Climate Change
and Environment
Action Plan of

Pune District

Recommendations

Cover page images

Top left image:
Pawna dam in Pune

Bottom right:
Car manufacturing unit of Mahindra, Pune

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

| ■ Forest (evergreen) | ■ Forest (deciduous) | ■ Forest (mixed) | ■ Cropland | ■ Fallow Land |
| ■ Built-up Land | ■ Shrubland | ■ Barren Land | ■ Waterbodies | |

Climate Change and
Environment Action Plan of

Pune District

Recommendations

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Municipal Commissioner
Pimpri Chinchwad Municipal Corporation

सत्यमेव जयते

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Message

Climate change has emerged as a global threat, prompting nations to come together to tackle the challenge. At the COP26 held in Glasgow, in November, 2021, India announced its intention to achieve net zero emissions by 2070, amongst other ambitious targets.

To achieve these goals, it is imperative that all the states commence their climate actions immediately and make their best contributions towards the national targets. Maharashtra is leading by example through its ambitious initiatives to combat climate change, such as the Majhi Vasundhara Abhiyan, the Project on Climate Resilient Agriculture (PoCRA), and the latest Electric Vehicle Policy, among many others. Further, Maharashtra has joined the Race to Resilience, and 43 cities in the state, including Pune, have announced their commitment for Race to Zero, both international pledges aimed at sustainable and low carbon development. In recognition of its efforts, the Maharashtra government received an award for 'Inspiring Regional Leadership' at the COP26 summit.

While state level policies and initiatives are being put in place, I am happy to share, a first of its kind, 'Climate Change and Environment Action Plan' (CCEAP) for Pune district prepared by Vasudha Foundation with support from Shakti Sustainable Energy Foundation. This Action Plan has been developed in consultation with Pimpri Chinchwad Municipal Corporation, district administration, and other stakeholders, with an aim to contribute towards state and national climate actions. The action plan is a comprehensive assessment of the climate variability and projections, sectoral greenhouse gas emissions, and climate change drivers in the district. Based on the assessment, the plan identifies various local level interventions, which are in line with state and national-level policies and programmes. It also incorporates a comprehensive set of recommendations, in alignment with the Sustainable Development Goals (SDGs), for various climate-related sectors and environmental issues of Pune district, as well as estimates mitigation potential of each sector.

I applaud the extensive efforts made towards developing the CCEAP for Pune district. This Action Plan can serve as a roadmap for mainstreaming climate action in alignment with the district's development priorities.

(Rajesh Patil)

डॉ. कुणाल खेमनार (भा.प्र.से.)

अतिरिक्त महापालिका आयुक्त
पुणे महानगरपालिका

Dr. Kunal Khemnar I.A.S.

Additional Municipal Commissioner
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Preface / Message

The recently concluded United Nations climate summit, COP26 at Glasgow, was a much-awaited conference specially for climate vulnerable countries seeking tangible action on anthropogenic GHG emissions. India has made ambitious commitments of generating 500 GW energy from non-fossil fuel sources and achieving net zero by 2070 at COP26.

Owing to its sheer size and diversity, India is one of the most climate vulnerable countries in the world. In the past few decades, India has witnessed an alarming rise in the frequency and intensity of extreme events such as floods, droughts and heatwaves among others. To tackle these emerging threats, India formulated its National Action Plan for Climate Change more than a decade ago and has since then also taken many initiatives and participated in multiple international commitments to combat climate action.

In addition to this, formulation of State Action Plans for Climate Change has helped streamline action at the state level. The Government of Maharashtra has made several proactive commitmentsto ensure low carbon growth and sustainable development in its various initiatives. Following the concept of a bottom-up approach a "Climate Change and Environment Action Plan" for Pune district has been developed. This Action Plan captures the ground realities of the district as well as provides region specific recommendations for various climate relevant sectors.

I am certain that this Action Plan will serve as a roadmap for the district and municipal level planning efforts to integrate climate action and development.I appreciate that Vasudha Foundation with support from Shakti Sustainable Energy Foundation has undertaken this detailed study in consultation with the Pune Municipal Corporation, district administration and other stakeholders.

(Dr.Kunal Khemnar)

ACKNOWLEDGEMENTS

RECOMMENDATIONS

RECOMMENDATIONS

SECTORAL

RECOMMENDATIONS BY DISTRICT COLLECTOR TO THE STATE DEPARTMENTS

Electricity and energy
- Increasing the RE share in electricity generation
- Demand-side management and energy efficiency

Habitat
- Energy efficiency in buildings
- Demand-side management

Transport
- Improving public transport including last mile connectivity
- Improving non-motorised transport and demotivating private vehicle use
- E-mobility
- Improving traffic flow

Industry
- Compliances of PAT targets
- Equipment efficiency
- Regular energy audit
- Efficient pumping system
- Other recommendations

AFOLU
- Agriculture
- Livestock
- Green spaces and forestry

Waste
- Solid waste
- Bio-medical waste, e-waste and hazardous waste
- Wastewater: Domestic and industrial
- Single-use plastic

Figure 2 Recommendations for CCEAP Pune

DISTRICT ENVIRONMENTAL ISSUES

Air pollution

Landslides and flooding

Carbon neutrality for Pune

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

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 Climate Change and Environment Plan of Pune District. 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, if implemented, have the potential to mitigate 79,50,325 tCO_2e in the energy sector, 7,53,303.33 tCO_2e in AFOLU and 2,42,797 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 are based on district-specific ground realities and situations.

- The state and district vision documents were factored in while developing the recommendations. Additionally, the recommendations are developed in synergy with actions in Maharashtra government's Majhi Vasundhara initiative.

- Information provided on timeframe and framework for implementation would enable the district authorities and concerned departments to prioritise actions.

- List of existing policies, programmes, and schemes that can help streamline the actions is provided along with the concerned primary and supporting departments in 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 given in this action plan.

- Further, the cross-sectoral benefits of each recommendation have been identified and indicated using the icons as listed in the following table:

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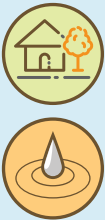
6.1.1 Electricity and energy: Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for Implementation	
Increasing RE share in the 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 generate awareness about RE in the residential sector	India has a target of 40 GW for solar rooftop (2022). As of February 28, 2021, only 4.32 GW has been achieved. Maharashtra has only 647.73 MW (as of February 2021) of solar rooftop capacity. In Maharashtra, in 2020, off-grid solar rooftops have been installed by MEDA in 26 out of the targeted 31 government buildings, with an upper cap of 20 kW. Case example calculation: a) If eqipped with solar rooftops, the government schools in Pune district alone can generate 103 MUs electricity avoiding 89,019 tCO_2e emissions, annually. b) If 50% households in the district are equipped with solar rooftops, total potential installed capacity would be 7,025 MW, which can help avoid 7.52 $MtCO_2e$ emissions, annually. Meeting the solar rooftop targets can be expedited by making it mandatory for hospitality industry and other new constructions (having a built-up area greater than 20,000 sq. ft) like private healthcare infrastructure (above certain bed-capacity). Ground-mounted solar: The current installed capacity of ground-mounted solar in Maharashtra stands at 1.64 GW (as of February 2021). Pune district has a huge potential for solar power generation, both rooftop and ground mounted. In the highly industrialised and urbanised Pune city, solar rooftop installation can be promoted. In the remaining parts of the district, ground mounted solar installations can be more viable.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for Implementation	
Battery storage for RE to be aggressively promoted.		Short to medium-term	Needs additional financial support	MEDA has installed 650 Ah (Ampere hour) batteries for a few solar projects in Maharashtra. MEDA has also proposed, and installed a few hybrid inverters for RE projects across Maharashtra. Hybrid inverters take power from battery/RE installation up to a particular load, and on increased load demand, switch to the grid supply.
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 build public awareness	Decentralised Renewable Energy (DRE) setups can power small/cottage industries, which in turn 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 and other rural non farm productive use appliances across the district can be powered by DRE. Cold storage networks could also be used for reliable storage of vaccines besides farm produce.
Energy demand side management (DSM) and energy efficiency				
Encourage faster penetration of Street Lighting National Programme (SLNP). This would ensure that all street and public lighting fixtures are replaced with energy efficient LED bulbs, prioritising premises and recreational areas of all government / public institutions.		Short-term	Policy framework and schemes exist (section 6.1.1.1)	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 as of September 16, 2021, only 1.22 crore LED lamps have been installed. Replacement of the existing 93,000 conventional lamps in Pune district with LED lamps under SLNP can potentially avoid 48,982 tCO_2e emissions, annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for Implementation	
Expedite installation of smart meters in collaboration with MSEDCL to develop Advanced Metering Infrastructure (AMI). Installing smart meters, along with its associated IT infrastructure 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 such as: (a) Time of day (TOD)/ time of use (TOU) billing, (b) Prediction and management of peak demand, (c) Providing real time energy consumption data to the consumer, (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 to be built for consumer segment	Implemented by EESL (BEE), Smart Meter National Programme aims to replace 25 crore conventional meters across the country with smart meters. Case example: Adani Electricity Mumbai Limited has announced plans to install over 7,00,000 smart meters in Mumbai. The Maharashtra Electricity Regulatory Commission (MERC) has approved capital expenditure schemes for the installation of smart meters. In Delhi, Tata Power Delhi Distribution Limited has installed 2,00,000 smart meters in partnership with Landis+Gyr and Siemens across its domestic, industrial and commercial consumer segments under its Advanced Metering infrastructure (AMI) project. These smart meters have proven to be extremely beneficial for the DISCOM in raising bills based on actual readings, instead of provisional ones, during the lockdown in April-May 2020. During this period, the company managed to raise over 3,50,000 bills, and avoided over 1,50,000 visits to consumer premises per month. MSEDCL can implement a similar smart-metering project in Pune and reap the benefits.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for Implementation	
Replace/upgrade existing inefficient pumping infrastructure with energy efficient pumps/solar pumps (where possible) for supply of piped drinking water in both rural and urban pockets of Pune district.		Short to medium-term	Relevant schemes and programmes can help achieve this goal (section 6.1.1.1) Inter departmental collaboration required	One of the objectives of the State Energy Conservation Policy, 2017 is to promote energy conservation measures in the street lighting systems and water pumping systems, both of which show significant energy conservation potential. Around 4% of the energy consumption in the state is through the state water supply and around 2% is through street lighting systems. MEDA provides financial assistance of up to ₹ 50 lakh through Energy Service Company (ESCO) to ULBs for implementing energy savings projects of street lighting and water pumping schemes. All the ULBs in Pune, in co-ordination with the relevant departments can avail the financial assistance/ benefits of the scheme to make their systems energy efficient.
In agriculture sector, promote energy efficient water pumps (provided by EESL), and solar pumps, wherever possible (through PM-KUSUM).		Short to medium-term	Policy framework exists (section 6.1.1.1)	According to BEE, 30% to 40% energy savings is possible in agriculture sector by adoption of energy efficient star labelled pump sets. Conversion of the existing electricity/diesel-operated tube-wells (those with permissions of operation under the Groundwater Development and Management Rules, 2018) to solar in Pune district could substantially reduce GHG emissions.
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 collector's office to the state departments)		Medium-term	Additional financial support can be created Create 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 to promote energy efficiency and green initiatives among households and bring down the power consumption in the National Capital Region. Under the programme, upfront rebate per air conditioner (BEE 5 star rated/ inverter) has been offered by BYPL to the consumer in exchange of their old non-star rated air conditioner. MSEDCL can implement a similar scheme in its area of supply, with a pilot in Pune district.

