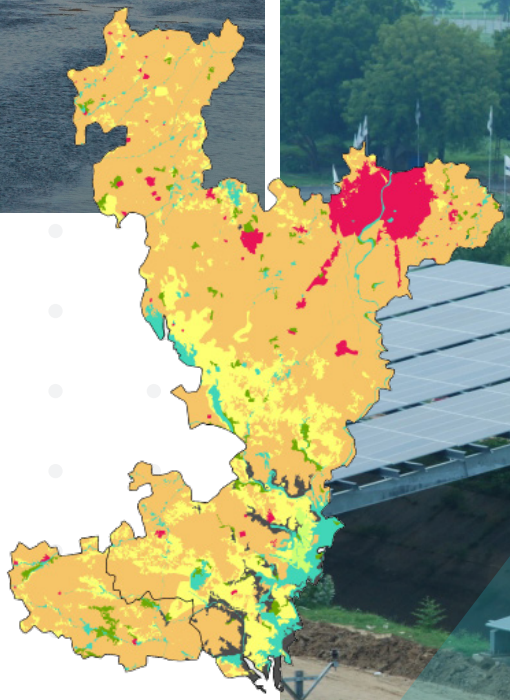
January, 2022

Climate Change and Environment Action Plan of

Ahmedabad District



Prepared By

VASUDHA FOUNDATION
Green ways for a good earth!

In Association with

Climate Change Department
Government of Gujarat

GEER FOUNDATION
Gujarat Ecological Education and Research Foundation

Supported By

SHAKTI SUSTAINABLE ENERGY FOUNDATION

The Climate Change and Environment Action Plans (CCEAP) have been developed for multiple districts of India by Vasudha Foundation with support from Shakti Sustainable Energy Foundation. For Ahmedabad, the plan was developed in collaboration with the Climate Change Department, Government of Gujarat and Gujarat Ecological Education and Research (GEER) Foundation, Forests and Environment Department, Government of Gujarat.

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

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January, 2022
Ahmedabad, Gujarat

Cover page images

Top left image:
Torrent power plant, Sabarmati, Ahmedabad (sourced from shutterstock)

Bottom right:
Solar panels over Narmada canal, Vadodara (photograph credit: Climate Change Department, GoG)

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

Built-up land	Crop-land	Fallow-land	Forest
Shrub-land	Grass-land	Waste-land	Water-bodies

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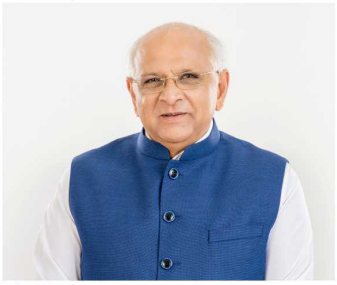

Bhupendra Patel

Chief Minister, Gujarat State

Apro/Jm/2022/01/17/rs

Dt: 17-01-2022

MESSAGE

"The world agrees that lifestyle plays a very important role in Climate Change. I would like to suggest a one-word movement in context of climate which can become a key basis for one world. This word is LIFE – Lifestyle for Environment."

- Narendra Modi

Gujarat is having the only natural habitat and an empire of Asiatic Lions. It has various kinds of ecosystem, ranging from marine biodiversity, inland wetlands, saline deserts to tropical deciduous forest. Being conscious to its varied biodiversity, the State has always been actively engaged in natural resource management, biodiversity conservation and addressing to global environmental threats like Climate Change. Under the visionary leadership of the then Chief Minister of Gujarat and incumbent **Honourable Prime Minister Shree Narendrabhai Modi** has undertaken several innovative initiatives for Climate Change Mitigation Measures.

I am much pleased to learn that with direct consultation of all stakeholders, an all encompassing **'Climate Change and Environment Action Plan (CCEAP)'** of Ahmedabad district has been developed by Vasudha Foundation with support from Shakti Sustainable Energy Foundation and in collaboration with the Climate Change Department and GEER Foundation, Government of Gujarat. I hope the district specific recommendations provided in this well curetted Action Plan are adopted and implemented in Ahmedabad, as this would help Gujarat and in turn India to reach the net-zero target of 2070.

(Bhupendra Patel)

Kiritsinh Rana

सत्यमेव जयते

No. M/F.&E.C.C.P.S./ 344 /2021

Minister,
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Date : - 4 JAN 2022

Message

The state of Gujarat is a front-runner and significantly contributes to the national GDP through various sectors. In addition to this, Gujarat is working to combat climate change and take timely climate mitigation actions. The state currently ranks 1st in solar rooftop installed capacity and contributes to 25% of the total national solar rooftop installed capacity. Moreover, Gujarat also stands 3rd for total installed renewable power in India.

While state level policies and initiatives are being put in place, a first of its kind,Climate Change and Environment Action Plan for Ahmedabad districtprepared by Vasudha Foundation will aid the district to effectively contribute in state's climate planning. I would like to congratulate Vasudha Foundation and all its partners for formulating a comprehensive district Action Plan that provides doable short, medium and long-term recommendations for various sectors.

I would encourage the district administration and relevant in-line departments to adopt this Action Plan and take initiatives that are climate cognizant.

(Kiritsinh Rana)

Jagdish Vishwakarma (Panchal)

सत्यमेव जयते

No.Co-Op.C.I.S.I.P.(Ind.)I.F.E.C.C.P.S.(Sta.Mi.)/ 249 /~~2021~~

Minister of State,
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Date : 27.1.2022

MESSAGE

Climate change has emerged as a global threat, prompting nations to come together to tackle the challenge. Under the visionary leadership of the Hon'ble Prime Minister, Shri Narendra Modi, India announced its intention to achieve net zero emissions by 2070 at the 26th Conference of Parties (COP26) meet at Glasgow, in November, 2021. India has also vowed to reduce the total projected carbon emissions by one billion tonnes, from now onwards until 2030. To achieve these goals, it is imperative that appropriate actions are undertaken at the state level.

The state of Gujarat is a high performing state in terms of environment management besides leading in development and industrial output. The state ranked first in the Composite Water Management Index 2019 (NITI Aayog) for the third year in a row. Its most populated city, Ahmedabad, was awarded India's 'Cleanest Mega City' in Swachh Survekshan, 2020. The 'SDG India Index and Dashboard 2020-21' by NITI Aayog, applauds Gujarat's performance in attaining the Sustainable Development Goals.

Gujarat was the first state in India and Asia, and globally the fourth to form an independent Department of Climate Change back in 2009. I take pride to say that Government of Gujarat believes in development that is sustainable in nature. I am thus delighted to see that a **Climate Change and Environment Action Plan has been developed for Ahmedabad district.** Developing a plan for the district that factors climate action is a crucial step in the bottom-up approach to meet the state and national climate targets. I am certain that this initiative would set the foundation for tangible actions towards climate conscious development.

I appreciate detailed study undertaken in consultation with various stakeholders to develop the **Climate Change and Environment Action Plan of Ahmedabad district.** I hope to see the implementation of this Action Plan soon.

Jagdish Vishwakarma (Panchal)

सत्यमेव जयते

Shri S. J. Haider, IAS
Principal Secretary
Climate Change Department
Government of Gujarat

Message

Climate Change Department, Government of Gujarat has been actively engaged for over a decade to effectively address climate change. The concerted actions initiated so far have helped bring forth several innovative initiatives for climate mitigation measures, like the installation of solar panels on Narmada branch canals that help generate clean power, while reducing water loss from evaporation. Gujarat is one of the front-runners in renewable energy growth. It ranks first by contributing 25% of the total national solar rooftop installed capacity. Moreover, the Department undertakes different studies from time to time as well as initiatives to enhance State's measures to combat climate change.

In one such endeavour, the 'Climate Change and Environment Action Plans' (CCEAPs) of Ahmedabad & Rajkot Districts have been developed by Vasudha Foundation in collaboration with the Climate Change Department and GEER Foundation. I appreciate the collective efforts put in, for accomplishing this task.

These district Action Plans recognize that there are no universal solutions for climate change. Therefore, regionally appropriate and district-specific Action Plans have been prepared for both the districts. They take into account the district-level baseline studies on: climate variability and projections, emissions profile and budgetary analysis to estimate climate expenditure, and other crucial aspects. They also bring forth a comprehensive set of recommendations for various climate-relevant sectors and environmental issues of the districts, along with case examples and estimated mitigation potential. These Action Plans, I hope, will be of use and relevance in the exercise of district-level planning to integrate climate action with development activities.

(S. J. Haider)

सत्यमेव जयते

GEER FOUNDATION
Gujarat Ecological Education and Research Foundation

U. D. Singh, ***IFS***
Director

Message

One of the most challenging threats today is climate change, which has caused regional level disturbances in rainfall, temperature, and extreme events. Countries across the world are realizing the danger posed by this threat and coming together to tackle it. In the most recent Conference of Parties held in Glasgow, India has made many ambitious commitments such as reducing the emissions intensity of its GDP by 45% by 2030 and meeting 50% of its energy requirements from renewable sources in the same timeframe. The most important of announcement was of India to achieve net zero target by 2070.

To meet these targets, particularly net zero by 2070, there is a need to understand the role that forestry sector can play not just as a sink of carbon emissions but also for its myriad ecosystem services for human well-being. The past few Forest Survey Reports have indicated that the recorded forest area in the state of Gujarat, currently standing at 11.03% of the geographical area, has been maintained. Further increase in forest cover, through strategic actions at local level, can reap multiple benefits for the state while combatting climate change in the long term.

In this context, I am pleased to see the efforts made by Vasudha Foundation, in association with the Climate Change Department and GEER Foundation towards developing the 'Climate Change and Environment Action Plan' (CCEAP) for the district of Ahmedabad. The CCEAP is a detailed study of the district and its priorities in alignment with state and national climate goals. The key takeaway from this action plan is a set of comprehensive recommendations, which can enable the district to mainstream climate action and contribute to India's climate goals. I hope the recommendations in the Action Plan are adopted and implemented by the respective departments.

U.D. Singh

(U.D. Singh)

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Collector & District Magistrate,
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सत्यमेव जयते

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MESSAGE

The pervasive effects of Climate Change have been unfolding across the world, more so, in the recent decades. As each year passes, voices from countries around the world, especially the vulnerable ones and those at the brink, have only been growing louder and stronger, advocating robust actions to avoid climate catastrophes. With over one-sixth of world's population, and an extensive coastline of 7516 km, India's role in mainstreaming climate action remains vital. The ambitious targets announced in the recently concluded climate summit at Glasgow, COP26, which include achieving net zero emissions by 2070, stand as a testimony to the country's commitment.

