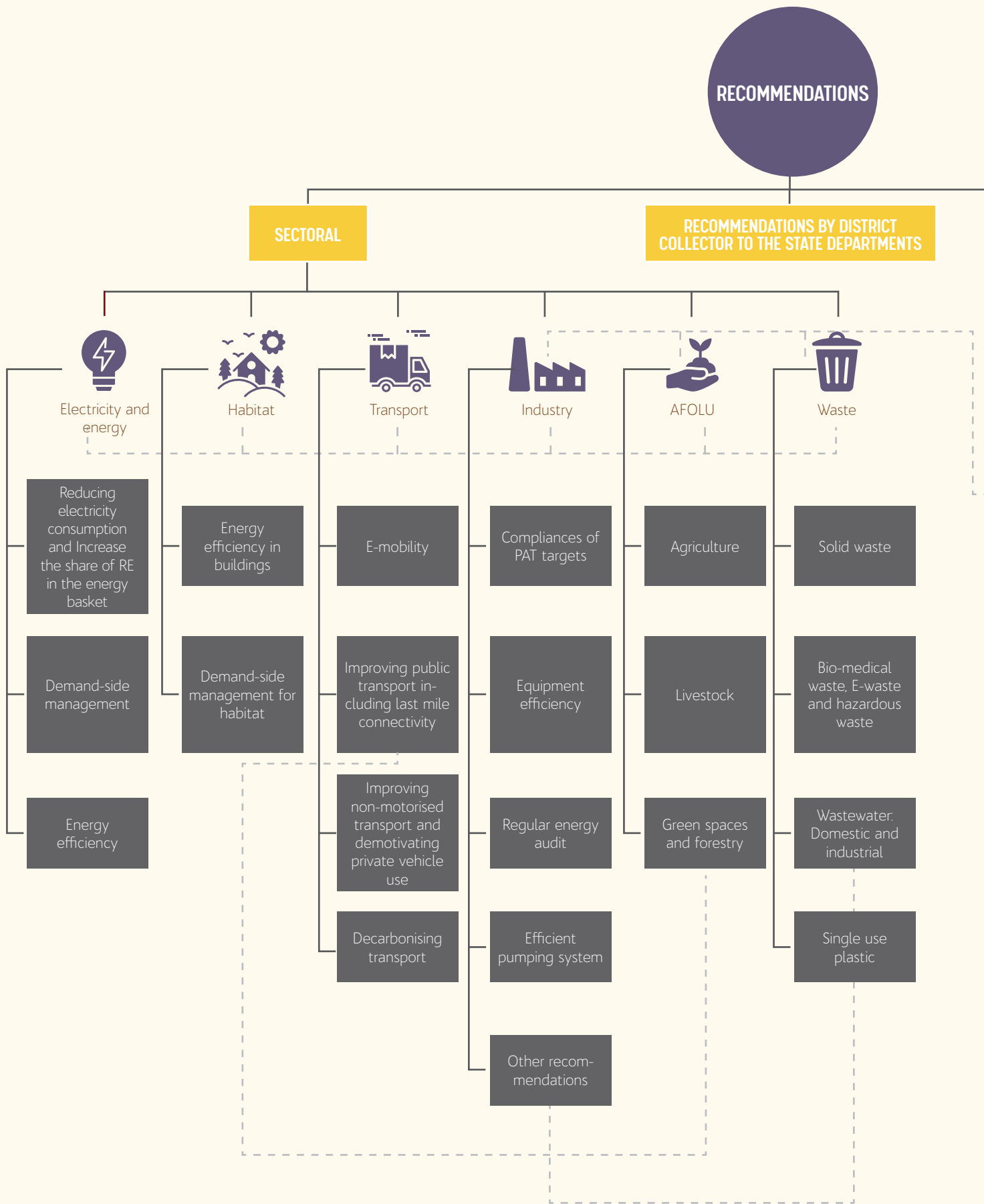


Figure 1 Recommendations for CCEAP Bhopal

DISTRICT ENVIRONMENTAL ISSUES



Water scarcity & water pollution



Air pollution

PROMOTING VOLUNTARY ACTIONS



Lighting



Transport



Housing



Kitchen



Daily use appliance



Waste management



Other recommendations

BEHAVIOURAL CHANGE COMMUNICATION



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)

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.

Overall, the mitigation actions suggested in the recommendations can help mitigate 6.86 Mt CO₂e per annum. The sectoral breakdown of the same is as following:

GHG mitigation potential of CCEAP recommendations (tCO₂e)

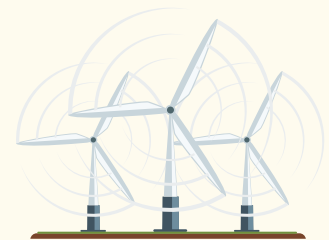


Some in-brief, sector-wise recommendations are provided in figure 1.

Power and energy

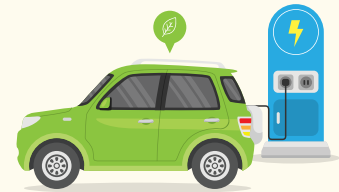
Though the energy sector is crucial to achieving India's growth ambitions, it is also responsible for around 70 percent of the country's annual GHG emissions. This calls for a paradigm shift in the energy sector.

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 is 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 Bhopal 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 developing extensive infrastructure to monitor air pollution and suggestions on interventions for preventive measures and improvement and sustainable management of the Bhoj wetlands in Bhopal.

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. Bhopal 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.





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.



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