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

Sub-sectors	Policies and programmes that can push forward the recommendation[1]	Primary departments/ agencies	Supporting departments/ agencies
Increase RE share in the electricity generation basket	1. Maharashtra State Renewable Energy Policy, 2020 2. Maharashtra Policy for Grid-connected Solar Projects 3. Maharashtra Off-Grid Policy, 2020 4. Maharashtra Grid Connected Wind Projects, 2015 5. National Solar Mission 6. i-SMART Project 7. PM KUSUM 8. Majhi Vasundhara	1. MEDA, GoM 2. Industries, Energy and Labour Department, GoM	1. ALL ULBs 2. Maharashtra Electricity Regulatory Commission (MERC) 3. Urban Development Department, GoM 4. Department of Rural Development and Panchayat Raj, GoM 5. Department of Housing, GoM 6. Department of Environment and Climate Change, GoM 7. MSEDCL, GoM 8. Department of Agriculture, GoM 9. Proposed District level Committee on Climate Change and Environment
Energy demand side management (DSM) and energy efficiency	1. Maharashtra State Energy Conservation Policy, 2017 2. Smart Meter National Programme (SMNP) 3. National Smart Grid Mission 4. Integrated Power Development Scheme 5. Streetlight National Programme (SLNP), 2015 6. UJALA Scheme, 2015 7. Standards and Labelling Programme 8. Sustainable Habitat Mission 9. Smart Cities Mission 10. National Mission for Enhanced Energy Efficiency 11. Municipal Energy Efficiency Programme (MEEP) 12. PM KUSUM 13. Maharashtra State Renewable Energy Policy, 2020 14. Majhi Vasundhara	1. MSEDCL, GoM 2. MEDA, GoM 3. BEE (EESL) 4. All ULBs 5. Panchayati Raj Institutions (PRIs) 6. Industries, Energy and Labour Department, GoM	1. Department of Environment and Climate Change, GoM 2. Department of Agriculture, GoM 3. Urban Development Department, GoM 4. Pune Smart City Development Corporation Limited (PSCDCL) 5. Proposed District level Committee on Climate Change and Environment

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1   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
		Time frame 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 ensure green building rating compliance in all new construction activities as a pathway to buildings having net zero energy consumption.		Medium to long-term	Policy framework exists (section 6.1.2.1) Inter-departmental collaboration required Need capital incentives / relevant exemptions over and above the existing provisions from the district administration	The residential and commercial sectors in Pune contribute to around 27% of the total electricity consumed in the district. MEDA is working to incorporate ECBC into building compliance systems in Maharashtra. The Building Permission Department of PMC encourages all new buildings to comply with ECBC/ IGBC rating system /GRIHA rating system. However, this incorporation is completely voluntary and no mandate has been issued by PMC as of now.
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 could help avoid significant GHG emissions.		Medium-term	Policy framework exists (section 6.1.2.1) Needs inter-departmental collaboration Capital incentives/ relevant exemptions from the district administration required	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 a thrust area of research under national S&T Programme, (v) Training and certification of 1,00,000 servicing sector technicians by 2022-23, synergising with 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 – 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 and other benefits.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/Case examples
		Time frame for the action to be accomplished	Framework for implementation	
Replace diesel powered backup with solar-powered or other RE powered backup in a phased manner. This can essentially be promoted in government / commercial / institutional buildings with built-up area above certain sq. ft.		Short to medium-term (government buildings) Medium to long-term (privately owned, commercial, institutional, and others)	Policy intervention is required Proper policy backup can mitigate GHG emissions and align India with its Paris targets Needs inter-departmental collaboration	A DG set of 200 kW (used in industries/ huge commercial buildings) operating at full-load consumes approximately 45 litres diesel/hour. This results to an emission of around 117 kgCO$_2$e/hour. Replacing DG sets with solar powered backup could help in avoiding these emissions. If 50% of the DG sets in the district are replaced with solar-powered, 58,854 tCO$_2$e emissions can be averted annually.
Upgrade public transport infrastructure to include RE and ECBC compliance. Roadside hoardings near such infrastructure can also be powered through RE.		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	Pune district can adopt and implement initiatives, similar to the one in Lucknow, where the municipal corporation has planned setting up 200 solar-powered bus stops.
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 generate data that will provide important investment information to the energy market.		Medium-term	Deploying public funding schemes like feed-in tariffs, leverage national and international funds, and providing digital upskilling opportunities to citizens can help promote the initiative.	
Encourage fast penetration of UJALA scheme in every household of Pune district.		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 estimate of the number of LED bulbs to be installed in households of Pune district under UJALA scheme can potentially avoid emission of 0.22 MtCO$_2$e. annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/Case examples
		Time frame for the action to be accomplished	Framework for implementation	
Enhance public awareness towards energy-efficient BEE star labelled home appliances.		Short-term and continuous	Need collaborations and awareness	
Demand side management for habitat				
Promote and subsidise good practices for all ULBs. For instance, installing rainwater harvesting setups in buildings can considerably reduce energy dependence on submersible motors for groundwater pumping.		Short-term	Schemes and programmes exist (section 6.1.2.1) Public awareness building required	Since 2007, RWH is mandatory for larger societies in Pune. PMC provides a 5% rebate in property tax to societies with an operatable RWH system and another 5%, if societies have solar energy and vermicompost. Since 2016, RWH is also mandatory for all new residential and commercial buildings with an area greater than 20,000 sq. m in Pimpri Chinchwad.
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 the energy consumption.		Medium-term	Policy intervention and public awareness building required	To check wastage of water, PMC commenced installation of water meters in November, 2020. Of 11.5 lakh properties in PMC area, 3.5 lakh water meters have been installed, free of cost. As per the report, this has been implemented at the society level. PMC can scale this operation to individual household level.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/Case examples
		Time frame for the action to be accomplished	Framework for implementation	
Encourage residential societies to install solar-thermal water heaters.		Short-term and continuous	Schemes and programmes exist (section 6.1.2.1) Inter-departmental collaboration required Scheme to be implemented as part of green buildings	According to BEE, multi-storey (up to 12 storeys) residential buildings can meet around 70% of the annual electricity requirement for water heating through community solar water heating systems on the roof (assuming utilisation of 60% of roof area).
Promote installation of automatic/ smart water pumps to control overflowing of tanks.		Short-term	Need to create awareness	
Water cess/ pricing by Municipal Corporation to be revised and gradually increased.		Medium-term	Existing policy framework to be revised	
Digital tools, such as GIS, remote sensing can be used to identify opportunities to reduce energy demand and implement energy efficiency interventions where it holds most value, and identify 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	By identifying optimal locations for water features or vegetation, Pune can counteract on heat islands through tree plantations that provide shade and reduce the power demand for cooling 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. Maharashtra State Energy Conservation Policy, 2017 2. ECBC 2017/IGBC rating system 3. India Cooling Action Plan, 2018 4. UJALA Scheme, 2015 5. Maharashtra State Renewable Energy Policy, 2020 6. Policy for Grid-connected Solar projects 7. Off-Grid Policy, 2020 8. Smart Cities Mission 9. Sustainable Habitat Mission 10. Majhi Vasundhara	1. Department of Housing, GoM 2. MEDA, GoM 3. All ULBs 4. Pune Smart City Development Corporation (PSDCL) 5. Panchayati Raj Institutions (PRIs)	1. MSEDCL, GoM 2. Department of Environment and Climate Change, GoM 3. Urban Development Department, GoM 4. Department of Rural Development and Panchayat Raj, GoM 5. BEE (EESL) 6. Maharashtra State Road Development Corporation Limited (MSRDCL) 7. Department of Motor Vehicles, GoM 8. Proposed District level Committee on Climate Change and Environment
Demand-side management	1. Maharashtra State Energy Conservation Policy, 2017 2. Maharashtra State Water Policy, 2019 3. ECBC 4. Building bye-laws 5. Majhi Vasundhara	1. Department of Housing, GoM 2. All ULBs 3. Panchayati Raj Institutions (PRIs)	1. Urban Development Department, GoM 2. Department of Rural Development and Panchayat Raj, GoM 3. Water Supply and Sanitation Department, GoM 4. Pune Smart City Development Corporation (PSCDCL) 5. Proposed District level Committee on Climate Change and Environment 6. Department of Environment and Climate Change, GoM

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

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Promote e-mobility				
Build awareness and disseminate information encouraging adoption of electric vehicles.		Short-term and continuous	Inter-departmental collaboration and dedicated long-running campaigns required	Maharashtra EV Policy, 2021 aims to promote a sustainable transport system through EV infrastructure development in major urban centres in the state, including Pune. The policy states that awareness programs will be designed and implemented by the state government in partnership with industry players and civil society organisations. The programme will aim to create awareness on EVs, their benefits and incentive support available under state and central government policies.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Increase 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 Maharashtra Electric Vehicle Policy, 2021 aims to increase the modal share of electric vehicles in major cities of Maharashtra, including Pune, through introduction of electric buses, two wheelers, three-wheelers, and cars in cities. The policy has set a target that by 2025, 10% of all new vehicle registrations in the state should be of electric vehicles. Further, to promote EV adoption, the policy offers subsidy of ₹ 5000/kWh on purchase of electric two, three and four-wheelers (capped at ₹ 10,000, ₹ 30,000 and ₹ 1,50,000, respectively), with further benefits to promote purchase of EV vehicles within the year.
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	The Pune Mahanagar Parivahan Mahamandal Limited (PMPML) has announced procurement of a fleet of 650 electric buses by 2022 in phases under FAME II. PMPML can avoid up to 318 gCO_2/km emissions per bus by switching to electric buses. The Maharashtra EV Policy, 2021 aims to electrify 25% of all public transport in major cities of the state including Pune. Furthermore, 15% of all MSRTC buses will be electrified by 2025. The policy provides incentives of up to ₹ 20,00,000 on purchase of electric buses to state transport undertakings.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Similarly, initiate transition of intermediate public transport (IPT) vehicles to electric by incentivising IPT 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 exists	If 5000 autos are replaced with e-autos (less than 10% of the total autos) in Pune, then it saves 13,470 tCO_2e emission. The Maharashtra EV Policy, 2021 aims to promote transition of IPT to electric in the state through a number of incentives and non-fiscal benefits. Some major provisions regarding subsidies and parking spaces are as follows: a) An incentive of ₹ 5,000/kWh to three-wheelers up to ₹ 30,000 is offered. Additional incentives for assured buyback and battery warranty of at least five years. b) ULBs are encouraged to provide lane and parking preferences to EVs. c) At least 25% of the total capacity of all dedicated off-road public parking spaces and the parking spaces of all institutional and commercial complexes to be made EV ready by 2023.[2] d) Free parking provisions for EVs in all future public parking spaces. e) The state government shall engage and encourage financial institutions and banks to offer preferential interest rates for EV customer segments such as e-autos, goods carriers, and taxis.
District administration, ULBs (for office use + solid waste transport activities) and all district level government offices can adopt e-vehicle fleets. Additionally, all these offices need to install charging infrastructure at the earliest.		Short to medium-term	Policy framework exists	In its latest budget (2021-22), PMC announced plans to convert half of its total office fleet to electric vehicles. Further, expanding such an initiative to departments and government offices across the district can help in this transition. In addition, the Maharashtra EV Policy, 2021 has announced that new vehicles inducted into the government fleet starting April 2022 will be electric-only. Further, it pushes for 100% conversion of the parking spaces of all government office complexes to be EV ready by 2025.