In a federal country like India, the role of each State in contributing towards national goals is instrumental. Gujarat is one of the leading states in the country in terms of climate action, as seen through several initiatives such as the launch of the latest State Action Plan on Climate Change. The state government has also taken a strong stance to reduce emissions from major sources by restricting commissioning of new thermal power plants altogether.The state also has an all-inclusive EV policy (Gujarat Electric Vehicle Policy 2021) which focuses not only on a major shift in the automobile segment from fossil-fuel based to electric, but also on supporting infrastructure.

Ahmedabad is one among the nine cities awarded four-star rating under Climate Smart Cities Assessment Framework, 2021 by the Ministry of Housing and Urban Affairs. The city was also awarded India's 'Cleanest Mega City' in Swachh Survekshan, 2020. The growing developmental needs in the city, and its peripheries within the district calls for comprehensive sectoral level analyses and interventions to curb greenhouse gas emissions. It is thus viewed that, as a first step in this direction, the Climate Change and Environment Action Plan (CCEAP) developed for Ahmedabad district serves its purpose well.

The Action Plan has been developed in consultation with District Administration of Ahmedabad, officials from relevant departments, academia, civil society organizations and other key stakeholders through multiple rounds of consultation. I believe a bottom-up approach such as this, when implemented, would eventually contributetowards achieving the larger goals set by the state and the country.

I appreciate the efforts made towards developing the CCEAP for Ahmedabad district. The recommendations given in this Action Plan can be implemented by the relevant departments for mainstreaming climate action in alignment with the district's development priorities.

(Sandip J. Sagale)

ACKNOWLEDGEMENTS

We would like to thank S.J. Haider, IAS (Principal Secretary), Shwetal Shah (Technical Advisor) and other officials from the Climate Change Department, GoG, and U.D. Singh, IFS (Director), R.D. Kamboj, IFS (Retd.) (former Director), Dr. Sweta Rajpurohit (Manager), and Vibha Goswami (Deputy Director) from GEER Foundation, Forest Department, GoG, as their inputs and support have been vital in development of the Climate Change and Environment Action Plan for Ahmedabad district.

We are obliged to Sandip J. Sagale, IAS (District Collector, Ahmedabad) for support and motivation to accomplish the completion of the action plan for Ahmedabad district.

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

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

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

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

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

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

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ACRONYMS

AFOLU	Agriculture, forestry and other land use
AMC	Amdavad Municipal Corporation
AMRUT	Atal Mission for Rejuvenation and Urban Transformations
APMC	Agricultural Produce Market Committee
ARR	Aggregate revenue requirement
ASP	Activated sludge process
AT&C	Aggregate technical and commercial losses
AUDA	Ahmedabad Urban Development Authority
BAU	Business as usual
BCC	Behaviour change communication
BEE	Bureau of Energy Efficiency
BMW	Bio-medical waste
BOD	Biological oxygen demand
BRT	Bus rapid transit
C&D	Construction and demolition
CAGR	Cumulative annual growth rate
CapEx	Capital expenditure
CAAQMS	Continuous ambient air quality monitoring system
CBWTF	Common bio-medical waste treatment facility
CETP	Common effluent treatment plant
CFA	Central Finance Assistance
CGWB	Central Ground Water Board
CHP	Combined heat and power
CPCB	Central Pollution Control Board
CPEIR	Climate Public Expenditure and Institutional Review
CPP	Captive power plant
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DG	Diesel generator
DISCOM	Distribution company
DRE	Distributed renewable energy
EC	Electricity consumption
ECBC	Energy Conservation Building Code
EEPS	Energy efficient pumping system
EESL	Energy Efficiency Services Limited
EF	Emission factor
EV	Electric vehicle
FAME	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles
FMCG	Fast moving consumer goods
FSI	Forest Survey of India
FY	Financial year
GAIC	Gujarat Agro Industries Corporation Limited
GDP	Gross domestic product
GHG	Greenhouse gas
GHGPI	GHG Platform India
GIDB	Gujarat Infrastructure Development Board
GIDC	Gujarat Industrial Development Corporation
GIM	Green India Mission
GoG	Government of Gujarat
GoI	Government of India
GPCB	Gujarat Pollution Control Board
GUDC	Gujarat Urban Development Company Ltd
GUVNL	Gujarat Urja Vikas Nigam Ltd
GW	Gigawatt
HW	Hazardous waste
ICAP	India cooling action plan
ICE	Internal combustion engine
IEC	Information, Education & Communication
IISS	Indian Institute of Soil Science
IMD	India Meteorological Department
IoT	Internet of things
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
IPT	Intermediate public transport
ISRO	Indian Space Research Organisation
ISWM	Integrated solid waste management
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KUSUM	Kisan Urja Suraksha evam Utthaan Mahabhiyan
KW	Kilowatt
kWh	Kilowatt hour
LED	Light emitting diode

LMV	Light motor vehicle
M&E	Monitoring and evaluation
MCF	Methane correction factor
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MLD	Million litres per day
MMM	Multi-model mean
MRF	Material recycling facility
MSME	Micro, small and medium enterprises
$MtCO_2e$	Million tonnes of carbon dioxide equivalent
MU	Million units
MW	Megawatt
NASA	National Aeronautics and Space Administration
NCAP	National Clean Air Programme
NDC	Nationally determined contributions
NEX-GDDP	NASA Earth Exchange Global Daily Downscaled Projections
NPK	Nitrogen, phosphorus and potassium
NRSC	National Remote Sensing Centre
NTPC	National Thermal Power Corporation
ORNL-DAAC	Oak Ridge National Laboratory Distributed Active Archive Centre
PAT	Perform, achieve and trade
PCCP	Personal care and cosmetic products
PEG	Public electricity generation
PGVCL	Paschim Gujarat Vij Company Ltd.
PLF	Plant load factor
PM	Particulate matter
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PRI	Panchayati Raj Institutions
PT	Public transport
PUC	Pollution under control
RCP	Representative Concentration Pathway
RE	Renewable energy
REC	Renewable Energy Certificate
RESCO	Renewable Energy Service Company
RO	Reverse osmosis
RPO	Renewable purchase obligation
RTS	Rooftop solar
RWA	Resident welfare association
RWHS	Rainwater harvesting system
SBR	Sequencing batch reactors
SDG	Sustainable Development Goal
SEZ	Special economic zone
SLNP	Streetlight National Programme
SMB	Solar municipal bonds
SMNP	Smart Meter National Programme
STP	Sewage treatment plant
SUP	Single-use plastic
SW	Solid waste
SWM	Solid waste management
T&D	Transmission and distribution
TOE	Tonnes of oil equivalent
ToU	Time of use
TPD	Tonnes per day
TPL	Torrent Power Limited
TPP	Thermal power plant
TSDF	Treatment, storage and disposal facility
UDAY	Ujwal DISCOM Assurance Yojana
UGVCL	Uttar Gujarat Vij Company Limited
UJALA	Unnat Jyoti by Affordable LEDs for All
ULB	Urban local body
W	Watt
WEEE	Waste electrical and electronic equipment
WSP	Waste stabilisation pond
WTE	Waste to energy
WW	Wastewater
ZEV	Zero emission vehicle

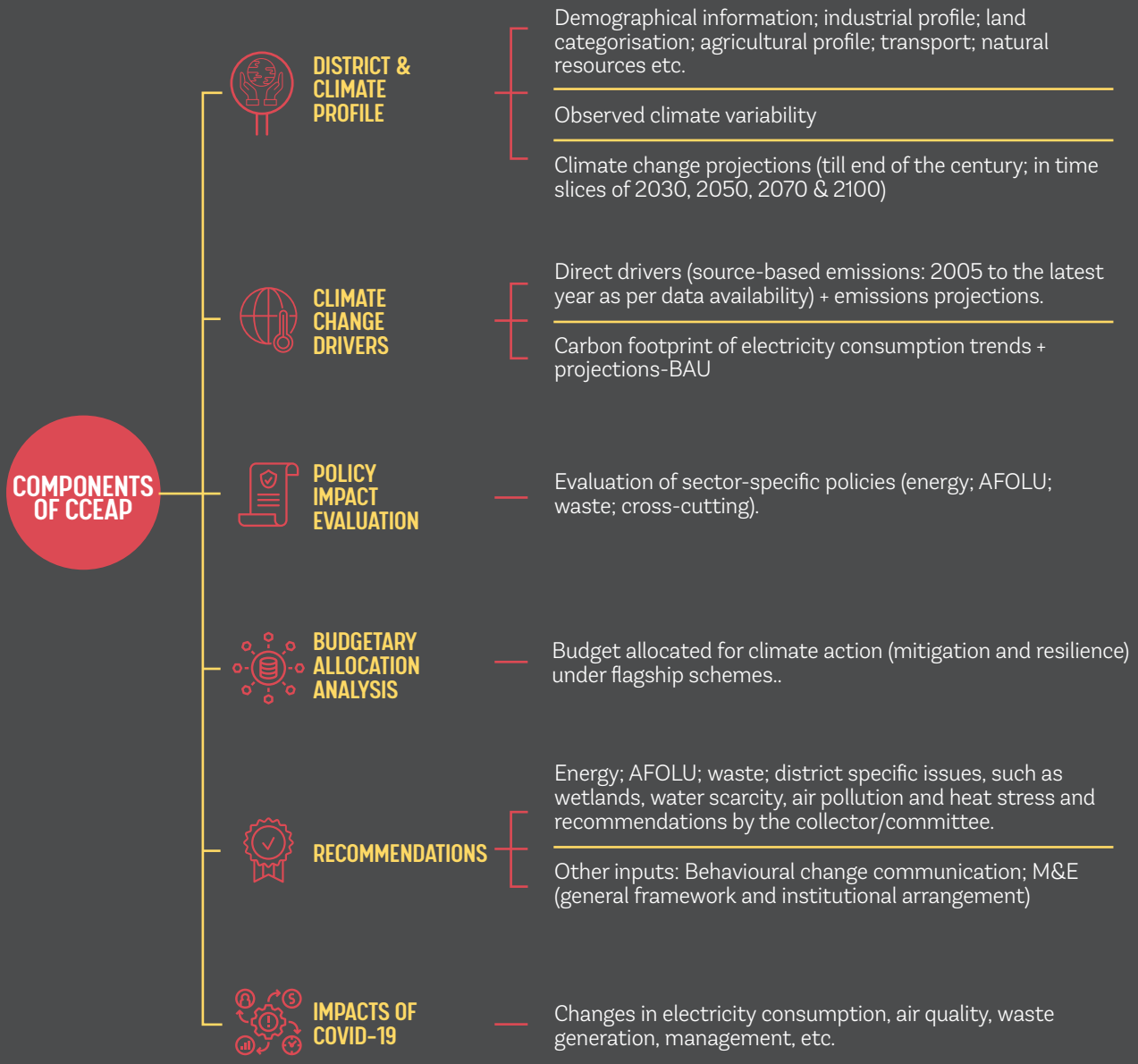
EXECUTIVE SUMMARY

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

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

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

The key components of this Action Plan are summarised in the chart below:



CLIMATE PROFILE AND PROJECTIONS

This section analyses historical data and projects changes in rainfall and temperature for Ahmedabad district using IMD and NASA's NEX-GDDP datasets, following the multi-modal mean (MMM) approach. Here are some findings for the district:

- **Rainfall expected to increase:** The seasonal rainfall is projected to increase by 8 to 17 percent under RCP4.5 and 13 to 40 percent under RCP8.5 emission scenarios.[1] The number of rainy days is also projected to increase during monsoon, particularly in July and August.
- **Summers are getting hotter:** A significant trend of increase in the maximum temperatures during summer months is seen in the district, which is observed to be accelerated during the last decade. The mean percentage of warm days has shown an increasing trend of around 8 to 10 percent. The minimum temperature has shown an increasing tendency during the season. Cold days show a decreasing trend in the recent decade.
- **Warms days to increase:** Maximum temperatures are projected to increase by about 1.2°C to 2.4°C under RCP4.5 and 1.4°C to 3.5°C under RCP8.5 emission scenarios. In future, the percentage of warm days are also projected to increase by over 45 percent of the present climate. The minimum temperatures also show an increasing trend – the percent of cold days may decrease in all epochs under changing climate conditions.