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2   A parking spot is defined as EV ready when it is provided with charging infrastructure and a separate meter connection.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Develop robust and widespread charging infrastructure: a) Charging infrastructure to be at strategic locations – commercial hubs, public parking, airports and railway stations etc., preferably RE powered. b) Adopt relevant policies. c) Prioritise land acquisition for setting up charging infrastructure. d) Introduce dedicated parking spaces for EVs with charging facilities. e) Incentivise restaurant owners, fuel stops and other commercial spaces along the highways to install charging infrastructure for e-vehicles in order to make long journeys with e-vehicles hassle-free. f) Install integrated EV charging points within lamposts as a cost effective solution to reduce street clutter and to open access to charging facilities, particularly for those without garages. This can be initiated as a trial solution and scaled up further in the future.		Medium-term	Policy framework exists (section 6.1.3.1) Inter-departmental collaboration required	Maharashtra State Electricity Distribution Company Ltd. (MSEDCL) has sanctioned installation of 500 electric vehicle charging stations across the state. In the first phase, it allocated funds for installation of 10 electric charging stations across Pune. This can be further scaled up in the district in order to facilitate reduction in tail pipe emissions. The Maharashtra EV Policy, 2021 aims to establish 500 charging stations in Pune by 2025. The policy provides incentives for setting up public and semi-public charging stations, both slow and fast across the city as well as offers rebates in property tax to residential owners setting up private charging stations. These incentives will only be provided after the charging station is functional. The policy mandates new residential buildings as well as institutional and commercial complexes to make at least 20% and 25% respectively of total parking spaces EV ready. The policy has also targeted creation of low-emission zones that shall be served primarily by zero tailpipe emission vehicles.
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	Policy framework exists. Enhancing it towards holistic integration of e-vehicles.	The Maharashtra EV Policy, 2021 has a target of increasing the modal share of EVs by adding at least 3,00,000 electric vehicles in the state by 2025 and has recommendations suggesting means to promote EVs (as listed in the point above). Pune can lead by example in the state and the country by easing transition to EV through additional incentives, as suggested.
Promote fast registration of EVs at RTO.		Short-term	Policy framework exists Create awareness to popularise EVs	Maharashtra EV Policy, 2021 has provisions to incentivise and fast-track adoption of EVs by exempting them from road tax and registration charges and renewal of registration.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Encourage development of local network of rental e-vehicles 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	Policy framework required	In 2020, PMC approved an e-bike rental scheme to develop an e-bike rental network across the city. Around the same time, Pimpri-Chinchwad Municipal Corporation (PCMC) also approved a pilot e-scooter rental initiative within its boundaries. Expansion of such a service to different parts of the district, as per the requirement, can help promote this sustainable means of transport.
Encourage and promote adoption of EVs for all delivery operations within the district.		Short to medium-term	Requires policy framework and inter-departmental coordination	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. The Maharashtra EV policy, 2021 also endeavours towards fast-tracking and ensuring time-bound registration of EV fleets owned by aggregators, last mile delivery providers, logistics players etc.
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 in popularising EVs, as it would allow users to plan routes that have charging points.		Medium to long-term	Needs support for digitalisation	
Smart lampposts can radically improve electrical efficiency and enable a number of new services, such as being equipped with PV modules to harvest and store solar energy during the day to power lighting at night. They can also come 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
		Time frame 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), entry to tourist sites, payment for rental vehicles, among other things, can make PT and IPT more popular with increased ease of use, b) Increasing fleet strength, c) Increasing frequency, d) Adding more stops, e) Enhanced reach to low or non-serviced areas to peri-urban and rural areas, f) Developing dedicated parking spaces for IPT.		Medium to long-term	Existing policy framework can be enhanced Inter-departmental collaboration required	As of 2018, the share of public transport in Pune is 19% and is relatively low compared to India's most populous cities. Public transport services in Pune include PMPML bus fleet, private fleets and Rainbow BRTS, which was the second BRTS programme launched in the country. PMPML bus network consists of: approximately 1,400 buses (including 25 electric), 371 routes, 2392 stops. Rainbow BRTS: approximately 1200 buses (125 electric), 6 routes, 61 km, 102 stops. The option of smart card, called 'Mi', for PT payments is available. However, as the awareness is low, its utilisation is low with only 2% to 3% passengers opting for this payment option. 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 MSRTC services. The frequency of services can be enhanced, as well as the number of stops can also be expanded to these areas. The share of IPT by ridership in Pune city is <10% with majority of the population opting for private vehicles for commuting. Currently, the IPT sector is not formalised completely and the connectivity is limited to certain routes, majorly in and around popular commercial and residential areas. 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.
District administration can collaborate with ULBs to develop fiscal measures to discourage the use of personal vehicles, like variable parking charges for peak hours.		Short-term and continuous	Requires policy intervention based on research and inter-departmental cooperation	While the existing Pune Parking Policy, 2016 has a pricing scheme for parking of vehicles, efforts need to be made to upgrade the pricing scheme to a variable one based on peak hours, to particularly discourage the use of private vehicles during those hours.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Implement policy measures to discourage the use of private vehicles through: a) A parking policy for vehicle ownership, b) No car days on certain roads, c) By allowing parking only in dedicated areas.		Short to medium-term	Requires proper policy backing based on research and inter-departmental cooperation	Pune has the highest rate of two-wheeler ownership and the second highest rate of car ownership in India. To discourage the use of private vehicles in the district, initiatives such as the ones stated below can be adopted: 1) Sikkim Parking Policy, 2010 mandates that only houses with parking slots can procure vehicles. 2) In February 2016, Gujarat University announced that the first and the fifteenth 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	
Augment Non-Motorized 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	Proper policy backing based on research and inter-departmental cooperation is required	Current modal split in Pune indicates that the share of NMT is approximately 30%, and has been on a decreasing trend over the years. Efforts need to be made to make NMT a preferred and viable option.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
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	
Promote cycle hire service in key locations across the district.		Short-term	Policy framework needs to be enhanced Further, PPP models can be explored for successful implementation.	Various private bicycle hire services are available in Pune city. Further, Pune has a cycle plan to promote the use of bicycles. Additionally, the Maharashtra State Urban Transport Policy, 2017 as well as the National Urban Transport Policy, 2006 promote development of cycling infrastructure in cities.
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 proper policy based on research along with multi-stakeholder and inter-departmental cooperation	Pune 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. A 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) Promote business/corporate centres to have mandatory private parking with sufficient 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	The Pune Parking Policy, 2016 has measures in place to discourage street parking. Further, development of parking zones in a strategic manner and popularising the parking spaces through awareness initiatives can popularise the parking structures developed by PMC.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Develop dedicated areas for street vendors to free up the pavements, so that traffic congestion on the roadsides can be minimized.		Short to medium-term	While the policy framework exists, implementation is irregular and for short timeframes. Multi stakeholder and inter-departmental cooperation is required.	Providing dedicated areas for their business can ensure their livelihoods as well as help in decongestion. Town vending committee(s) in the district could help in identifying all street vendors and be of aid in formulating an effective plan of action for rehabilitation.
Regular maintenance of roads to ensure smooth flow of traffic can help reduce GHG emissions while extending the life of the road.		Short to medium-term and continuous	While the policy framework exists, implementation is lacking in some areas Multistakeholder and inter-departmental cooperation is required.	

6.1.3.1 Transport: Policy framework and concerned departments/agencies

Sub-sectors	Policies and programmes which can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Promoting e-mobility	1. FAME II 2. Maharashtra EV Policy, 2021 3. JNNURM 4. National Electric Mobility Mission Plan 5. Smart Cities Mission 6. AMRUT 7. Proposed national e-vehicle Policy (as per 2021-22 Union Budget) 8. National Urban Transport Policy, 2006 9. Majhi Vasundhara	1. All ULBs 2. RTOs 3. MSEDCL 4. EESL	1. Housing and Urban Development Department, GoM 2. MEDA, MSEDCL 3. Department of Motor Vehicles, GoM 4. Roads and Buildings Department, GoM 5. State Knowledge Management Centre on Climate Change (SKMCC) Department of Environment, GoM 6. Rural Development Department, GoM 7. Pune Smart City Development Corporation Limited 8. PRIs 9. Airport Authority of India 10. Western Railways - Pune Division 11. Proposed District level Committee on Climate Change and Environment
Public transport and intermediate public transport	1. BRTS 2. JNNURM 3. ECBC 4. Smart Cities Mission 5. AMRUT 6. National Urban Transport Policy, 2006 7. Majhi Vasundhara	1. All ULBs 2. Pune Smart City Development Corporation Limited (PSCDCL) 3. PMRDA 4. MSRTC	1. Housing and Urban Development Department, GoM 2. Department of Motor Vehicles, GoM 3. RTOs 4. Roads and Buildings Department, GoM 5. State Knowledge Management Centre on Climate Change (SKMCC)-Environment Department, GoM 6. Rural Development Department, GoM 7. MEDA, MSEDCL 8. Proposed District level Committee on Climate Change and Environment

Sub-sectors	Policies and programmes which can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Augment non-motorised transport	1. Smart Cities Mission 2. AMRUT 3. Maharashtra State Urban Transport Policy, 2017 4. National Urban Transport Policy, 2006 5. Majhi Vasundhara	1. All ULBs 2. Pune Smart City Development Corporation Limited (PSCDCL) 3. PMRDA	1. Housing and Urban Development Department, GoM 2. Roads and Buildings Department, GoM 3. State Knowledge Management Centre on Climate Change (SKMCC)-Environment Department, GoM 4. Rural Development Department, GoM 5. PRIs 6. MEDA, MSEDCL 7. PMRDA 8. Police Department 9. Proposed District level Committee on Climate Change and Environment
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. Pune Smart City Development Corporation Limited (PSCDCL) 3. RTOs	1. Urban Development and Housing Department, GoM 2. Roads and Buildings Department, GoM 3. State Knowledge Management Centre on Climate Change (SKMCC)-Environment Department, GoM 4. Rural Development Department, GoM 5. Police Department 6. Industries, Energy and Labour Department, GoM 7. PRIs 8. MIDC 9. PMRDA 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
		Time frame for the action to be accomplished	Framework for implementation	
The district can develop an incentivising 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 intervention 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 is needed 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
		Time frame for the action to be accomplished	Framework for implementation	
Optimise equipment efficiency. Equipment that are not usually turned off during down time, such as heating or cooling equipment, pumps, alarm systems, etc, need to be energy efficient and strategies must be developed to switch them off whenever possible.		Medium-term	Policy framework exists (section 6.1.4.1)	As per Maharashtra State Energy Conservation Policy, 2017: a) It will be binding on all commercial consumers like malls, multiplexes and industrial consumers in the state whose contract demand is 1000 kVA or more, to get energy audit conducted through companies registered with MEDA and to implement the audit report within two years. b) Industries will be encouraged for energy management system certification. Financial assistance of 50% of the cost of such certification and training program up to a maximum of ₹ 50,000/- will be provided to industries by MEDA. c) There are about five lakh MSMEs functioning in Maharashtra where enhancing energy efficiency is extremely essential. Cluster development programme will be implemented by MEDA, in collaboration with the Industries, Energy and Labour Department on a pilot basis. Information from successful programmes will be shared with other industries so that they too can implement similar energy conservation programme. A target is set to implement such pilot programmes in at least 100 clusters by 2022. d) A special training programme based on energy efficiency is planned for capacity building of technical staff in various industries for enhancing industrial energy efficiency.
Invest in green projects, such as plantation drives and afforestation activities within and around industrial areas.		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 for successful implementation	
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

Sub-Sectors	Policies and programmes which can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Industry	1. Maharashtra State Energy Conservation Policy, 2017 2. Maharashtra State Renewable Energy Policy, 2020 3. National Mission on Enhanced Energy Efficiency	1. Industries, Energy and Labour Department, GoM	1. Maharashtra Industrial Development Corporation (MIDC) 2. District Industries Centre 3. BEE 4. MSEDCL 5. 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
		Time frame for the action to be accomplished	Framework for implementation	
Agriculture				
Promotion of sustainable farming practices and programmes, like use of non-chemical fertilisers and '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, Pune used approximately, 1.6 lakh tonnes of urea in agriculture. If 10% of current urea used in Pune is replaced with non-chemical fertilisers, it will help avoid 11,769.53 tonnes of CO_2 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 waste sector). b) Reducing harmful agricultural run-off, thereby, reducing water pollution and eutrophication.
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 act as an alternative source of income for the farmers.		Short to medium term	Policy framework required Collaboration required Farmers need easy access to markets/ industries that would take crop residue/stubble	Improved harvesting practices like use of Happy Seeder, which has a capacity to eliminate 78% of the GHG emissions (from crop residue burning). It also has the potential to add at least 10% profit to the farmers. Feasibility studies may be undertaken for cost-benefit analysis to support the farmers with such improved harvesting machines and practices. Direct sowing of rice reduces the soil disturbance, enabling it to retain more nutrients, moisture and organic content. It also, removes the need to stubble burning, thereby reducing air pollution. Other feasibility studies or projects can be initiated. For example, the development of biofuel pellets from crop residue.
Farmers should be encouraged to follow the recommendations given in soil health cards.		Short to medium-term	Can be implemented by raising awareness	According to Soil Health card portal, so far 28,51,525 samples have been tested in cycle-II in Maharashtra. In Pune, 21% of the soil samples tested have reported very low nitrogen and 9% of them have reported very low phosphorous content. The micronutrient (Zn, Fe, Cu, Mn, B, S) status is reported to be sufficient by Soil Health Card information under Department of Agriculture Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers Welfare, GoI.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
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	According to PMKSY Achievement Report, 4,550.38 ha of land in Pune was brought under MI between 2019-20. This helped in averting approximately 3,846.84 tonnes of CO_2e emissions per annum (w.r.t to conventional irrigation through groundwater).
Encourage adoption of latest technologies, such as: a) Solar pumps (under PM KUSUM Yojana), 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	In order to facilitate daytime irrigation and to promote use of renewable sources of energy, the GoM has declared 'Mukhyamantri Saur Krushi Pump Yojana' (MSKPY) to install 1,00,000 off-grid 3 HP and 5 HP Solar Photovoltaic Water Pumping Systems in a phased manner. With the implementation of MSKPY, farmers will get day time solar power to operate agriculture pumps. Further, it will reduce interruptions due to breakdown/ transformer failure. 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 of CO_2 emission. These initiatives will increase farmers' 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	According to Press Information Bureau's press release dated September 23, 2020, Maharashtra has 619 total number of cold storages with a storage capacity of 10,09,693 MT.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
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) is needed	Encouraging intensive cultivation of Sesbania grandiflora, which produces about 7.8 kg/tree/year or 93.6 MT/year/ha, and feeding them to lactating crossbred cows can increase milk yield by 11.97%.[3] Straws from millets, corn and maize have better feeding quality than straws from rice, barley and wheat. This change in quality of forage species leads to better productivity, estimated to reduce emissions by 30%. 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 Pune at the district level.[4]
Promote cattle breeds with higher productivity. Moreover, productivity of indigenous cattle should also be improved (for instance, through 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 that the biodiversity of the region is not impacted) Need to generate awareness Provide monetary support to the pastoral community	These initiatives will help meet the growing demand of milk while keeping the livestock headcount low. If there is a 10% decrease in the number of indigenous cattle over a period of 5 years, the loss in milk production will be 14 lakh litres. To compensate for this loss in milk production, a total of 87,846 new crossbreed cattle need to be introduced, which will lead to 79,325.4 tCO_2e. emissions. The net emissions avoided per year will be 1,534 tCO_2e.
Promote the use of waste from livestock and poultry as an important source of organic manure for crops. Poultry manure, which is rich in nitrogen, can be used for various crops like sugarcane, potato etc. for enhancing crop production.		Short to medium-term	Policy framework is available (section 6.1.5.1) Collaboration between different communities (farming and pastoral) is needed	Poultry manure fertiliser is rich in nitrogen and contains all the 13 essential nutrients required for crop production. In comparison to cow manure, it is 2-3 times richer than inorganic fertiliser content.

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3   Earagariyanna M.Y. et. al., 2017, Fodder Resource Management in India-Critical Analysis
4   http://nianp.res.in/harit-dhara-tamarin-plus

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
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 the 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 required	According the Environmental Clearance Report 2019, 624.66 ha of total forest area in Pune has been diverted since 1980. In 2019, Maharashtra received ₹ 5,770 crore from CAMPA, which aims to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses.
Measures to increase trees outside forest (TOF) area and green spaces in Pune: a) Setting up of urban parks, b) Adopting Miyawaki Urban Forestry method, c) Transplanting trees with the help of tree transplanter machines, d) Setting up of floating gardens, butterfly gardens etc. e) Initiating afforestation activities on wastelands and fallow lands. f) MGNREGS can take up plantations along village roads. g) Development of a green belt along the major terrain roads, and those surrounding industrial areas.	📢 🏡🌳 💧	Medium to long-term	Policy framework is available (section 6.1.5.1) Requires capital investment, research collaboration, and inter-departmental cooperation	As per the FSI report 2019, Maharashtra has the largest extent of TOF at 26,945 sq. km. This includes both forest cover outside the recorded forest area/ green wash and tree cover. Pune Tree Census Project, involving a team of 120 people including surveyors, taxonomist and technical staff, was carried out for two years using geo-tagging technology. According to the Pune Tree Census Project, the civic body has counted 40.1 lakh trees in 2019. In the 2013 census, PMC counted 38.60 lakh trees. Common tree species found in Pune were Ashoka, Neem, Giripushpa, Subabul, Nilgiri, Babool, Arjun, etc.

CO_2 uptake

CH_4
N_2O
CO_2

CH_4
N_2O

Stubble burning

Manuring

Fertilier

CO_2
N fixation

CH_4

Rice

Soil Carbon

Soil respiration

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame 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 along with adoption of the following measures: a) Control illegal timber trade. b) Carry out mapping of agroforestry areas to monitor the coverage c) Create provisions of financial instruments/relaxation in other taxes (over and above the existing schemes) to encourage the farming community to adopt agroforestry d) Encourage plantation of most found local, fast-growing species, particularly key stone species, fodder trees, fruit bearing trees, like, peepal (Ficus religiosa), neem (Azadirachta indica), etc. through various techniques/strategies (Miyawaki) to aid increase of tree density.		Medium to long-term	Policy framework and budget is available, implementation is required Stringent monitoring and evaluation	Currently, the forest cover of Pune district is only 10.94% of the total geographical area. If 16.5% of the geographical area of Pune (equivalent to the state's percentage of forest cover to total geographical area) is to be converted to forest over a period of 10 years, emissions of around 27.68 MtCO$_2$e can be avoided. Miyawaki urban forestry method has reported 15% faster growth rate per year compared to other reforestation methods.
Ensure ULBs regularly monitor the survival of trees under plantation drives. a) Undertake thorough study on the 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 that survive 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	According to the State Forest Minister, between 2017 and 2019, a target of 28.50 crore trees was set and approximately 28.34 crore trees were planted. Out of these, 81.63% survived.
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 Requires multistakeholder collaboration	According to the 2019 Forest Survey of India, there is an increase in forest cover by 2.86 sq. km in Pune from 2017 assessment.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Various aspects of joint forest management (JFM) need to be promoted: a) Capacity Building and skill development of the JFM committees in tribal and non-tribal areas by conducting 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 available	As per ENVIS-Committees and Forest Area Under JFM, until 2015, total area covered under JFM in Maharashtra is 24,03,344 ha. There are about 12,665 joint forest management committees in the state.
Prevent invasion of non-indigenous species by adopting the following measures: 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	Undertake research studies of flora specific to the region Exclusive communication strategy and IEC material to be developed and used Requires funding, M&E, stakeholder collaboration	*Prosopis juliflora, Lantana camara, Parthenium hysterophorus, Gliricidia sepium* are some major invasive alien species in Maharashtra. 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.
Develop participatory forest fire management strategies such as: a) Collecting baseline forest fire data w.r.t. perceptions, beliefs, expectations and behaviour of local people regarding forest fires. b) Training local communities to tackle forest fires. c) Organizing awareness programmes in local schools. d) Building capacities 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 Requires M&E and collaboration among different stakeholders	According to Technical Information Series Volume-II (2019), published by the Forest Survey of India, in Maharashtra, 3.4% of the total forest cover area lies in the extreme fire prone area, 16.65% under moderately fire prone area and 60.34% under least fire prone area.

6.1.5.1 AFOLU: Policy framework and concerned departments/agencies

Sectors	Policies and programmes which can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Agriculture	1. Rashtriya Krishi Vikas Yojana: Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RAFTAAR) 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. Saur Krishi Vahini Yojana 9. Maharashtra Agriculture Pump Electricity Policy, 2020 10. Integrated Cold Chain, Value Addition and Preservation Infrastructure Scheme 11. Majhi Vasundhara	1. Department of Agriculture, GoM	1. Department of Environment and Climate Change, GoM 2. Rural Development and Panchayat Raj Department, GoM 3. Water Resources Department, GoM 4. State Energy Department 5. Industries, Energy and Labour Department, GoM 6. Forests and Environment Department, GoM 7. Directorate of Industries, GoM 8. Department of Animal Husbandry, GoM 9. APMCs 10. 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. Navinya Purna Yojana 9. National Mission on Food Security 10. Rashtriya Krishi Vikash Yojana: Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RAFTAAR)	1. Department of Animal Husbandry, GoM	1. Maharashtra Forest Department, GoM 2. Department of Agriculture, GoM 3. Department of Environment and Climate Change, GoM 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 8. Atal Bamboo Samrudhi Yojana 9. Majhi Vasundhara	1. Maharashtra Forest Department, GoM	1. Department of Agriculture, GoM 2. Department of Environment and Climate Change, GoM 3. All ULBs (PMC + PMRDA + other Municipalities) 4. Directorate of Geology and Mining, GoM 5. Department of Housing, GoM 6. UDD & RDD 7. Proposed District level Committee on Climate Change and Environment 8. All PRIs

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Time frame for the action to be accomplished	Framework for implementation	
Solid waste				
Waste prevention: Reducing landfilling				
Minimising landfill waste disposal by: a) Promoting waste reduction at source through product reuse, extending lifetime (maximum use of resources), and putting in place consumers' right to repair, b) Ensuring efficient and 100% segregated waste collection 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.	(icons)	a) Medium to long-term b) Short to medium-term c) Medium-term d) Long-term	a) Needs policy intervention, awareness building and incentivisation b) Policy framework exists (section 6.1.6.1), needs resource allocation and execution c) and d) Need policy intervention and execution (Resource Efficiency Policy has been drafted by NITI Aayog but not implemented as of date)	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 some initiatives adopted in Pune (mostly the city area) that will reduce landfill emissions in the city and can be adopted in the district as well. Pune region generates 3,627.82 TPD solid waste, of which 2,672.85 TPD, i.e., about 74% gets treated (MPCB Annual Report, 2018-19). Pune city has 100% waste collection efficiency. Treatment facilities include composting or bio-methanisation, material recycling facility (MRF), refuse derived fuel (RDF), bio-mining, etc. PMC has proposed a waste to energy (W2E) plant of 200 TPD capacity at Ramtekdi Industrial Estate. The zero-garbage project of PMC has significantly reduced waste dumping to the landfill at Uruli Devachi, Phursungi. PCMC too has proposed a W2E plant at Moshi with 1000 TPD waste processing capacity and 11.5 MW power generation potential. A bio-mining project is also under implementation at Moshi garbage depot that aims to reduce the legacy landfill waste. Pune city ranked 5th and Pimpri-Chinchawd ranked 19th out of the 48 cities with million+ population in India by Swachh Survekshan, 2021 (cleanliness, hygiene and sanitation survey).

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Time frame for the action to be accomplished	Framework for implementation	
Minimising single use plastic (SUP): Detailed information and recommendations on SUP are given in section 6.1.6.2.		Short to medium-term	Already a national priority Policy framework exists (section 6.1.6.1), but can be accelerated with district level interventions/ implementation	
Implementing producers (manufacturers/brand owners, etc) take-back mechanism (Solid Waste Management 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, etc., for efficient management of these waste materials. This will reduce inert landfill waste load.		Short to medium-term	Mandated by the SWM Rules (2016) Needs regional policy formulation and interventions	Disposable SW take-back has not been implemented in Maharashtra as of now. About 34% of the total waste generated in Pune is inert waste and 6% paper waste, much of which can be treated/recycled, thereby (potentially) leading to a significant landfill waste reduction. Currently, 180 TPD plastic waste is being treated at MRF.
Ensure 100% recycling of recyclables at landfill through material recycling facility (MRF), refuse derived fuel (RDF), waste to energy, etc. Encourage use of LDPE and HDPE plastic waste in road construction.[5]		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 and implementation Capital investment in infrastructure needs to be enforced	