SECTORAL GREENHOUSE GAS EMISSIONS PROFILE: CLIMATE CHANGE DRIVERS

- **Greenhouse gases have risen by 78 percent since 2005:** Between 2005 and 2019, the total greenhouse gas (GHG) emissions of Ahmedabad district increased by 78 percent (from 5.16 million tonnes CO_2e in 2005 to 9.18 million tonnes CO_2e in 2019) with a CAGR of 4.20 percent. These estimates cover GHG emissions from 13 categories under three major sectors – energy, AFOLU (agriculture, forestry and other land use) and waste.
- **Energy sector is the highest contributor of emissions:** The energy sector (direct fuel combustion in transport, electricity generation, CPP, agriculture, residential etc.) is the highest contributor with 77 percent of total emissions in Ahmedabad district. This is followed by AFOLU (13 percent) and waste (10 percent).
  - Energy sector emissions have increased by 71.32 percent (from 4.14 Mt of CO_2e in 2005 to 7.09 Mt of CO_2e in 2019) with a CAGR of 3.92 percent.
  - Public electricity generation and transport are the highest contributors towards energy emissions. This is followed by residential, captive power plants, agriculture and industries.
- **Enteric fermentation and rice cultivation are major contributors to AFOLU emissions:** Emissions from the AFOLU sector have increased at a CAGR of 4.02 percent (by 73.93 percent between 2005 and 2019). Major emission contributors are enteric fermentation and rice cultivation. Increase in forest cover in recent years has added to the sink potential of the Ahmedabad district.
- **Waste sector emissions are growing rapidly:** Although the waste sector has the smallest contribution in economy-wide emissions, it witnessed the highest growth between 2005 and 2019, growing at a CAGR of 7.06 percent. Total waste emissions have increased by 159.85 percent (2005-2019).
- **Business-as-usual scenario will be disastrous:** If no actions/policies are put in place to mitigate the emissions – i.e. the business-as-usual scenario -- the total emissions of Ahmedabad are likely to grow by 96 percent till 2030, with respect to 2015 levels.

ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE

A total of 40 major national/state level policies and programmes of energy, AFOLU and waste sector was evaluated for their climate mitigation potential.

- **Power and energy:** Twelve policies/programmes were evaluated. UDAY and PAT schemes were found to be the biggest contributors to GHG mitigation.
  - Policies related to clean energy generation mitigated 96,000 tCO_2e emissions.

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

- Policies pertaining to energy-efficient buildings and processes helped avoid 83,31,667 tCO_2e.
- Transportation interventions led to emission avoidance of 3,64,361 tCO_2e.

- **AFOLU and cross-cutting:** Twelve policies were assessed
  - Forestry policies alone led to a mitigation of 16,12,544 tCO_2e emissions.
  - Policies pertaining to livestock proved to be beneficial for climate action, avoiding 598.97 tCO_2e emissions.
  - In agricultural sub-sector, impact of only one policy could be computed – the National Food Security Mission added 11,515 tCO_2e emissions.
  - Policies pertaining to cross-cutting sector helped mitigate 6,79,686 tCO_2e emissions.
- **Waste:** Fifteen policies were assessed.
  - Policies pertaining to sanitation added 2,29,215 tCO_2e. emissions.
  - Composting as a part of solid waste management practices mitigated 3,977 tCO_2e emissions.
  - Domestic wastewater treatment interventions have led to 4,99,332 tCO_2e. emissions.

BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION

This action plan analyses the district expenditure to estimate spending on climate action. A total of 38 flagship schemes were reviewed to identify those with climate resilience and mitigation relevance. Of these, based on the availability of information across districts as well as relevance to climate actions, five schemes were selected for further analysis.

Table 1: Summary of flagship schemes – budgetary analysis for Ahmedabad district

Scheme	Climate -relevant activities	Year	Total allocation to district under the scheme (in ₹ lakh)	Allocation to climate action (₹ lakh)	% of total scheme budget for climate action at district level*
MGNREGS	Eleven out of 17 activities were identified as climate relevant – drought proofing, fisheries, flood control and protection, land development, micro-irrigation, renovation of traditional water bodies, rural connectivity, drinking water, sanitation, water conservation and water harvesting	2018-19	139009	194.61	14
		2019-20	1,097.77	153.69	
PMKSY	Micro-irrigation activities	2016-17	641	442.29	69
		2019-20	206	142.14	
GIM	Enhancing forest cover, ecosystem restoration, agro-forestry, social forestry, wetland restoration, promoting alternative fuels	2017-18	165.22	165.22	100
		2018-19	107.56	107.56	
		2019-20	39.97	39.97	
AMRUT	Water supply, sewage and septage management, urban transport, drainage, green spaces	2015-16	7,170	4,282.50	54
		2016-17	12,425	6,341.90	
		2017-20	27,128	15,175.60	
DDUGJY + Saubhagya	New sub-stations and upgradation of existing ones, LT lines, feeder segregation, consumer metering, DTR metering etc	Up to April 2020	2,035	1,017	50

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

RECOMMENDATIONS

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

The recommendations factor-in state/district vision documents/development plans. They also list the current policies, programmes and schemes and identify concerned departments that can help streamline the actions. This section also provides information on SDGs and other co-benefits that will be addressed through these recommendations. Overall, the mitigation actions suggested in the recommendations can help mitigate 5 Mt CO_2e per annum. The sectoral breakdown of the same is as following:

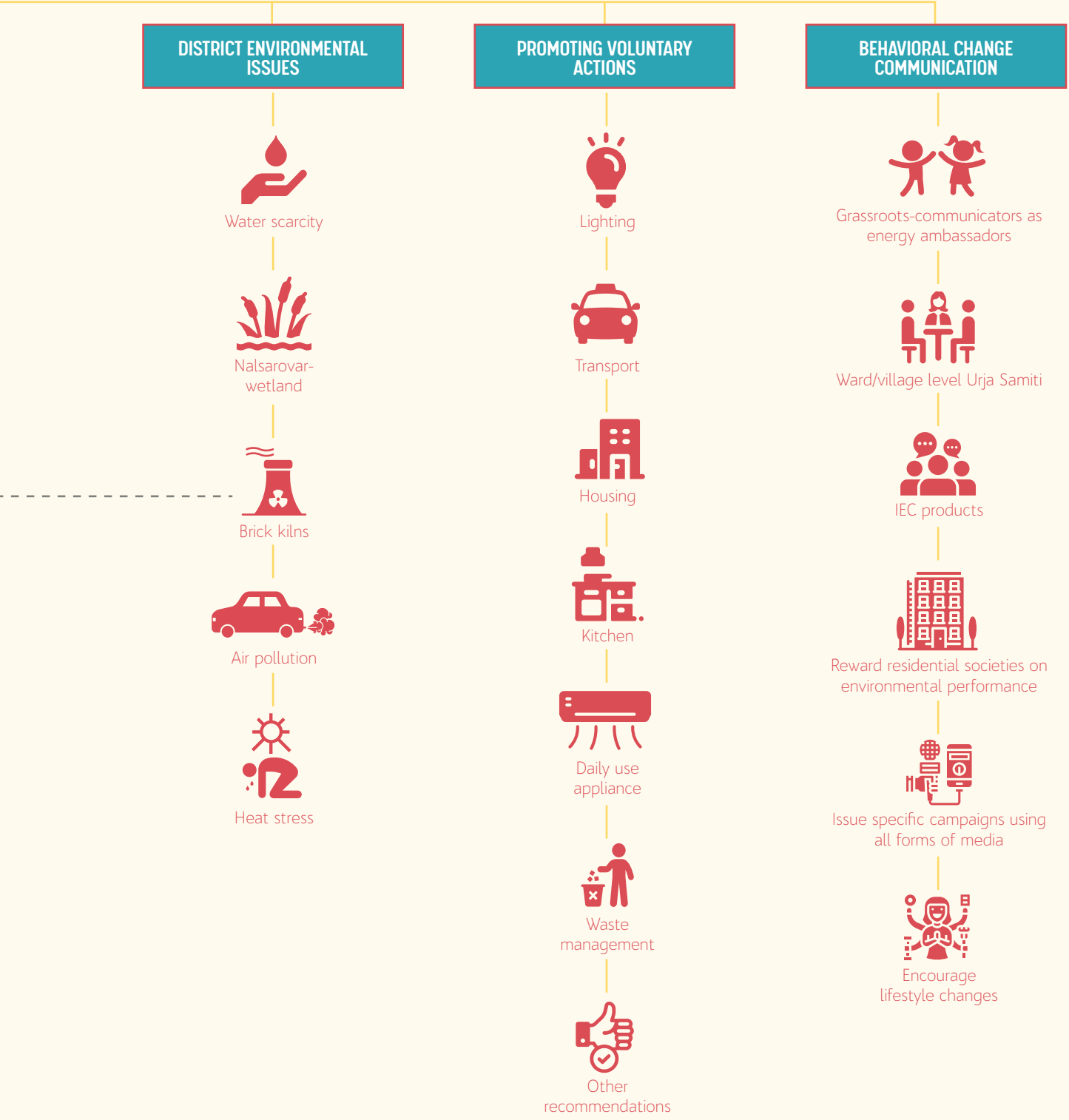
GHG mitigation potential of CCEAP recommendations (tCO_2e)

Energy **30,54,254**

AFOLU **13,66,129**

Waste **5,85,044**

Figure 1: Recommendations for CCEAP Ahmedabad


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

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

Power and Energy

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

Therefore, the action plan recommends (a) increasing the share of RE generation in the district by advancing on-grid and off-grid solar rooftop, ground-mounted installations and other RE installations; (b) encouraging faster penetration of energy-efficient and star-labelled fixtures and upgrading existing power-grid infrastructure to advanced metering infrastructure (in public, institutional and commercial setups); (c) promoting energy efficiency in the residential sector by encouraging the incorporation of ECBC in the building bye-laws, implementation of India Cooling Action Plan, 2018, etc.; and (d) promoting energy conservation in the industrial sector by introducing measures such as a "cap and trade" system for MSMEs at the district level, encouraging industries to follow the Gujarat Industrial Policy, 2020, etc.

Transport

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

AFOLU

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

Waste

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

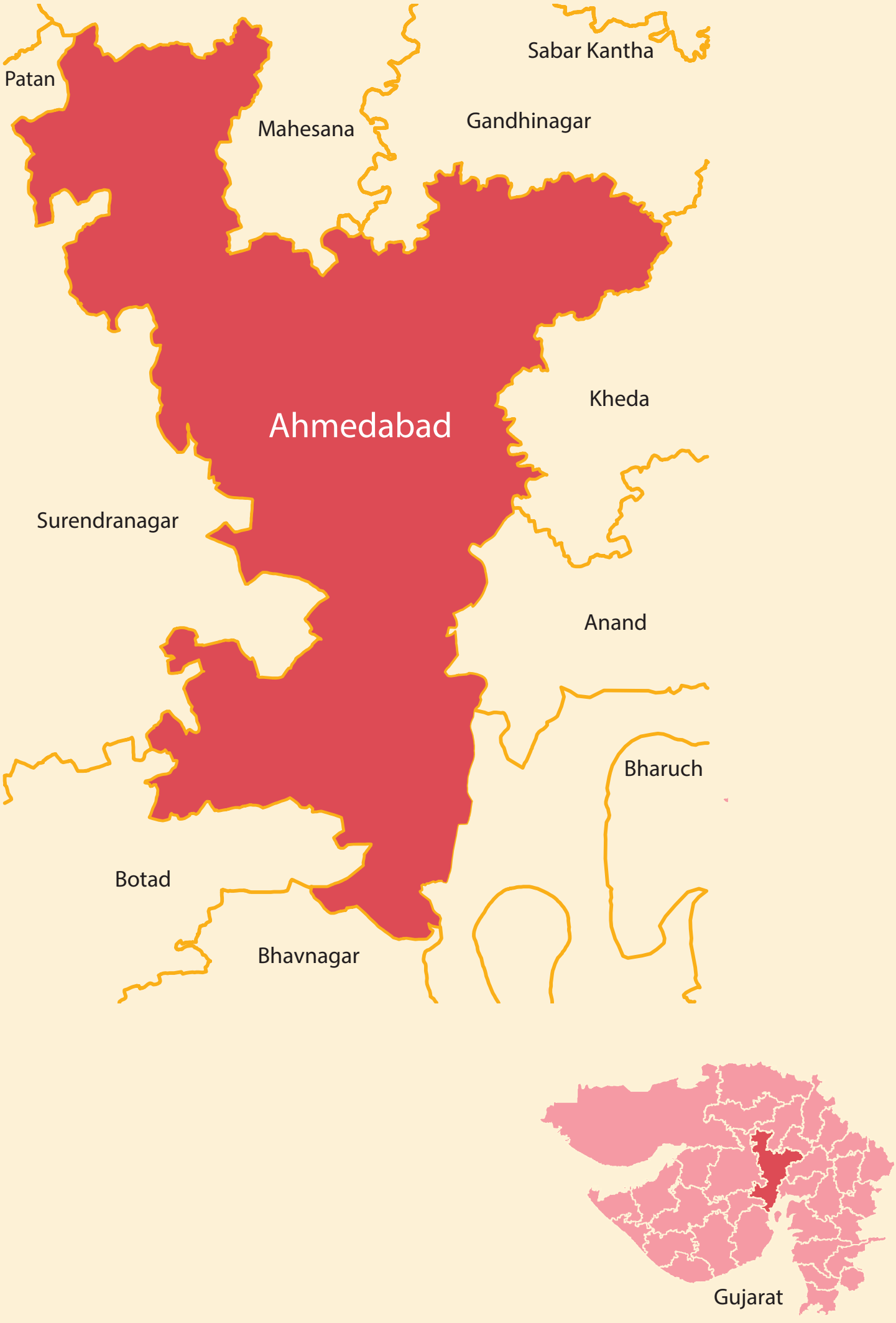
Given the unique environmental issues of the district, the action plan also recommends:

1. Adopting a holistic approach to water conservation and wastewater management, including conservation techniques such as rainwater harvesting, net zero water infrastructure, minimising losses in water supply, installing water-efficient fittings, water metering and adoption of inclusive and sustainable water governance.
2. Developing extensive infrastructure to monitor air pollution and suggestions on interventions for preventive measures.
3. The action plan also identifies degradation of Nalsarovar wetland, need for improving sustainability of brick kilns and management of heat stress in the district as key environmental issues and lists recommendations for the same.

COVID-19 IMPACT

This section presents an assessment of how the COVID-19 pandemic has impacted various sectors and the developmental measures. During the national lockdown in 2020, the district saw a 63 percent reduction in electricity generation (between January and August 2020) at the Sabarmati Thermal Power Plant. In agriculture, harvesting activities got interrupted due to the lockdown. The sector also witnessed supply chain problems. However, reverse migration benefitted *kharif* crops with 21.20 percent increase in sown area in the district.

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


Patan
Sabar Kantha
Mahesana
Gandhinagar
Ahmedabad
Kheda
Surendranagar
Anand
Bharuch
Botad
Bhavnagar
Gujarat

DISTRICT PROFILE

Aerial view of Ahmedabad

1. DISTRICT PROFILE

Ahmedabad is one of the most developed districts of Gujarat and the eighth most populous district in India. The district is a part of Gujarat plain – the level plain gradually rises towards the north and the east – and is sub-divided into five micro regions – Viramgam plain, Sabarmati basin, Khari Meshwo plain, Bhadar Bhogavo low land and Bhadar river plain – based on the topography, climate geology, soils and natural vegetation (Census of India, 2011).

1.1 Key statistics

Table 2: District profile of Ahmedabad

General characteristics of the district			
Location	Central Gujarat, western India		
Latitude	21'-58' to 23'-3' North	**Area**	8,087 sq. km
Longitude	71'-37' to 72'-50' East	**Elevation**	56 m (184 ft)
Agro-climatic Zone (CRIDA, 2011)			
North Gujarat zone (19.87%)			
Bhal and coastal area (14.26%)			
North-west Zone (36.38%)			
North Saurashtra (24.49%)			
Administrative units (District Administration Ahmedabad, 2020)			
Taluka (Block)	10	**ULB**	Municipal corporation: 1; municipality: 7 cantonment area: 1
Constituency	21	**Gram panchayat**	466 (villages: 486)
Demography (Census of India, 2011)			
Population (total)	72,14,225	**Population density**	890 person/km^2
Population (urban)	60,63,047	**Household**	15,10,134
Population (rural)	11,51,178	**% urbanization**	Population share: 84% Household share: 85%
Population growth	24% (decadal)	**Women-headed household**	1,49,271
Land-use classification 2017-18 (area sq. km) (Directorate of Agriculture, 2018)			
Fallow lands other than current fallows	23	**Culturable wasteland**	329
Land put to non-agricultural uses	974	**Current fallow**	84
Barren and unculturable land	392	**Net area sown**	4,874
Pasture and other grazing land	281	**Gross cropped area**	6,696
Land under misc.	0	**Area sown more than once**	1,821
Agricultural profile (Dept of Agriculture & Cooperation, 2015; Directorate of Agriculture, 2020; CRIDA, 2011)			
Major crop season	Kharif (rainfed/irrigated) and rabi (rainfed/irrigated)		
Major agriculture produces	Food grains: Rice, wheat, gram, bajra, math, isabgul, jowar, maize Oilseeds: Castor, groundnut, rapeseed, mustard, sesamum Important cash crop: Cotton, tobacco, onion, potato, etc.		
Major Soil types (GGRC & NABCONS, 2016)	Black soil (22.5%), medium black soil (43.7%), sandy loam soil (31.1%), sandy soil (2.7%)		
Industrial profile (MSME, 2014)			
Registered industrial unit	1,15,611 (till 2013-14) medium and large-scale industries: 422	**No. of industrial areas (GIDC)**	15 (8,109 industrial units)

Table 3: Ahmedabad vs Gujarat: a comparative profile (DoE&S, 2018)

Particular	Ahmedabad district	Gujarat	Percentage contribution
Total population (2011)	72,14,225	6,04,39,692	11.9%
Urban population (2011)	60,63,047	2,57,45,083	23.5%
Percentage of urban population	84%	42.6%	2 times higher than the state
Geographical area (sq. km)	8,087	196,244	4%
Forest cover (sq km) (FSI, India State of Forest Report 2019: Gujarat Vol 2, 2019)	131.21 (very dense: 0; moderately dense: 12.75; open forest: 118.46)	14,857 (very dense: 377.9; moderately dense: 5,092; open forest: 9,387.43)	0.88% (No dense forest in the district)
Per capita forest area (ha/ person)	0.0018	0.024	13 times less than that of the state
Total registered vehicles	46,16,919	2,32,86,418	19.83%
Total rice production (in '000 tonnes)	323	1,692	19.08%
Installed capacity of electricity generation (conventional, MW)	362	25,236	1.43%
Major types of industries (MSME, 2017)	Pharmaceuticals, chemicals and other healthcare, textiles, food processing & agro-based, milk products, metallurgical, plastic, mineral based industries, etc.	Pharmaceuticals, textiles, chemicals, gems and jewelleries, marine products, milk products, food processing, etc.	--
Total MSME units registered	1,13,156	4,89,617	23.11%

1.2. Power and energy sector

Ahmedabad is home to Sabarmati Thermal Power Plant, a coal-based plant by Torrent Power Limited, with a total installed capacity of 362 MW. Bulk of the electricity in the district is supplied by Gujarat's north zone DISCOM – Uttar Gujarat Vij Company Limited (UGVCL), which in turn procures electricity from Gujarat Urja Vikas Nigam Limited (GUVNL). The remaining portion of the electricity is supplied by Torrent Power Limited-Distribution company (TPL-D). The industrial sector is the predominant electricity consuming sector in the district, followed by residential, commercial and agricultural sectors (Figure 2). The overall electricity consumption increased by 8.59 percent CAGR between 2012 and 2018, with the consumption mix remaining unchanged for that period (GERC, 2021).