5   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
		Time frame for the action to be accomplished	Framework for implementation	
Increasing consumer awareness and access to recycling facilities and repair options.		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.
Education and awareness drives for 100% at source segregation of biodegradable waste, non-biodegradable waste, domestic hazardous waste and household biomedical waste.		Short-term		
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, like, energy efficiency, water conservation.		Short-term and continuous	Needs sustained campaign for 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 awareness 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
		Time frame 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 the SWM Rules, 2016 Capital investment in infrastructure development (for treatment) is required, which can be obtained from the producers	
Transitioning the district to a 'green market' approach by: a) promoting local circular business models, b) mainstreaming of alternative sustainable business models for the consumers to have a basket of choices.		Medium-term and continuous	Needs alternative business models, collaborations and awareness	
Reducing emissions from waste transportation: a) Encourage shifting to electric or zero emission vehicles (ZEVs) for all kinds of waste transport, 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	PMC has 396 garbage collection vehicles, of which there are 160 trucks for house-to-house collection. Thus, waste collection and transport are potentially leading to significant emission which can be avoided by transitioning to ZEVs. Though, there are several specifications for CBWTF vehicles to ensure efficient management and monitoring of BMW, it does not account for the emissions from transport.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Time frame for the action to be accomplished	Framework for implementation	
Waste treatment: Composting				
Encourage 100% conversion of organic waste to biological waste 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 initially leads to emission, but reduces GHG emissions drastically in the long-run, when compared to landfill emissions. However, it takes at least three decades of landfill emissions to balance with those from aerobic composting. A number of best practices and technologies are available for reducing GHG emissions from composting. Even in the absence of a gas management system, composting is considered more environmentally sustainable practice than methane capturing from landfilling of organic waste, simply to avoid its multi-layered pollution potentials and reduce landfill loads. About 45% of the solid waste generated in the district is biodegradable. However, currently only 19% is getting treated biologically. Pune Municipal Corporation has an effective microorganism (EM) composting system. It encourages household-level composting units too through a decentralised system. However, none of these composting units have any gas management system to capture CH_4 emissions. Composting emission potential (for 606.6 TPD reported by MPCB AR 2018) is 18,598 tCO_2e/year. Maharashtra is the only state to have registered its own brand "Harit Maha City Compost" for promotion of marketing and sale of city compost which is as per the Fertiliser (Control) Order (FCO), 1985 standards, and SWM Rules, 2016. Composting with gas management of 100% of the organic waste going to landfill can reduce emission by 31,367 tCO_2e/year in Pune district.
Develop composting facilities at ULB level in addition to cluster level to avoid: a) loss of carbon content in long route organic waste transport, 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 composting units 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 required Research collaboration required	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Time frame 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, etc. is important for accurate city or district-level emissions estimations from the waste sector.		Short-term	Needs research collaboration	
Ensure better compliance to the 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 in most cases (section 6.1.6.1)	
Bio-medical waste and hazardous waste				
a) Promote installation of modern incinerators with energy-recovery facilities (like, use of recovered heat for preheating of waste to be burnt or use of incinerator steam to generate electricity) for new CBWTFs and TSDFs 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 very well recommended treatment due to its emission potential, incineration prevents manual scavenging and further contamination from certain kind of infectious waste, (particularly, the anatomical, contaminated waste, discarded medicines and chemical waste) and is the best available and recommended practice currently in India. Current annual BMW incineration emission in the district is 1,418 tCO$_2$e/year. Energy recovery incineration is not practiced. Pune has one TSDF which received 1,10,288.43 MT/year hazardous waste during 2018-19, out of which 25,712 MT/year was incinerated leading to an annual emission of 21,213 tCO$_2$e. However, only Pune region generated 4,02,502.77 MT/year hazardous waste during 2018-19, of which 83,546.9 MT/year was incineration waste.
Strict monitoring of adherence to recommended incineration technologies, standards and practices through regular monitoring by District Bio-medical Waste Management Monitoring Committee.		Short-term and continuous	Mandated by the Rules (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
		Time frame 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	Preparation of e-waste inventory is mandated by the rules (section 6.1.6.1) Needs research collaborations	About 95% of the e-waste in India is processed informally (largely through rudimentary operations like open burning, acid wash, open smelting, etc.). City-based studies show that efficient management and recycling of electrical and electronic waste (WEEE) can significantly contribute to emissions reduction targets. An assessment of e-waste in Mumbai-Pune area by MPCB conducted in 2007 that considered only four categories (cell phone, TV, PC, refrigerator) projected 50,000 tons and 3,500 tons of e-waste generation in Mumbai and Pune respectively, in 2015. The assessment was done before even the first rules (2011) came. The current rules (2016) include 22 categories of electrical and electronic products as e-waste. Widely regarded as the second major IT hub of India, Pune's current e-waste generation will outgrow this projection with a large margin. During 2018-19, only 9,475 tons of WEEE was collected formally as reported by MPCB) in the entire state, which clearly indicates informal routing of most of the e-waste generated.
Ensure stringent policy implementation: trace informal routing, ensure proper collection, restrict informal processing of e-waste (open burning, metal smelting, etc.), ensure proper disposal of electrical waste (lighting infrastructure including mercury containing lamps) and strict monitoring to stop landfilling of the same.		Short-term and continuous	Policy framework exists (section 6.1.6.1) Needs monitoring, research and awareness	
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 the recyclers/producer responsibility organisations (PROs)	
Improve consumer awareness on responsible e-waste disposal and make information readily available about e-waste collection points, recyclers, producers (manufacturers), 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 awareness campaign required Can be achieved by collaborating with producers	
Formulation of district level E-waste management programmes.		Short to medium-term	Needs state and district collaboration	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Time frame for the action to be accomplished	Framework for implementation	
Wastewater: Domestic and industrial				
Achieve 100% domestic wastewater treatment through: a) 100% closed and underground sewer collection network coverage of both rural and urban areas of the districts, b) Shift 100% domestic wastewater treatment (STP) to aerobic set ups by having only aerobic STPs for new constructions and transitioning the old anaerobic STPs to aerobic set up. c) Operation and regular maintenance of sludge removal facilities of all STPs. The sludge can be used again 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, open sewers create anaerobic conditions, leading to CH_4 emissions. Closed underground sewers, on the other hand, are considered to be an insignificant source of CH_4. Currently, Pune district has 21 aerobic STPs of 700 MLD capacity. Pune city is covered with 92% sewerage network of 2,200 kms length with 6 intermediate sewage pumping stations (IPS) and 9 STPs (aerobic). The district sewerage network coverage is less and is proposed to be expanded until 100% coverage. No specific information is available on the rural sewerage coverage. Japan International Cooperation Agency (JICA) project with Pune Municipal Corporation proposed augmentation of existing sewage treatment capacity by adding 11 new STPs (396 MLD capacity) to cover sewage generation up to 2027 (under construction now). 100% closed and underground sewer connection and centralised aerobic well-managed STPs can potentially reduce 2,11,430 tCO_2e emission from STPs to negligible in Pune. The Maharashtra government has mandated the reuse of treated wastewater for cooling thermal power plants and has introduced 'Maharashtra Water Resources Regulatory Authority Water Entitlement Transfer (WET) and Wastewater Reuse Certificates (WRC) Platform Regulations, 2019'. Example: Ahmedabad Municipal Corporation has set up the first sewage sludge hygienisation plant in the country at Pirana (operational from 2019) which can convert 100 tonnes of dry sludge into fertiliser per day. A similar plant can be developed for Pune.
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 the industries to utilise treated industrial and domestic wastewater. Provide subsidy/tax rebate provisions to industries, healthcare, hospitality sectors for implementation of smart, recycled water investments.		Medium to long-term	Policy implementation required 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
		Time frame 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.		Medium to long-term	Needs policy intervention, inter-departmental collaboration	
Encourage data transparency by the industries for wastewater generation, treatment and discharge information including those of CETPs.		Short to medium-term	Needs collaborative efforts	Pune region has five operational CETPs with collective treatment capacity of 13 MLD. The total industrial effluent generated in this region during 2018-19 was 4.85 MLD. The quantity of effluent received and treated at these CETPs during 2018-19 was 4.45 MLD.

Data transparency on wastewater generation by industries is key to reducing water pollution, which can be further enhanced 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 encourage public participation. |

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Landfill emissions can be reduced through

Reduced landfill load

Reduced waste   Resource recovery   Reuse/repair

Waste segregation

Waste treatment   Recycling
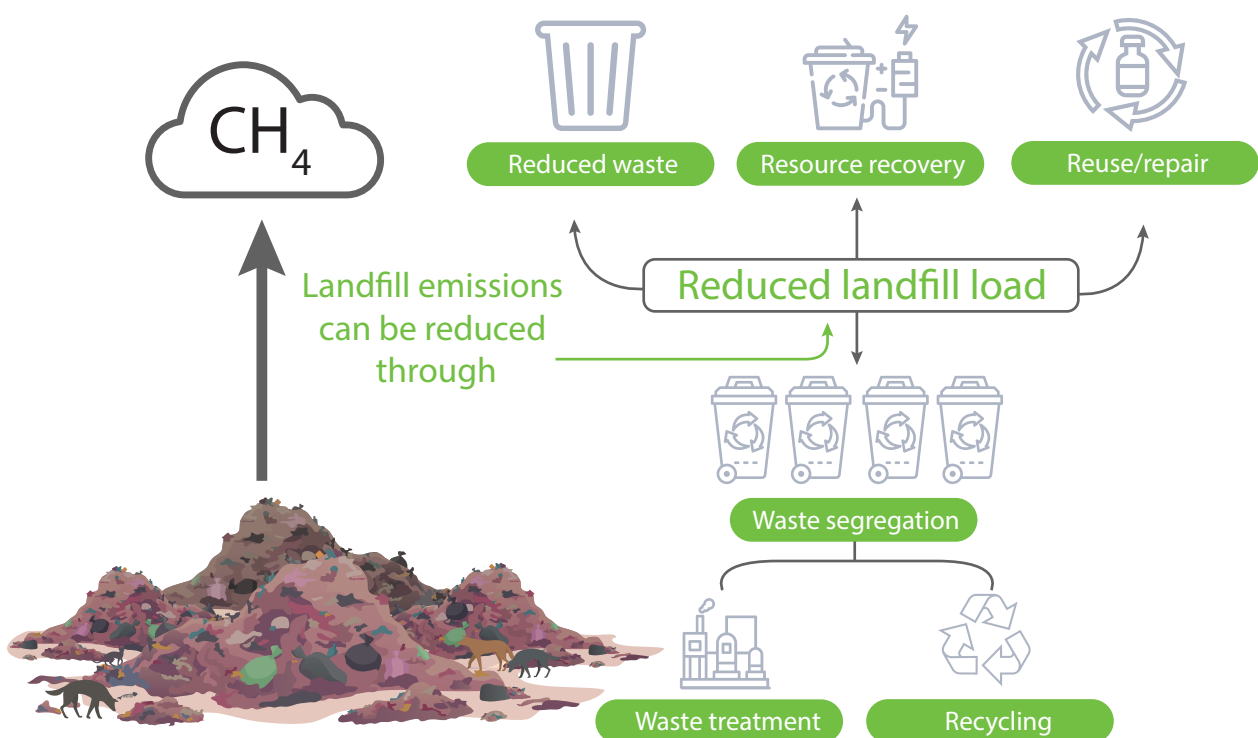
6.1.6.1 Waste Management: Policy framework and concerned departments/agencies

Sectors	Policies and programmes which can push forward the recommendation	Primary departments/agencies	Supporting departments/agencies
Solid waste	1. Solid Waste Management Rules, 2016 and Amendment, 2018 2. Plastic Waste Management Rules, 2016 and Amendment Rules, 2021 3. Construction & Demolition Waste Management Rules, 2016 4. Integrated Solid Waste Management Project 5. Swachh Bharat Mission - Urban & Rural 6. Pune Master Plan 2041 & City Development Plan 7. Pune Smart Cities Mission 8. National Resource Efficiency Policy (draft) 9. Guidelines on Environmental Management of C&D Waste Management in India, 10. Maharashtra Water Resources Regulatory Authority Water Entitlement Transfer (WET) and Wastewater Reuse Certificates (WRC) Platform Regulations, 2019 11. MPCB Annual Report 12. Majhi Vasundhara	1. Urban Development Department, GoM 2. All ULBs (Pune Municipal Corporation, Pimpri Chinchwad Municipal Corporation, Lonavala Municipal Council, Indapur Municipal Council) 3. Rural Development and Panchayat Raj Department, GoM 4. All Gram Panchayats 5. Maharashtra Pollution Control Board (MPCB)	1. Pune District Administration & the proposed District Level Climate Change & Environment Committee 2. Maharashtra Urban Infrastructure Development Company Limited (MUIDCL) 3. Pune Metropolitan Region Development Authority (PMRDA) 4. Department of Environment and Climate Change, GoM 5. Community or Residential Associations
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. MPCB Annual Reports (for data availability) 5. Revised Guidelines for Common Bio-medical Waste Treatment and Disposal Facilities, 2016, CPCB	Research funding can be obtained from Department of Environment and Climate Change, GoM, MPCB, etc.[6]	1. MPCB 2. Pune District Administration & 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,	Only implementation monitoring and research needs resources which can be obtained from the Department of Environment and Climate Change, GoM, MPCB, etc.[7]	1. MPCB 2. Pune District Administration and the proposed District Level Climate Change & Environment Committee 3. Electronic and Electrical Producer Manufacturers/Producers/Brand owners, Producer Responsibility Organisations

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

7   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 which 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) – Maharashtra 6. Swachh Bharat Mission (Rural) – Maharashtra 7. Pune Smart City Mission 8. Pune Master Plan, 2041	1. Urban Development Department, GoM 2. Water Resources Department, GoM 3. Rural Development and Panchayat Raj Department, GoM 4. All ULBs	1. PMRDA 2. MUIDCL 3. Pune Smart City Development Corporation 4. All Gram Panchayats 5. Pune 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. MPCB Annual Report 4. Majhi Vasundhara	1. MPCB 2. MIDC	1. City and Industrial Development Corporation (CIDCO) 2. Department of Environment and Climate Change, GoM 3. Pune District Administration & the proposed District Level Climate Change & Environment Committee

6.1.6.2 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 are ingested by aquatic animals; b) stay in the environment 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 the food chain.

Single use plastic

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
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 and e-commerce	Bio-plastics, recycled paper	**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
Plastic bottles, tubes for household, personal care and 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	**Bio-plastics** • Pros: Bio-degradable, moisture resistant, inexpensive, light-weight • Cons: Contains significant number of plastic polymers leading to microplastic pollution; needs commercial composting facility to degrade; can mistakenly be mixed with plastic recyclables in municipal solid waste; needs quality check and control
Plastic sachet	LDPE	FMCG, (food & beverages, PCCP), hospitality	Cellophane/ another bio-degradable alternative	
Styrofoam products (plates, tray, cups)	Expanded polystyrene (EPS)	--	Bioplastic, recycled paper, leaf, bamboo	
Biscuit tray, plastic box, air seal for food, etc.	Polypropylene (PP)	FMCG (food & beverages), hospitality	Bioplastic	**Paper** • Pros: Bio-degradable, low manufacturing cost, can be made from recycled paper • Cons: Water intensive, high carbon footprint, not durable, not moisture resistant
Plastic water and other drink bottles	Polyethylene terephthalate (PET)	Hospitality, FMCG (food & beverages)	Glass, metal, ceramics, bulk vending	
Plastic cutlery, plates, cups, and stirrers	Polystyrene (PS)	Hospitality	Bioplastic, recycled paper, steel	**Glass** • Pros: Inert, infinitely recyclable, no toxic chemical additives, low manufacturing carbon footprint • Cons: Fragile, higher cost, injury and health risk, weight
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 & beverages), Hospitality	Tetra Pak, bottling and bulk vending	**Metal** • Pros: Renewable resource, durable, can be recovered and infinitely recycled • Cons: Expensive, higher transportation carbon footprint, tin-coated steel can leach into food and contaminate, heat conductor
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. The European Commission defines them as 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 industries; 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 these sources, intentionally-added microbeads in cosmetics and personal care products are 'designed to drain' SUPs. Replacement of microbeads in PCCPs come 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: Ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene (thermocol) for decoration shall be prohibited from January 1, 2022, b) The manufacture, import, stocking, distribution, sale and use of the SUPs (including polystyrene and expanded polystyrene) items – 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, 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 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.

- Government of Maharashtra published the 'Maharashtra Plastic and Thermocol Products (Manufacture, Usage, Sale, Transport, Handling and Storage) Notification, 2018' under 'Maharashtra Non-Biodegradable Garbage (Control) Act, 2006'. The notification bans manufacture, usage, transport, distribution, wholesale and retail sale and storage, import of plastic bags with handle and without handle, and the disposable products manufactured from plastic and thermocol (polystyrene) such as single use disposable dish, cups, plates, glasses, fork, bowl, container, disposable dish/ bowl used for packaging food in hotels, spoon, straw, non-woven polypropylene bags, cups/ pouches to store liquid, packaging with plastic to wrap or store the products, packaging of food items and food grain material in the state of Maharashtra. The ban also applies to plastic and thermocol for decoration (Environment Department, GoM, 2018).

Recommendations[8]

- 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.

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8 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

- Formulate policies with provisions to: a) mandate producer responsibility for awareness, labelling requirement 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 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 of other selected categories of SUP products (by granting the producers some transition time). The phasing out can be achieved by sensitising key producers and sectors and encouraging them to take voluntary action.

- Promote eco-friendly alternatives to SUPs through: a) identifying alternative sustainable products; b) identifying micro-enterprises and cottage industries for the products; c) integrating them into the mainstream business models through connecting/cross-cutting policies; d) providing financial incentives for the 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 (for instance, resin or plastic powder should not be mixed in the product as an alternative).

- Promote extended lifespan and reuse of products (including sustainable ones) through continued and lasting campaigns for 'No Single Use' to ensure public participation. Replacing the concept of 'single use' is critical as biodegradability or recyclability have 'time' and 'conditions' (such as energy and water footprint, transport requirement, etc) attached to them.

- Introduce economic incentives/support: a) Invest in R&D to develop alternatives to different SUP products, b) support technology incubation and stimulate creation of micro-enterprises to drive job creation, c) introduce livelihood support schemes and/or include special provisions in the existing schemes to accommodate the job loss from plastic industry, d) tax rebate to alternative models, public-private partnerships, etc; e) incentivise plastic industries for shifting to sustainable alternatives.

6.2   Innovative financing

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Time frame for the action to be accomplished	Framework for implementation	
Promote green municipal bonds to mobilise untapped investments towards green projects, such as RE infrastructure, waste management, etc.		Medium to long-term	Needs policy formulation Collaboration among various stakeholders Create specific financial instruments	In June 2017, Pune Municipal Corporation raised ₹ 200 crore through municipal bonds (listed on BSE) at an interest of 7.59% to finance its 24x7 water supply project. PMC's plan was to issue municipal bonds worth ₹ 2,300 crore over a period of five years, of which bonds worth ₹ 200 crore were issued in 2017.
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	Needs feasibility studies, research and inter-departmental and multi-stakeholder collaboration Institutional structure needs to be established	Case example: In 2020, Smart City Indore collected carbon credit of around ₹ 50 lakh through the smart city's two bio-methanisation plants. The gas generated from these plants is used by the city buses - City Bus and iBus. Through these projects, Indore has avoided emissions of 1,70,000 tCO_2e since 2019 and generated carbon credits.

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 recommend.	Framework for implementation	
Managing air pollution				
Increase the number of Continuous Air Quality Monitoring Stations (CAQMS) to statistically, spatially, and temporally represent the mix of sources and range of pollution in the city. Increase the number of air quality display facilities in public places.		Short to medium-term	Policy framework and budgetary provisions exist	Air quality in Pune is considered to be an urgent public health issue and has been deteriorating since 2013 with $PM_{2.5}$ consistently exceeding the limits. Pune is also one of the 124 non-attainment cities in India under the National Clean Air Programme (NCAP).
Enforce environmental standards on exhaust fumes/emissions from industries.		Short-term and continuous	Robust M&E required	An IITM-SAFAR inventory identified transport (49%), dust (29%), industrial operations (17%) and solid fuel combustion (5%) as the major sources of local air pollution in the city (IITM, CEE, IIPH, & NRDC, 2019).
Sprinkling of water (preferably, recycled grey water) to settle suspended road dust during peak pollution episodes.		Short-term and continuous	Inter-departmental co-operation required	Pune currently has 15 air pollution monitoring stations of which five are operated by MPCB, SAFAR, and 10 are operated by IITM. In addition, Pune Smart City Development Corporation also maintains an independent network of 50 environmental monitoring stations.
Open waste burning (of solid waste, biomass, plastic, horticulture waste, etc) should be regulated by the municipal corporation/nagar panchayats.		Short to medium-term	Needs implementation of existing rules/regulations	As a non-attainment city, air pollution prevention measures such as, dust suppression through deployment of mechanical sweeper, water sprinkler, traffic synchronisation system, electric/gas-based crematorium, proper collection and disposal of horticulture waste, such as composting-cum-gardening approach, promoting e-mobility, controlling C&D waste etc., are identified under the city action plans of PMC along with other non-attainment cities of Maharashtra.
Implementation of action plan for management of construction and demolition waste (as per CPCB guidelines).		Short to medium-term	Policy framework exists	
Facilitate source apportionment studies to identify the sources and develop specific containment measures.		Short to medium-term	Needs research collaboration	
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 Robust M&E	

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommend.	Framework for implementation	
Increase the modal share of public and non-motorised transportation (see detailed recommendation under Transport Sector). Further, promote transition to e-vehicles. Ban on registration of diesel and petrol-driven auto-rickshaw and complete conversion to CNG/gas engine.		Medium to long-term	Policy framework available Awareness generation, capital investment and inter-departmental coordination required	Maharashtra State Urban Transport Policy aims to decongest traffic by discouraging private vehicle ownership; promoting public transport, walking and cycling to enhance air quality; and making transport infrastructure focused on people as opposed to vehicles. Only a partial conversion of polluting auto-rickshaws to CNG/gas engines is recommended in Pune city to Control Air Pollution. Auto-rickshaws that run on diesel, petrol, and LPG dual combination are still available in the district. Several provisions in the latest Maharashtra state E-vehicle Policy, 2021 can aid these recommendations (detailed recommendations under transport sector).
Better traffic management, redirection 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 in the district.		Medium to long-term	Inter-departmental coordination required Efficient maintenance and monitoring of plantation sites required	
a) Shifting of industries from non-conforming zones (refer Development Control and Promotion Regulations for Pune Metropolitan Regional Development Authority and the same for Pimpri-Chinchwad New Town Development Authority). b) Switching over to clean technologies, clean fuels and pollution control devices. c) Development of green belt around the industrial zones.		a) Medium to long-term b & c) Short to medium-term	Policy framework exists Needs compliance	The New Industrial Policy, 2019 offers financial assistance for pollution control systems and captive RE power plants.

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommend.	Framework for implementation	
Landslides and flooding				
Design and implement early warning system (EWS) for flood and related disasters in the district. Further, improving weather and rainfall monitoring network and ensuring information dissemination to the public can significantly help reduce damage due to these disasters.		Short-term	Policy provisions exist Requires inter-departmental collaboration	
Biological reclamation of land/soil: Improved and area specific agriculture/ soil management practices, such as broadcasting of grass seeds, growing cover crops, bio-technical measures like using micro culture and plantation to avoid further land degradation.		Short to medium-term and continuous	Needs research, stakeholder collaborations and capacity building	Landslide hazards rank high among the hydro-geological hazards because of the threat and widespread loss they pose to lives, livelihoods and resources. National Institute of Disaster Management (NIDM) lists the Malin landslide of Pune district in 2014 as one of the 10 major landslides in India in the last three decades (NDMA, 2019). Landslide is a severe problem in the Western Ghats of Maharashtra, particularly in the upland region of Deccan Volcanic Provinces (DVP) due to its topography, human interference (construction, ecologically unsuitable land use, agricultural practices, etc.) and heavy rainfall. The part of the State Highway-70 between Bhor of Pune district and Mahad of Raigad, a neighbouring district, is highly landslide prone and frequently blocked during the rainy season (Khamkar, Mhaske, & Sabale, 2018). In a report by PMC, 9 of the 41 wards (Aundh, Warje Karvenagar, Ghole Road, Kothrud, Bhavani Peth, Kasba Vishram, Tilak Road, Kondhwa Wanawdi, Dhanakawadi) of the city are identified as highly vulnerable to landslides (PMC, 2015).
Promote and restore ecosystems with higher carbon sequestration potential (e.g., wetlands, rangelands, forests), agro-forestry, afforestation, etc. and providing incentives for maintenance of ecosystem services. Initiate studies to adopt metrologies like The Economics of Ecosystems and Biodiversity Services (TEEB).		Medium to long-term	Policy framework exist Needs research, inter-departmental collaboration	

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommend.	Framework for implementation	
Promote coordination between different government departments and projects, formulation of localised integrated action plans for holistic development of the local area in line with central and state programmes (mentioned in case example).		Medium-term	Needs inter-departmental coordination	
Research and identification of best practices and sustainable development technologies for landslide management of areas with similar geo-climatic conditions and adoption/ implementation of the same through policy formulation.		Medium-term	Needs research and cross-cutting policy integration / Capacity building of relevant department officials through cross exposure visits	In a recent initial evaluation based on National Landslide Susceptibility Mapping (NLSM), projects of GSI, Tamhini Ghat hill route section of Pune-Mangan Road (a hilly pass cutting across Western Ghat Escarpment to join Pune to Konkan region) and parts of Ambegaon Tal in Pune district have been identified for 1:10,000 scale landslide susceptibility zonation (NDMA, 2019).
Development of zone-wise ecologically sensitive land-use plan (land-use zoning), integrated landscape planning and district-specific land policies (community mapping, co-management, decentralisation, etc.) to reduce land-use intensification.		Medium to long-term	Existing policy framework needs to be enhanced / Research and inter-departmental coordination required	Independent research has been carried out to develop landslide hazard zonation mapping of landslide prone areas of Pune district, which can be used for landslide mitigation programmes and developmental planning (Gujarathi & Mane, 2013). GSI has also done a survey of 200 villages in Maharashtra, including some from the hilly areas of Pune district. Land degradation is addressed by several central and state programmes, for example, Integrated Wastelands Development Programme (IWDP), National Watershed Development Project for Rainfed Areas (NWDPRA), NABARD projects, etc.
Develop region and ward specific strategies for landslide management in urban areas, such as relocation of slum population residing in the steep slopes of Parvati hills (Warje Malewadi ward, Dhankawdi ward), sustainable road construction in Dhankawadi (population of 7,000 at risk), restrictions on stone mining in the vulnerable Yerawada Sangamwadi Ward, etc.		Short to medium-term	Needs inter-departmental collaboration and financial investment required	