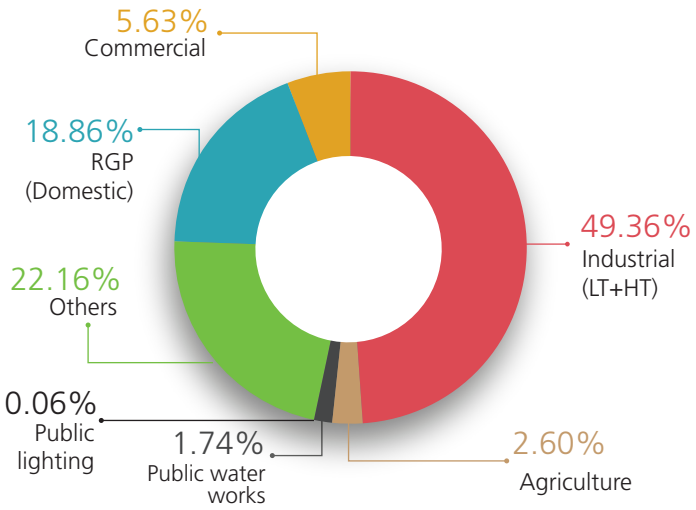


Figure 2: Consumer-wise electricity consumption in Ahmedabad (2019)

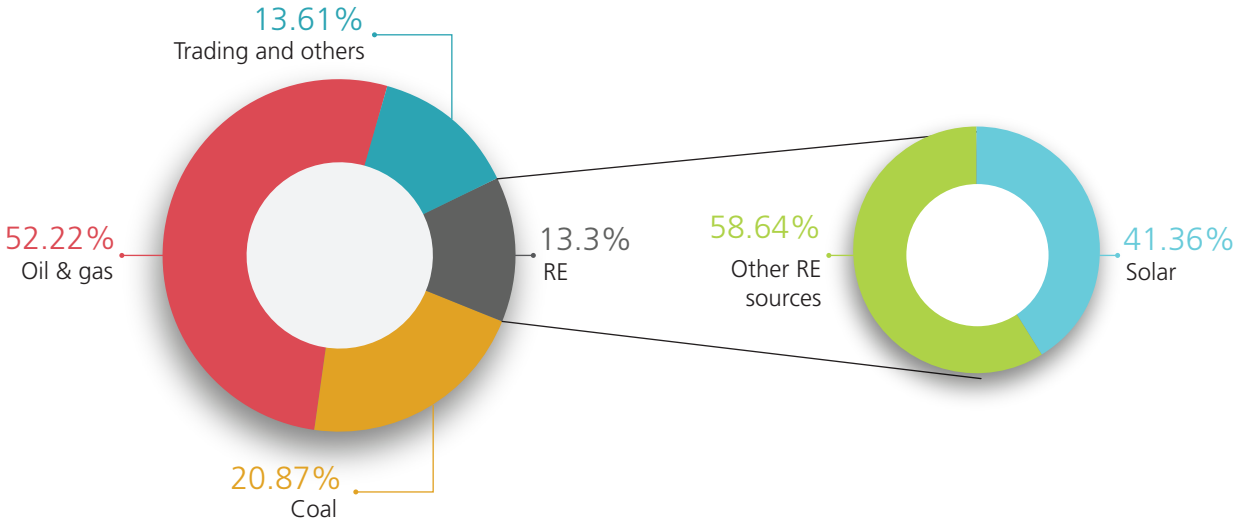


Figure 3: Electricity procurement mix of TPL-D (2019-20)

For FY 2019-20, TPL-D purchased 12,382 MUs of electricity, of which around 52 percent came from gas, followed by coal and renewable sources-based generation, as illustrated in Figure 3 (GERC, 2021) (Vasudha Power Info Hub, 2021). In the renewable energy (RE) basket, solar power contributed to around 41.36 percent of the electricity procurement. (GERC, 2021) (Vasudha Power Info Hub, 2021).

For FY 2019-20, GUVNL purchased 98,262 MUs of electricity, of which around 80 percent came from coal, followed by renewable sources and gas-based generation, illustrated in Figure 5 (GERC, 2021) (Vasudha Power Info Hub, 2021). Out of the total RE purchased, wind power contributed around 55 percent (GERC, 2021) (Vasudha Power Info Hub, 2021).

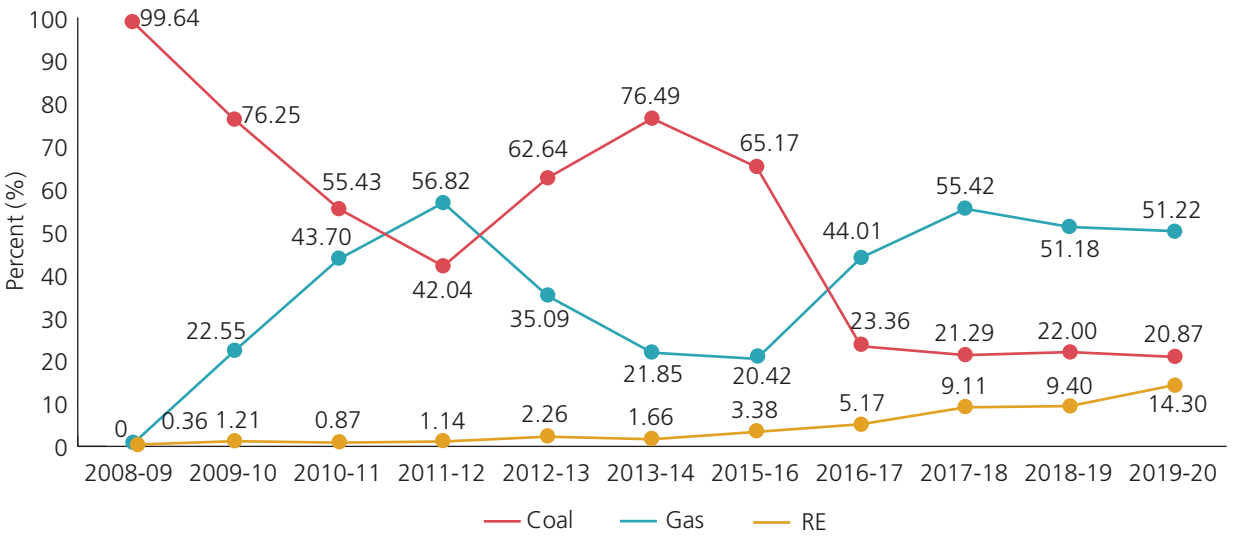
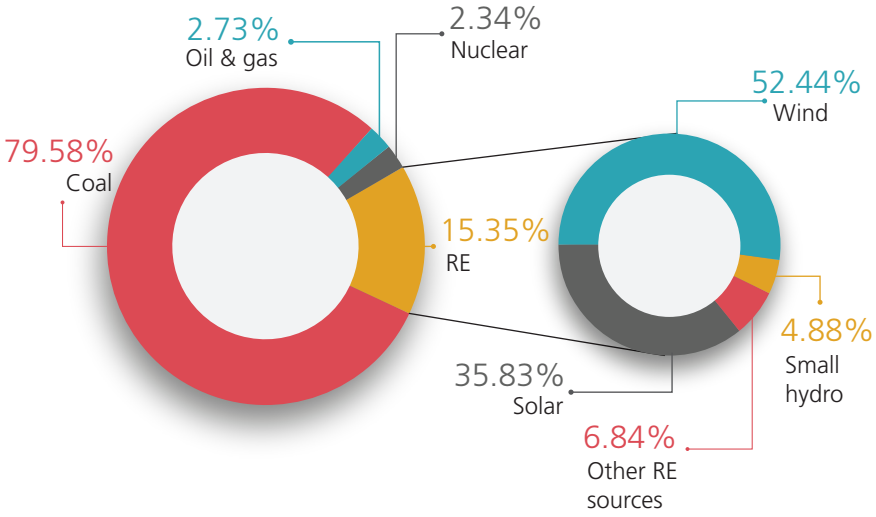


Figure 4: Trend of electricity-mix of TPL-D from 2008-09 to 2019-20 (in %)

The transmission and distribution losses for TPL-D were 11.7 percent during the FY 2016-17 (GERC, 2018), while for UGVCL they were 7.9 percent during the same time period (GERC, 2018). T&D losses for both the DISCOMs were much lower than the national average of 21.42 percent (CEA , 2019). At present, the T&D losses of UGVCL stand at 6.06 percent (GERC, 2021).



Wind energy contributes highest to the RE basket of GUVNL electricity procurement

Figure 5: Electricity procurement mix of GUVNL (2019-20)

UGVCL is one of the best performing DISCOMs in India having

6%

T&D losses in 2018-19

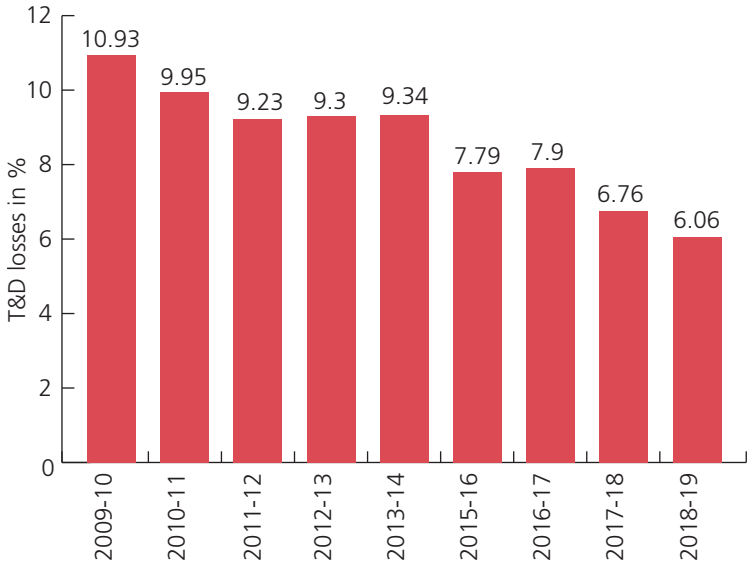


Figure 6: T&D losses (in %) for UGVCL from 2009-10 to 2018-19

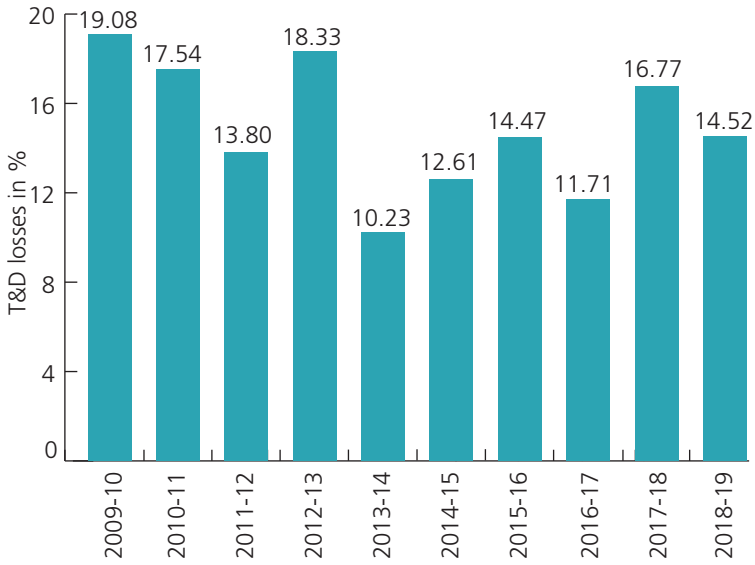


Figure 7: T&D losses (in %) for TPL-D from 2009-10 to 2018-19

T&D losses in TPL-D though remained much below the national average but has scope to improve

Category-wise electricity consumption (EC) of Ahmedabad district and projections of electricity consumption are given in Chapter 3.[2]

1.3. Transport and related infrastructure

Ahmedabad district is spread over an area of 8,087 km^2. The Ahmedabad urban agglomeration area is about 1,866 km^2, of this 465 km^2 falls under the Ahmedabad Municipal Corporation (AMC). Ahmedabad has two major public transport systems – the Ahmedabad Municipal Transport Service (AMTS), a bus service running in mixed traffic; and the Bus Rapid Transit System (BRTS), operated by Ahmedabad Janmarg Limited (AJL) that runs on dedicated corridors. Both AMTS and BRTS are wholly-owned subsidiaries of the AMC (Shah & Adhvaryu , 2016). The Ahmedabad BRTS is the most successful bus rapid transport in India. However, over the years, the population using public transport has dropped from 15 percent in 2013 to 11 percent in 2019 (CEPT University, 2019). Details on vehicle registration from Ahmedabad district RTOs are given in Chapter 3.

Table 4: Total registered motor vehicles in Ahmedabad (2015-16) (Ministry of Road Transport, 2016)

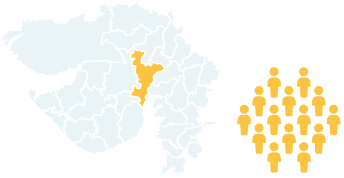
Mode	Vehicle type	Number (2016)
Public transport	Bus	30,625
IPT	Taxi/cab	20,099
	Auto-rickshaw	1,69,254
Private	Two-wheeler	25,93,116
	Four-wheeler	6,09,677

In 2014, the Union Cabinet approved ₹ 10,773 crore for Phase-I of Ahmedabad Metro, a 40.03 km stretch. The metro is envisioned to connect four corners of the city with two corridors, covering 32 metro stations in all. In March 2019, 6.5 km stretch between Apparel Park and Vastral Gam was inaugurated as part of the East-West corridor, covering 17 stations (Financial Express, 2019). Until July 2019, the total ridership for the metro was around 2,67,000 passengers (Ahmedabad Mirror, 2019).

In 2014, the Union Cabinet approved ₹ 10,773 crore for Phase-I of Ahmedabad metro, a 40.03 km stretch

1.4 Habitat (urban and rural)

Ahmedabad district's 84.04 percent population resides in urban areas, which is twice the state average (Census, 2011). With a geographical area of 4.13 percent of Gujarat, the population density of the district (around 890/sq.km) is the second highest in the state, and thrice the state average. Ahmedabad's population density is more than twice the national average. This indicates a huge pressure on its resources and infrastructure. There are eight urban local bodies in the district – while Ahmedabad has a municipal corporation, there are seven municipalities of Bareja, Bavala, Bopal, Dhandhuka, Dholka, Sanand and Viramgam. The increase in urban sprawl of Ahmedabad city is summarised in Figure 9.



84.04% population of Ahmedabad district resides in urban areas

2 Electricity is supplied in the district by TPL-D and UGVCL DISCOMs.

Ahmedabad has also seen a significant jump in the built-up area, as illustrated in Figure 8:

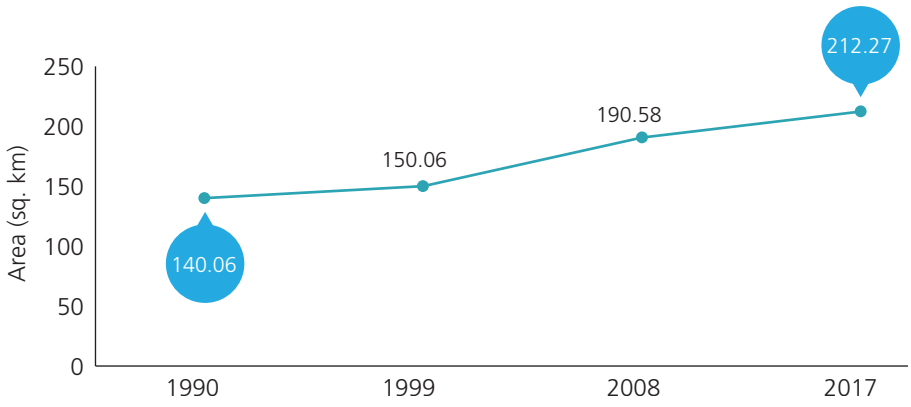


Figure 8: Built-up area (sq. km) in Ahmedabad city over the years (CEPT, 2019)

The built-up area has gone up by **52%** since 1990

Urban sprawl has increased over **5 folds** since 1973

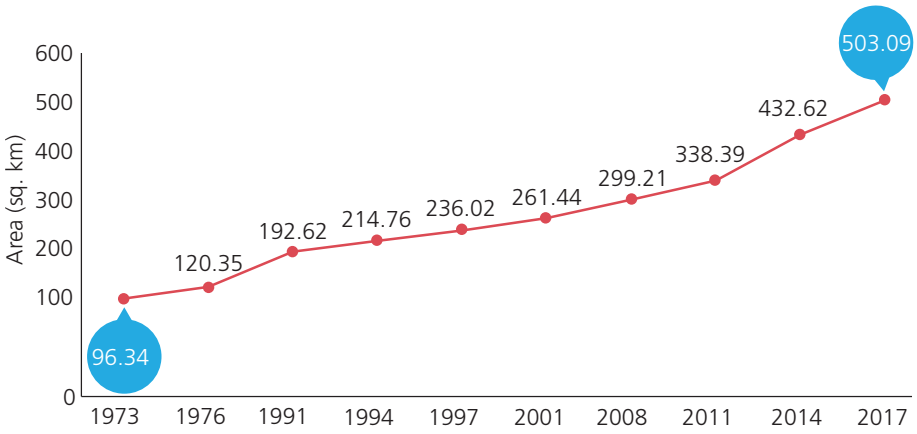


Figure 9: Urban sprawl (CEPT, 2019) in Ahmedabad city over the years (in sq. km area)

1.5 Industrial profile

Ahmedabad district has 12 main industrial estates, 12 special economic zones and 10 industrial parks. The industrial zones are restricted to the surrounding areas of Ahmedabad metropolis and some industrial towns of the district. The New Industrial Policy has enabled the government to identify certain areas in the industrially backward *talukas* of the district. Many industrial units have been coming up along the Saarkhej-Bavla Road and Sarkhej-Viramgam Road, due to the incentives provided to investors. Overall, the district has well-developed infrastructure and connectivity that are conducive for the growth of industries in the region.

The district has 265 large-scale industries and public sector undertakings, some of which contribute to the industrial processes and product use (IPPU) sector emissions as per IPCC. There are 22,839 MSME units, established at an investment of ₹ 4,170 crore (MSME - Development Institute, 2012) that employ 2,38,254 workers. Base metal products, machinery equipment and parts are the largest type of industry in Ahmedabad district. For further details please refer to Annexure 1.1.

1.6 Natural resources

The district has four agro-climatic zones – north Gujarat, Bhal and coastal area, north-west zone, and north Saurashtra zone – with conditions varying from arid, semi-arid to dry-sub humid. The district has an overall cropping intensity of 137 percent, with a net sown area of over 5,60,000 hectares (CRIDA, 2012). Major crops include cotton, paddy, wheat and horticultural products such as *ber* (*Ziziphus mauritiana*), citrus, cucurbits, brinjals and tomatoes. The net irrigated area is 1,85,000 hectare and the rainfed area is 3,14,000 hectare.

The total livestock population of the district is 80,771 (Gujarat Forest Department, 2018) (details provided in Annexure 1.2). Ahmedabad has 2.4 percent of the Gujarat's cattle population; 3.8 percent of the state's buffaloes, 0.97 percent

of sheep, 2.9 percent of goats, 25 percent of pigs, and 2.7 percent of the state's poultry share (Department of Animal Husbandry and Dairying, 2012).

The forest area is 13,121 hectares, comprising of 1.62 percent of the geographical area of the Ahmedabad district and is much below the state average of 7.57 percent (FSI, 2019). Table 3 gives details of the forest cover.

Ahmedabad lies on the banks of Sabarmati, with the river dividing the city into distinct eastern and western regions. According to the Revenue Department and Urban Development Department, Ahmedabad has 60 lakes, including Kankaria and Vastrapur. Seventeen lakes were turned into eco-recreational zone spaces during the last decades by the AMC and AUDA. However, most of the lakes have gone dry due to lack of maintenance.

Nalsarovar Lake in Ahmedabad has been notified as one of the wetlands of national conservation significance. It is a Ramsar site since September 2012 and has been a bird sanctuary since 1969. As per the State Forest Report 2017, the net area under wetlands in the district is 3,200 hectare (down from 3,300 hectare in 2015) (Gujarat Forest Department, 2018).

In terms of groundwater availability and use, majority of the district (72 percent) can be categorised as semi-critical. Overall groundwater development (percentage of extraction) in the district is 78.36 percent (CGWB, 2014).[3] CGWB statistics indicate that in 2017, the groundwater levels in the district were in the range of 0.13 to 9.22 metres with respect to the decadal averages from 2007 to 2016 (CGWB, 2019).

As per the analysis based on IWRIS data, the pre-monsoon groundwater level of 27 stations located in the eight blocks of Ahmedabad indicate a significantly improved water level in the lower part of the district.[4] However, regions in the upper part, which largely feed the urban agglomeration, have seen marginal improvement (Figure 10). Post-monsoon trend, on the other hand, shows an improved water level across the district in the last 15 years (Figure 11).