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommend.	Framework for implementation	
Flood hazard mapping with anticipated inundation area and landslide susceptibility mapping with areas of landslide risk and information for safe evacuation and intimation of the same to the identified areas through rural and urban local bodies.		Short-term	Needs research and interdepartmental collaboration	Central Pune is located at the confluence of the Mula and Mutha rivers. In addition, Pavana and Indrayani rivers, and the tributaries of the Bhima River, flow along the north-western outskirts of the Pune Metropolitan Region. Moreover, there are three dams in the upstream. During heavy monsoon, Mula and Mutha rivers flood and the dams release water when their capacity goes full (PMC, 2015).
Building embankments around rivers (preferably natural embankments) to protect low lying areas in the district.		Short-term and continuous	Policy framework exists	
Ensure sustainable construction and development (of bridges, dams, etc) along the rivers. Consider the river hydrology, river flow and catchment area ecosystems, in adherence with existing norms, for any new or existing C&D.		Continuous	Policy framework exists Needs area-specific research	PMC and the Irrigation Department have marked low and high flood lines. Constructions are not allowed in flood zone of the PMC. However, there are old and unauthorised constructions and slums in flood zones. The Khadakwasla Dam poses the highest flood risk in Pune. PMC has identified 9 wards (Aundh, Kothrud, Bhavani Peth, Kasva Vishram, Tilak Road, Bibvewadi, Hadapsar, Kondhwa Wanawdi, Dhanakawadi) as highly vulnerable to flooding and three wards (Warje Karvenagar, Ghole Road, Sahakarnagar) with medium vulnerability to flooding (PMC, 2015).
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 sector to surface water sources.		Medium-term	Policy framework exists Strict monitoring and reporting required.	
Promote rainwater harvesting: a) Renovation of existing rainwater harvesting structures, b) Ensure rainwater harvesting structures in new construction of residential buildings, institutional, commercial centres, and industries in the district as per building bye-laws.		Short to medium-term	Policy framework exists Align with existing regulations.	PMC has an SOP, Flood Control Action Plan for floods and flash floods, an early warning system in coordination with the Police and the Fire Department, and a system for relocating flood zone population along with temporary shelters.

Recommendations	Cross-cutting with	Qualifying priority		District scenario / case examples
		Time frame to attain the recommend.	Framework for implementation	
Efficient planning, operation and maintenance of storm water drainage is required to halt flooding situations.		Short- term	Policy provisions exist	PMC has initiated Pune River Development Project aiming to reduce the threat of flooding.
Create programmes for the revival of local lakes/ponds and rejuvenation of polluted river stretches through desilting, aquifer recharging, and integrated watershed development.		Medium-term and continuous	Requires long-term planning and financial investment	Maharashtra Water Resources Department has a Pune Flood Control Portal maintained with all emergency contacts.

6.3.1 District-specific recommendations based on identified environmental problems: Policy framework and concerned departments/agencies

Sectors	Policies and programmes which can push forward the recommendation	Primary departments/agencies	Supporting departments/agencies
Managing air pollution	1. Air (Prevention and Control of Pollution) Act, 1981 2. Environment (Protection) Act, 1986 3. National Clean Air Programme 4. Solid Waste Management Rules, 2016 & Amendment, 2018 5. Construction & Demolition Waste Management Rules, 2016 6. Majhi Vasundhara	1. Department of Environment and Climate Change, GoM 2. MPCB	1. District Administration and the proposed District Level Climate Change & Environment Committee 2. Maharashtra Forest Department, GoM 3. Motor Vehicles Department, GoM 4. RTO 5. All ULBs 6. All Gram Panchayats
Landslide and flooding	1. Disaster Management Act, 2005 2. Landslide Risk Management Strategy, 2019 3. Pune River Development Project 4. Development Control & Promotion Regulations, 2018 5. Flood Management Action Plan, 2017 6. Landslide Hazard Zonation, National Landslide Susceptibility Mapping (NLSM) 7. Majhi Vasundhara	1. District Disaster Management Authority (DDMA) 2. All concerned ULBs 3. District Administration and the proposed District Level Climate Change & Environment Committee 4. Urban Development Department, GoM	1. State Disaster Management Authority, GoM 2. Department of Housing, GoM 3. Maharashtra State Road Development Corporation 4. Maharashtra Forest Department, GoM 5. Maharashtra Krishna Valley Development Corporation 6. Maharashtra Water Resources Regulatory Authority (MWRRA)

Initiatives by Pune Smart City Development Corporation

Good practices of PSCDCL so far

- **E-mobility** Out of the 150 smart e-buses planned for the Pune city (PMPML), 125 had been launched in 2019. In Pune, only 10% of the public transport fleet runs on diesel.

- **Efficient street lighting** A total of 90,000 LED streetlights were installed in Pune. More streetlights are being planned to cover the road stretch of 4.2 km in Aundh, 10.2 km in Baner and 16.5 km in Balewadi.

- **Community farming:** In a self-sustained project, 1500 sq. m of barren/ waste land of PMC was converted into community farms where vegetables are grown by the community. The revenue generated is shared among the community.

- **Greening:** a) Green medians created by planting 8,000 sq. m of shrubs along a road-stretch of about 12 km. b) The city has planted 5,000 trees of different native species. Main species planted include, Bakul, Champaca, Karanja, Mahogany, Kanchan, Gulmohar, Saptaparni, etc (see Table 12 for a list of tree species and their sequestration potential in Pune).

- **Biodiversity parks:** Seven theme biodiversity parks have been developed in Pune. Water conservation structures have been created in one of the theme parks with IEC display on the significance of efficient water management.

- **Waste management:** PSCDCL is running a zero-waste project in an effort to ensure no organic waste goes to the landfill by implementing composting units at the society level. Bulk organic waste generators, such as housing complexes generating >100 kg waste, are currently running their own composting units. Pune currently has 236 bulk generator housing complexes with 80+ flats, and 318 with 60+ flats, out of which 109 and 131, respectively, are practicing composting of organic waste at the premises.

- **Pune Integrated Command Control Centre (ICCC)** is formed with 800 smart elements. The system has a network of 136 public address centers across the city with emergency call box for citizens to reach out to ICCC for any emergency. This network is being used to monitor the Covid 19 situation in the city and has the potential to be used for a number of awareness campaigns.

Proposed projects of Smart City Pune

In addition to the above projects, Pune Smart City Development Corporation (PSCDCL) has proposed 34 projects for area-based development in Aundh-Baner-Balewadi region of Pune and 18 pan-city projects. These projects are aimed at upgradation of the transport infrastructure and modal share, water use efficiency and treatment, energy efficiency, and sustainable infrastructure development in Pune city.

Race to Zero – achieving carbon neutrality in Pune

In September 2021, Pune, along with 42 other major cities in Maharashtra, joined the Race to Zero, a commitment to achieve carbon neutrality by 2050. The following recommendations can enable the city as well as the district head in this direction.

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 Pune district, if equipped with solar rooftops, can generate 103 MUs electricity, thereby avoiding 89,019 tCO_2e annually.
        ii. If 50 percent of the households (having a potential of 7,025 MW) install solar rooftops, 7.52 Mt CO_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.
    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 15 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

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 15: Indicative CO_2 sequestered by different tree species of Pune[9]

Species	Girth class (cm)	Carbon sequestered by one tree (kg/tree)	Average carbon sequestered by one tree (carbon-kg/tree)	Total no. of trees in Pune	CO_2 sequestered by all trees of each species (tonnes) = Avg.*no. of trees*44/12*10³
Mangifera indica (Aam/Mango)	10 to 30 cm	11.3	334.64	53,164	65,292.24
	31- 60 cm	40.5			
	61 – 90 cm	83.3			
	91 – 200 cm	727.4			
	> 200 cm	810.7			
Leucaena leucocephala (Subabul)	10 to 30 cm	1.9	98.44	5,85,401	2,11,490.63
	31- 60 cm	72.3			
	61 – 90 cm	112			
	91 – 200 cm	140			
	> 200 cm	166			
Prosopis juliflora (Mesquite)	10 to 30 cm	6.13	300.3	82,980	91,452.341
	31- 60 cm	91.50			
	61 – 90 cm	192.51			
	91 – 200 cm	401.36			
	> 200 cm	810			
Acacia nilotica (Babul)	10 to 30 cm	3.2	250.3	78,025	71,673.84
	31- 60 cm	38			
	61 – 90 cm	294.1			
	91 – 200 cm	374.2			
	> 200 cm	542			
Cocos nucifera (Coconut)	10 to 30 cm	45	81.04	50,458	15,007.05
	31- 60 cm	51.1			
	61 – 90 cm	69.7			
	91 – 200 cm	99.4			
	> 200 cm	140			
Polyalthia longifolia (Ashopalav)	10 to 30 cm	7.4	465.18	63,662	1,08,684.44
	31- 60 cm	100.2			
	61 – 90 cm	130.9			
	91 – 200 cm	497.4			
	> 200 cm	1590			
Azadirachta indica (Neem)	10 to 30 cm	11.7	105.47	72,187	2,79,41,775.8
	31-60 cm	56.2			
	61 – 90 cm	248.5			
Total CO_2 sequestered by all the trees of the mentioned species					**28,505.37 million tonnes**

9   Indicative CO_2 sequestered by different tree species of Pune: An exercise has been done to estimate CO_2 sequestered by the commonly found species in Pune city. Species-wise data on total number of trees was given by PMC. Whereas, the carbon sequestration potential has been taken from the 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. Carbon dioxide sequestration is calculated by taking an average of girth-wise carbon sequestered and multiplying it with the total number of trees counted during the Pune Tree Census Project (2019). The carbon sequestered is then converted into CO_2 by multiplying it with the ratio of molecular weight of CO_2 to carbon. This is a basic methodology and this can be further refined if girth-wise number of trees for each species is available. This is just an indicative calculation for the most common tree species found in Pune (for which carbon sequestration potential was available). This exercise can be scaled up with the availability of the required data/information.

6.4 Actions district authorities can recommend to state departments

Recommendations that can be pursued by the district collector/state-level committee	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe 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 AT&C losses of MSEDCL for FY 2018-19 are 16.9%. This is way higher than the international standard range of 6% to 8%. However, for Pune zone, AT&C losses of MSEDCL stood at just 5.31% for April 2018. MSEDCL needs to upgrade its infrastructure, introduce solutions, such as smart metering and 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, on average a 5% reduction in AT&C losses, remote disconnection provision for defaulters and has completely eliminated manual meter reading requirements, leading to reduced expenditure (as per EESL). Similar pilot projects can be introduced in Pune by MSEDCL.
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% to 25% of energy savings, in different climates, when compared with the conventional buildings (BEE, 2017).
HABITAT: 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 contributes, not only in facilitating more people for living, but also towards the environment. It averts the loss of green cover and makes the transport mechanism much more efficient. High-rise building construction has been allowed in Pune since November, 2007.
TRANSPORT: Energy efficiency of infrastructure in railways can be enhanced through the following measures: a) Installing solar panels along electrified tracks and on railway station rooftops. b) Installing 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 the district can also be developed along similar lines.

Recommendations that can be pursued by the district collector/state-level committee	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
TRANSPORT: Use fiscal instruments to discourage the use of personal vehicles, such as: a) Increase charges on registration of internal combustion engine (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 the imposition of additional taxes on old vehicles that are unfit for roads, calling them 'green taxes.'
TRANSPORT: Identify and shift key commercial / business centres from all the ULBs to areas outside city limits to reduce traffic load.		Long-term	Needs proper policy, based on research and inter-departmental cooperation	
INDUSTRY: a) Ensure regular PAT compliance of DISCOMs and other designated consumers in the district. b) Increase the number of designated consumers 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	Till PAT Cycle VI (2020-21) only four designated consumers had volunteered under the scheme in Pune district.[10] Over the years, these designated consumers from Pune district have helped avoid around 53,536 tCO_2e of emissions by improving their systemic energy efficiency, under the PAT scheme.
INDUSTRY/ENERGY: Ensure compliance of 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 17.5% in the state, as set by MERC.
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 (Zero Hunger): 2.1, 2.3, 2.4	In Pune, the production of Bajra increased from 63,100 tonnes (2015-16) to 1.91 lakh tonnes (2019-20).
AGRICULTURE: To compensate for predicted decrease in crop productivity, initiate research on high yield, drought and temperature resilient genotypes for 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 (Zero Hunger): 2.1, 2.3, 2.4, 2.a	Area under oilseed cultivation in Pune increased from 1.29 lakh ha (2015-16) to 1.82 lakh ha (2019-20), leading to increased production from 1.19 lakh tonnes (2015-16) to 1.33 lakh tonnes (2019-20). However, the yield reduced by 20.8%. In order to meet the food demand of future, climate-smart agriculture is the key to reducing crop failures.