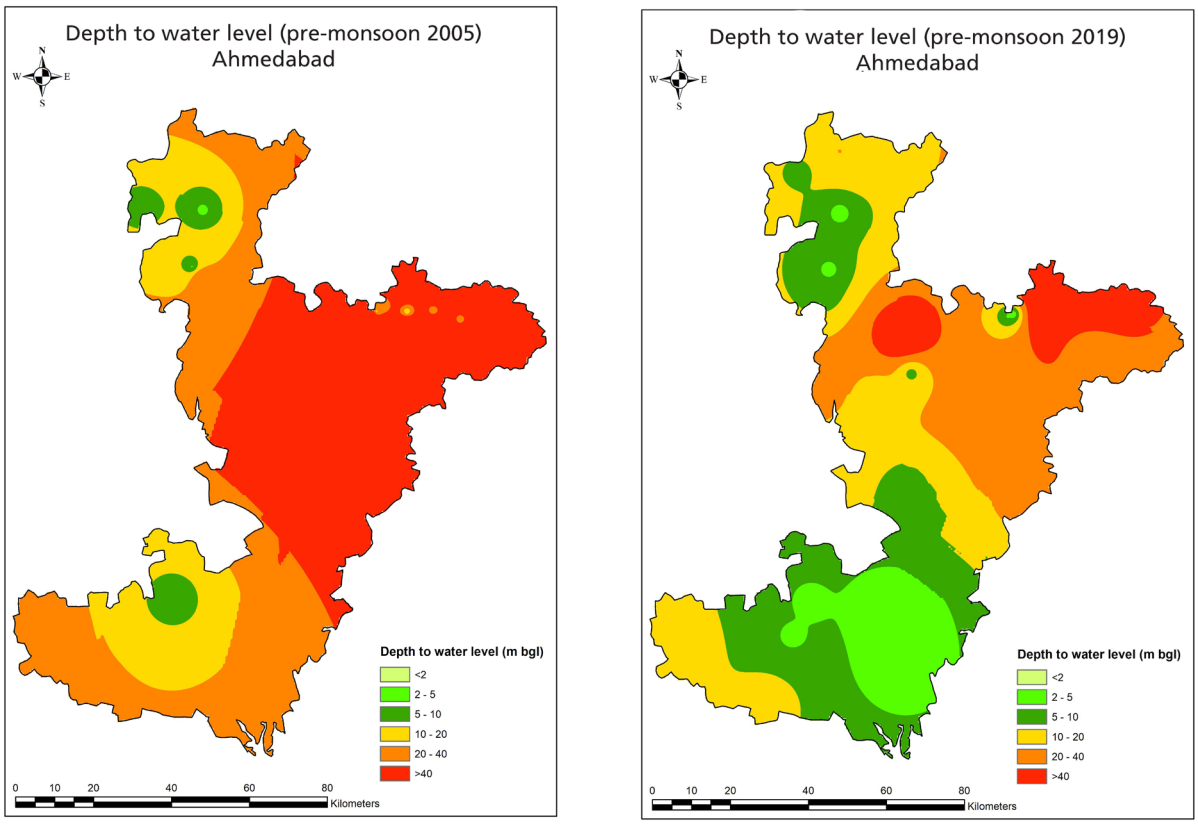


Figure 10: Pre-monsoon groundwater levels in Ahmedabad: a) 2005 and b) 2019

3 The stage of ground water development is a ratio of annual ground water draft and net annual ground water availability in percentage.

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

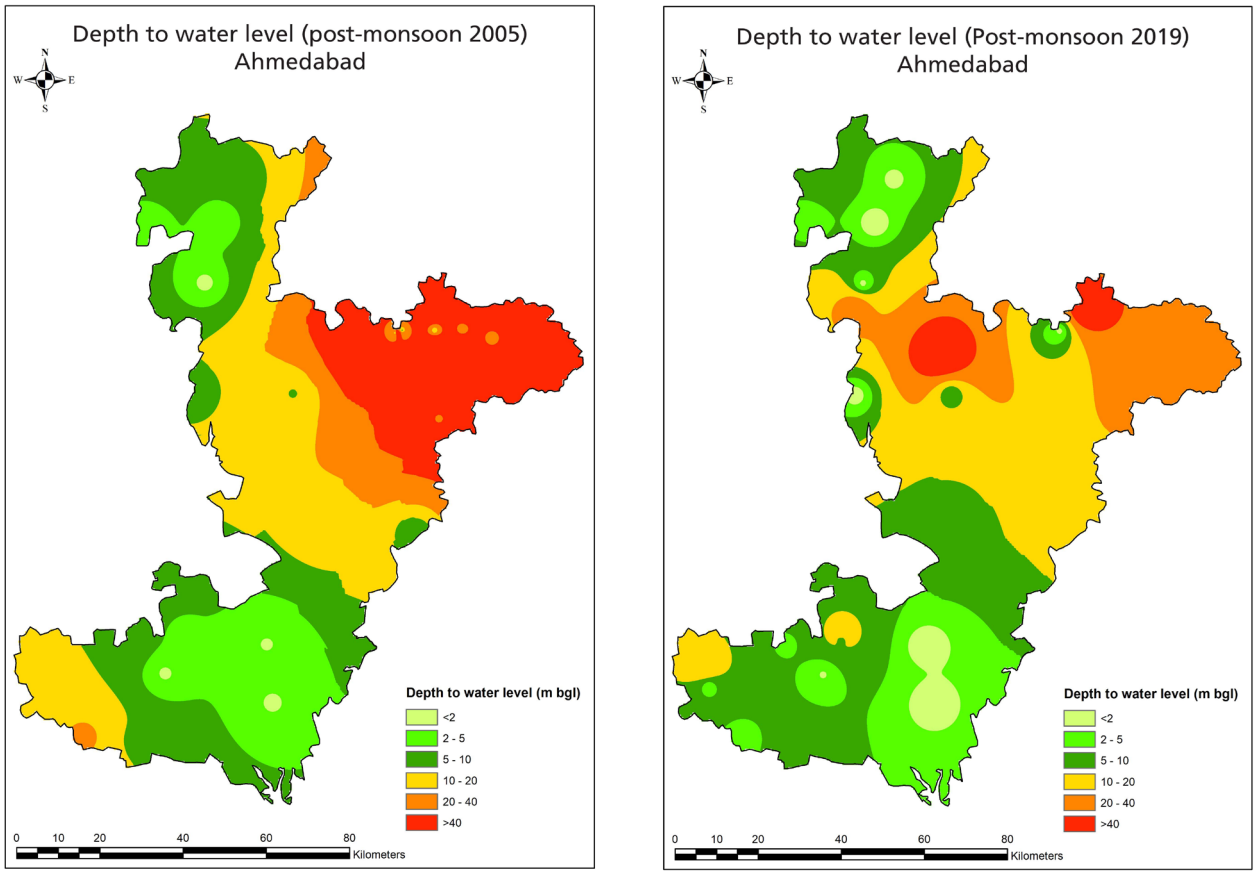
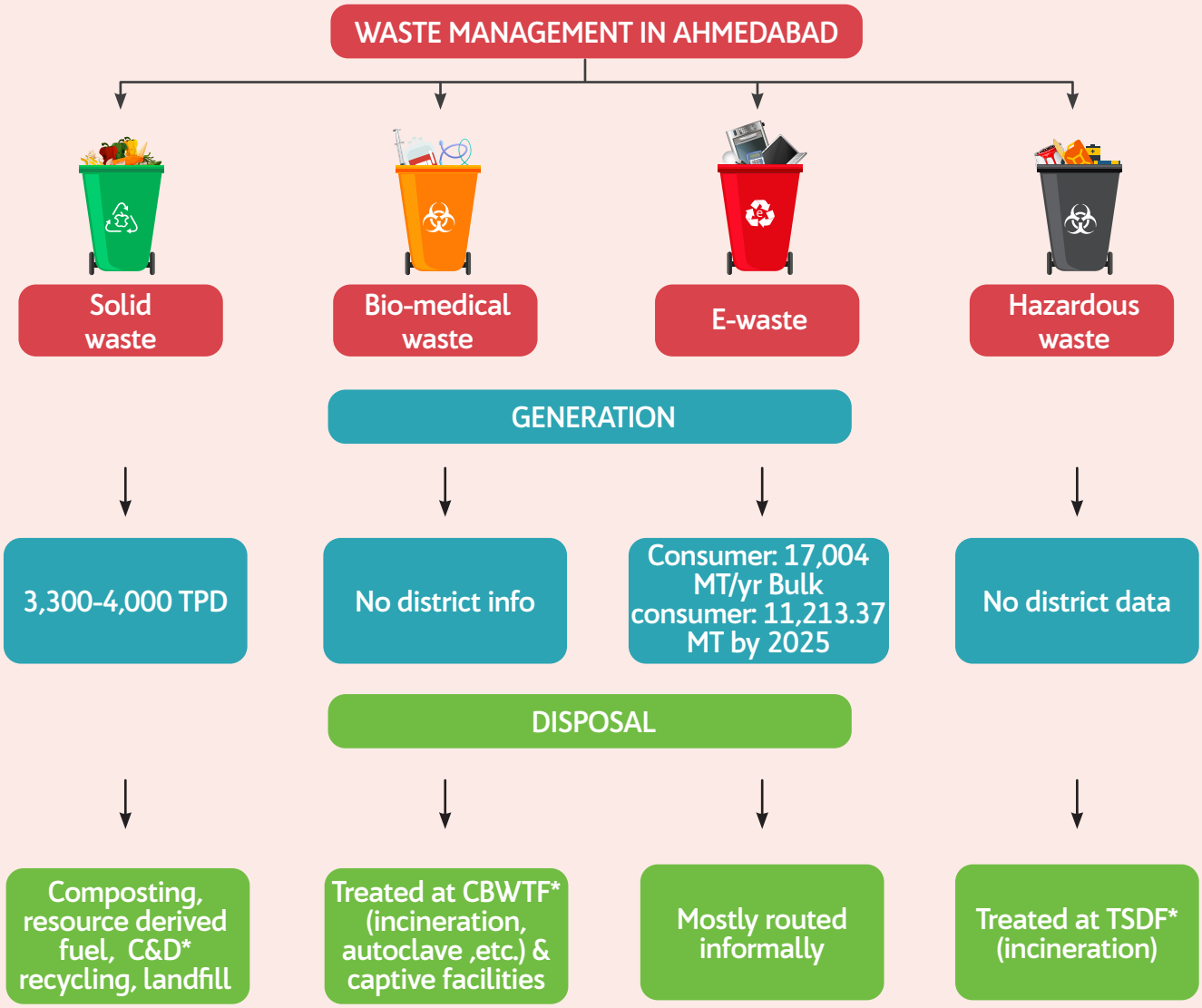