10 Names of Designated Consumers- Century ENKA Ltd, Bombay Dyeing and Manufacturing Co., BILT Graphic Paper, Padamjee Paper Products Ltd.

Recommendations that can be pursued by the district collector/state-level committee	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
AGRICULTURE: For overall reduction in electricity consumption and water savings in agriculture, subsidies must be reduced by some percentage in a phased manner		Medium to long-term	Policy intervention needed Need to create both awareness and collaboration among the farming communities	The agricultural tariff in Maharashtra is only around 50% of the average cost of supply (ACoS). In addition, GoM is providing a substantial subsidy against even this lower tariff under Section 65 of the Electricity Act, 2003. [11] The approved tariff has decreased by 6% and 1% for high tension-agriculture and low tension-agriculture metered, respectively for FY 2020-21.
FORESTRY/GREEN SPACES: Promote regeneration of degraded and open forest areas through CSR/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 belts on the boundaries of industries help 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: Adopt 'green marketing' approach by promoting green products through displaying product lifespan on the label on e-products to influence purchase decisions, thereby using the labels as a behavioural intervention.		Medium to long-term	Needs policy intervention, collaboration and awareness generation	

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11 https://www.mahadiscom.in/consumer/wp-content/uploads/2020/03/Order-322-of-2019.pdf

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

Sub-sectors	Policies and programmes which can push forward the recommendation	Primary departments/ agencies	Supporting departments/ agencies
Power sector	1. Maharashtra State Energy Conservation Policy, 2017 2. National Smart Grid Mission 3. Smart Metering National Programme 4. Integrated Power Development Scheme (IPDS) 5. Restructured Accelerated Power Development and Reforms Programme (R-APDRP) 6. UDAY Scheme, 2015 7. National Mission on Energy Efficiency, specifically PAT (Perform, Achieve and Trade) Scheme 8. Maharashtra State Renewable Energy Policy, 2020 9. Policy for Decentralized Renewable projects, 2016 10. Standards and Labelling Programme	1. Industries, Energy and Labour Department, GoM 2. MSEDCL, GoM 3. MEDA, GoM 4. BEE (EESL)	1. Department of Environment and Climate Change, GoM 2. West Central Railways – Pune Division 3. Proposed District Level Climate Change and Environment Committee
Habitat	1. ECBC	1. Urban Development Department, GoM 2. MEDA, GoM 3. All ULBs 4. Pune Smart City Development Corporation Limited (PSDCL)	1. Proposed District Level Climate Change and Environment Committee 2. MSEDCL
Transport	1. ECBC 2. JNNURM 3. Smart Cities Mission 4. AMRUT	1. Department of Motor Vehicles, GoM 2. All RTOs 3. All ULBs	1. MSRTC 2. MEDA 3. MSEDCL 4. Pune Smart City Development Corporation Limited 5. West Central Railways - Pune Division (implementation support for relevant recommendations)
Industry	1. PAT Scheme 2. Industrial Promotion Policy, 2014 3. BEE-SME Program	1. Department of Industry, Energy and Labour, GoM	1. District Industries Centre 2. Proposed District Level Climate Change and Environment Committee
AFOLU	1. National Mission on Food Security 2. Rashtriya Krishi Vikas Yojana: RAFTAAR 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, GoM 2. Forest Department, GoM	1. APMCs 2. MIDC 3. Energy Department, GoM 4. Maharashtra Agro Industries Development Corporation 5. Department of Geology and Mining, GoM 6. Maharashtra State Agriculture Marketing Board 7. Proposed District level Committee on Climate Change and Environment
Waste	1. E-Waste Management Rules, 2016	Directorate of Information Technology, GoM	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
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 (agriculture)
	Target 2.3: Double Agricultural Productivity.	AFOLU (agriculture)
	Target 2.4: Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.	AFOLU (agriculture); landslide and flooding
	Target 2.a: Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research.	AFOLU (agriculture)
	Target 2.a; Article 10.3.e: Development of sustainable irrigation programmes for both crops and livestock.	AFOLU (agriculture 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.	Co-benefits from waste
	Target 3.4: Reduce by one third premature mortality from non-communicable diseases through prevention.	Co-benefits from waste
	Target 3.9: Substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.	Waste; air pollution
SDG 6: Clean Water & Sanitation	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)
	Targe 6.4: Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals.	Energy (habitat: demand-side management; industry); AFOLU (agriculture and green spaces)
	Target 6.5: Implement integrated water resources management at all levels.	AFOLU (agriculture and green spaces/ forestry)
	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

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 (agriculture)
	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 (agriculture and 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
	Target 8.9: Devise and implement policies to promote sustainable tourism	AFOLU (forestry/ green spaces)
SDG 9: Industry, Innovation and Infrastructure	Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure.	Energy (habitat: energy-efficiency in buildings); 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 (agriculture); waste, energy (industry)
	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)

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
	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 buildings)
	Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage.	AFOLU (forestry)
	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; industry); AFOLU
	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
	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
	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; energy (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
	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	Target 14.1: 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
	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, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.	AFOLU (forestry/green spaces); landslide and flooding
	Target 15.9: Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies.	AFOLU
	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
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 (transport); 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.
In areas with warm climate, installing window shades, shutters, screens, etc. on the windows can provide an extra layer of insulation, hence less cooling loss.

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.

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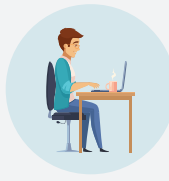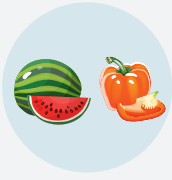
If possible, opt for work from home option for a few days in a week.

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.
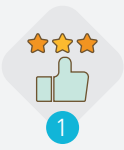
Include more meat-free meals and limit food wastage.

Buy local and organic food items not only for health but also to cut down emissions from transport and chemical fertilisers.
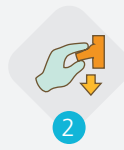
Opt for water saving fittings and fix any leakages in the house.

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 25ºC to 26ºC, for optimum cooling

Transport
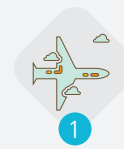
1. Choose direct flights to reduce carbon footprint

2. Travel light to reduce carbon emissions
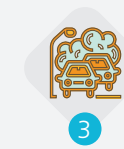
3. Strictly abide by pollution norms
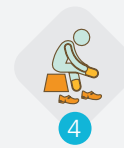
4. Put on your shoes for short trips
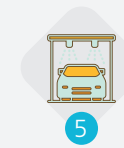
5. Ensure regular maintenance of vehicles

6. Choose inter-modal transport (private + public)
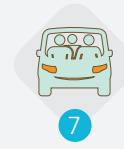
7. Reduce demand for vehicle travel by expanding personal mobility choices such as car-sharing and bike-sharing
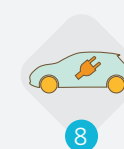
8. Shift to clean, non-petroleum fuels such as electricity (through RE) to power vehicles

9. Car pool to work, Use bicycles park and ride
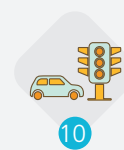
10. Swicth off the ignition at traffic signals

6.7 Behavioural change communication (BCC) techniques

Behavioural change communication

A cadre of grass-root communicators '*Urja Doot*' or 'Energy Ambassadors' can be created and trained to act as key change makers to further propagate messages of a particular campaign.

Urja Samiti or *Paryavaran Samiti* can be formed in every urban ward/village to channelize communication (from government department to beneficiaries and back). If a new *samiti* is not feasible, then the capacity of one of the existing *samitis* or SHGs can be developed.

Develop issue specific Information, Education and Communication (IEC) activities and material in Hindi, English as well as local language
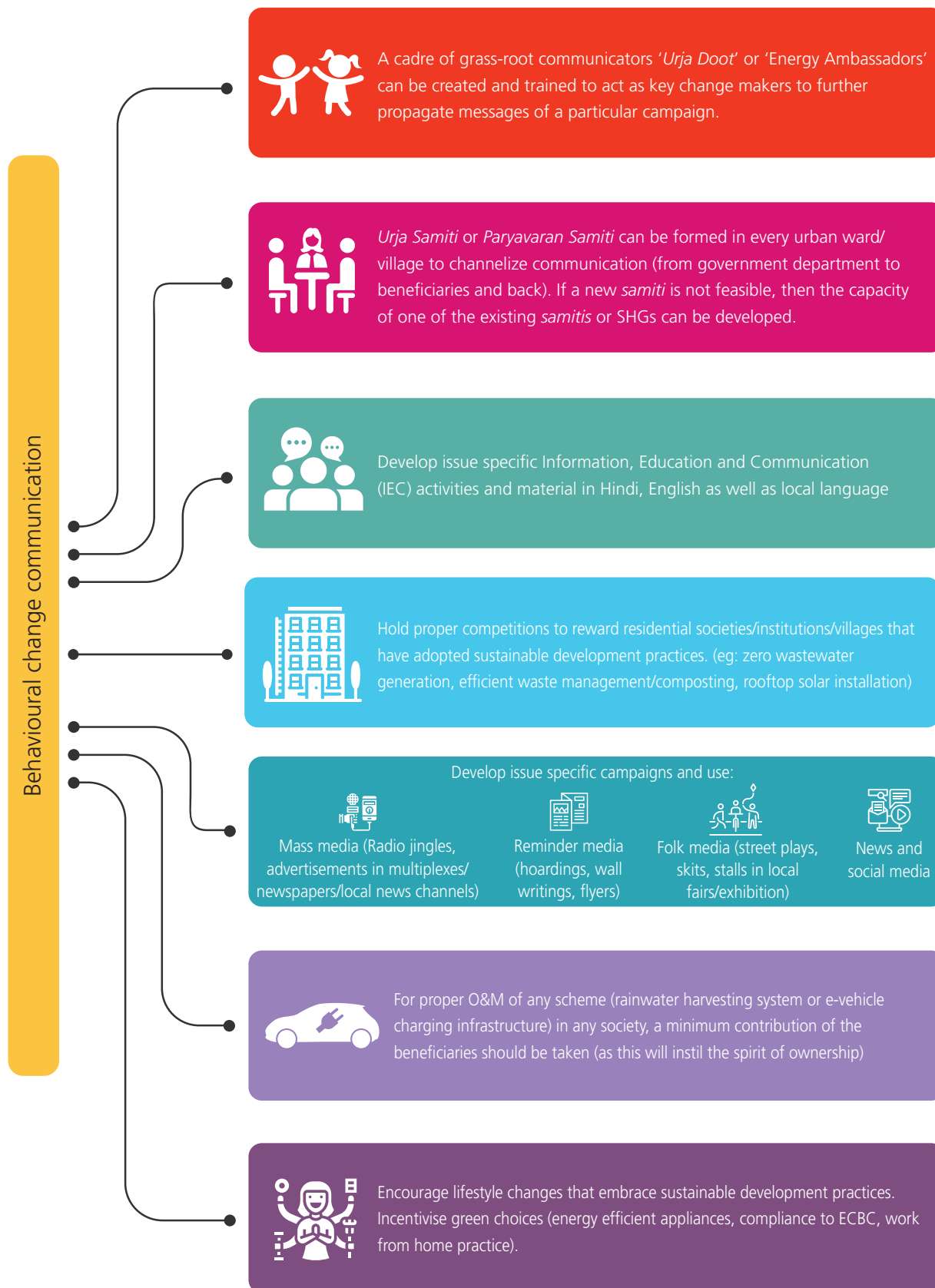
Hold proper competitions to reward residential societies/institutions/villages that have adopted sustainable development practices. (eg: zero wastewater generation, efficient waste management/composting, rooftop solar installation)

Develop issue specific campaigns and use:

Mass media (Radio jingles, advertisements in multiplexes/newspapers/local news channels)

Reminder media (hoardings, wall writings, flyers)

Folk media (street plays, skits, stalls in local fairs/exhibition)

News and social media

For proper O&M of any scheme (rainwater harvesting system or e-vehicle charging infrastructure) in any society, a minimum contribution of the beneficiaries should be taken (as this will instil the spirit of ownership)

Encourage lifestyle changes that embrace sustainable development practices. Incentivise green choices (energy efficient appliances, compliance to ECBC, work from home practice).

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'.