Figure 11: Post-monsoon groundwater levels in Ahmedabad: a) 2005 and b) 2019

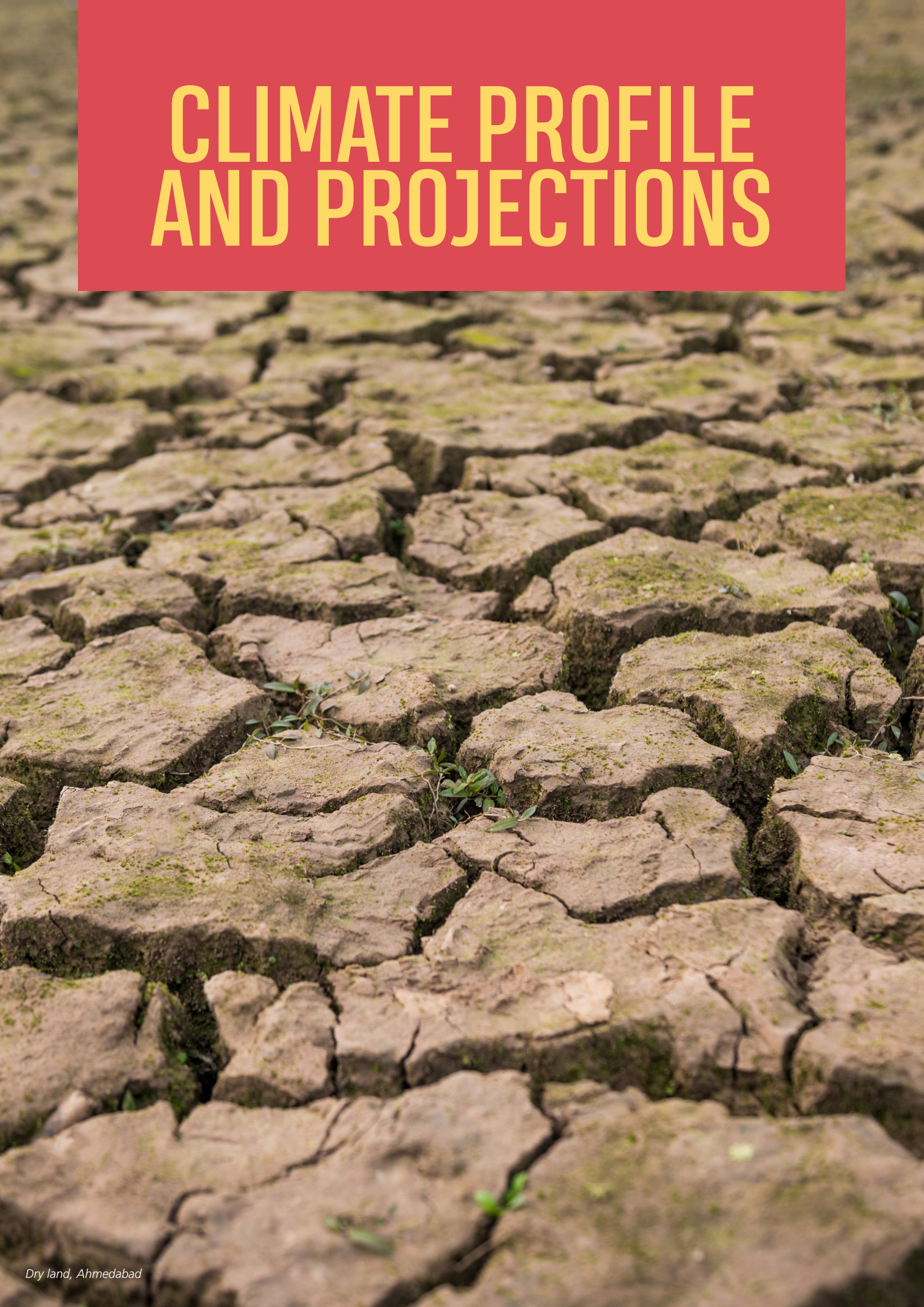
1.7 Waste sector

Ahmedabad is ranked fifth among 47 cities of India with a population of more than a million by Swachh Survekshan 2020 (cleanliness, hygiene and sanitation survey) (MoHUA, Swachh Survekshan 2020). The city has improved its rank from sixth in 2019, indicating an improvement in waste management. Gujarat has adopted the concept of common regional landfills for urban local body (ULB) clusters and vermi-compost treatment facilities at ULB level. The Ahmedabad cluster has five ULBs – Bareja, Motera, Bavla, Sanand and Dholka. Ahmedabad Municipal Corporation (AMC) has its individual landfill site and the collection efficiency within the corporation area is 100 percent (GPCB, 2019). The district is not fully-covered by underground sewerage, but AMC has nine sewage treatment plants or STPs (six aerobic and three anaerobic) for domestic liquid waste treatment with a total capacity of 1,075 MLD (CPCB, Inventorisation of sewage treatment plants, 2015). Although there are several industrial clusters in the district, industrial wastewater generation or treatment database is not in the public domain, with the exception of information on the common effluent treatment plants (CETPs). Ahmedabad has nine CETPs with a total of 128.69 MLD treatment capacity (GPCB, 2020).



*: C&D: Construction & Demolition; CBWTF: Common Bio-medical Waste Treatment Facility; TSDF: Treatment, Storage & Disposal Facility;

CLIMATE PROFILE AND PROJECTIONS



Dry land, Ahmedabad

2. CLIMATE PROFILE AND PROJECTIONS[5]

2.1 Observed climate variability over Ahmedabad district

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

In this section, we focus on the current mean climate variability in Ahmedabad district. Precipitation and temperature are used as the key climate variables in this analysis.

2.1.1. Precipitation variability

The climate of Ahmedabad district is hot and semi-arid with marginally moderate rainfall. The district receives rainfall in summer and monsoon (June-September). However, there is large variation in the distribution of seasonal rainfall. Ahmedabad is one of the driest districts in Gujarat, receiving 95 to 235 mm of precipitation, mostly during summer and monsoon months. The mean monsoon rainfall from June to September is around 625 mm. The number of rainy days (a day with rainfall of 2.5 mm or more) in the district vary from five to 14 during July and August, and it receives more than 30 days of rainfall in the summer monsoon season.

The year-to-year rainfall variability during monsoons as well as the seasonal mean for the period of 1951 to 2018 over Ahmedabad district (area averaged) are depicted in Figure 12. There is no significant trend observed in either rainfall or rainy days during the period, however, July and August – the principal rainy months for the district – showed higher variability in rainy days (Figure 13).

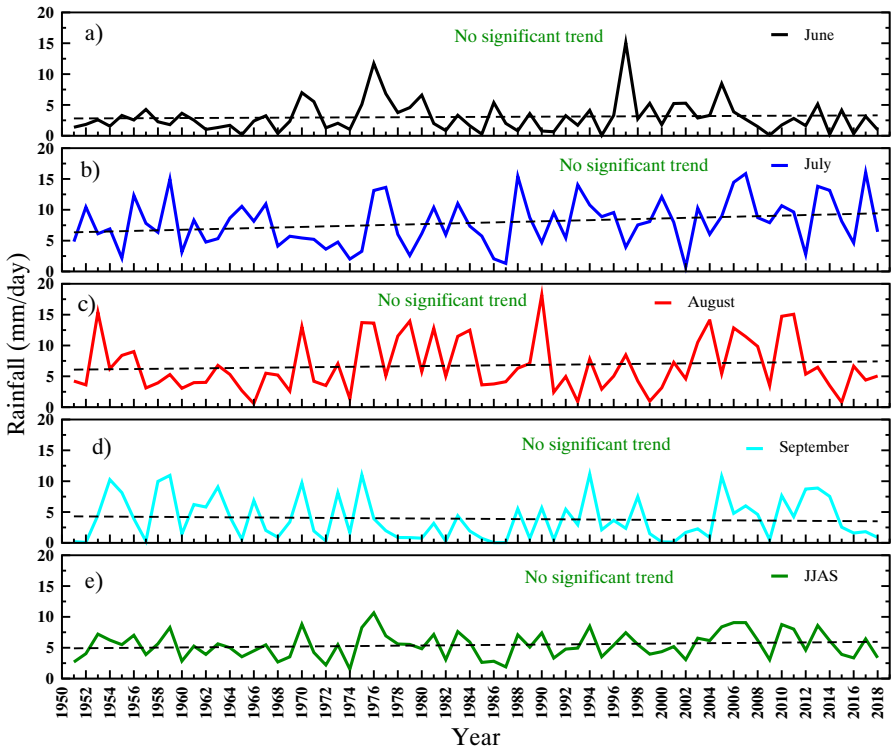
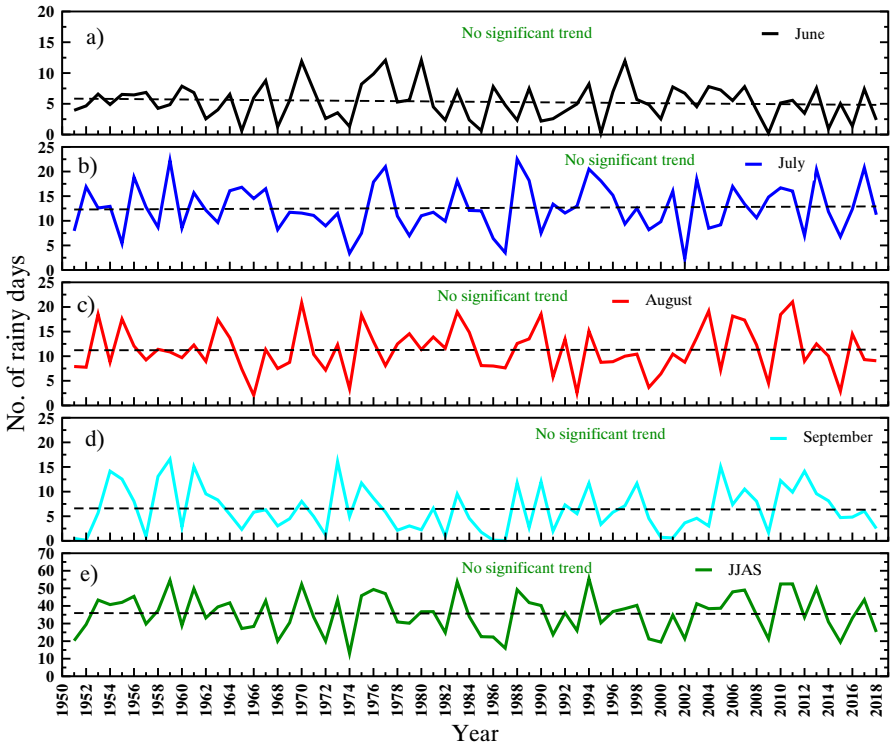


Figure 12: Inter-annual variability of rainfall (mm/day) over Ahmedabad for 1951-2018

One of the driest districts in Gujarat, Ahmedabad receives only 95-235 mm of rainfall with large variation in distribution

5 Refer to Annexure 2.1 for background note of climate projections and 2.2 for data source & methodology.



Higher variability in rainy days observed during July & August

Figure 13: Inter-annual variability of rainy days (days) over Ahmedabad for 1951-2018

2.1.2. Temperature variability

The mean temperature in the district ranges between 35°C and 40°C during summer-time (March, April and May) with May being the hottest month. The maximum temperature in these three months shows an increasing trend, which got accelerated in the last decade (Figure 14). The mean percentage of warm days also shows an increasing trend (Figure 15), ranging from 8 to 10 percent during 1986 to 2005.[6]

Maximum temperature during summer months shows an increasing trend

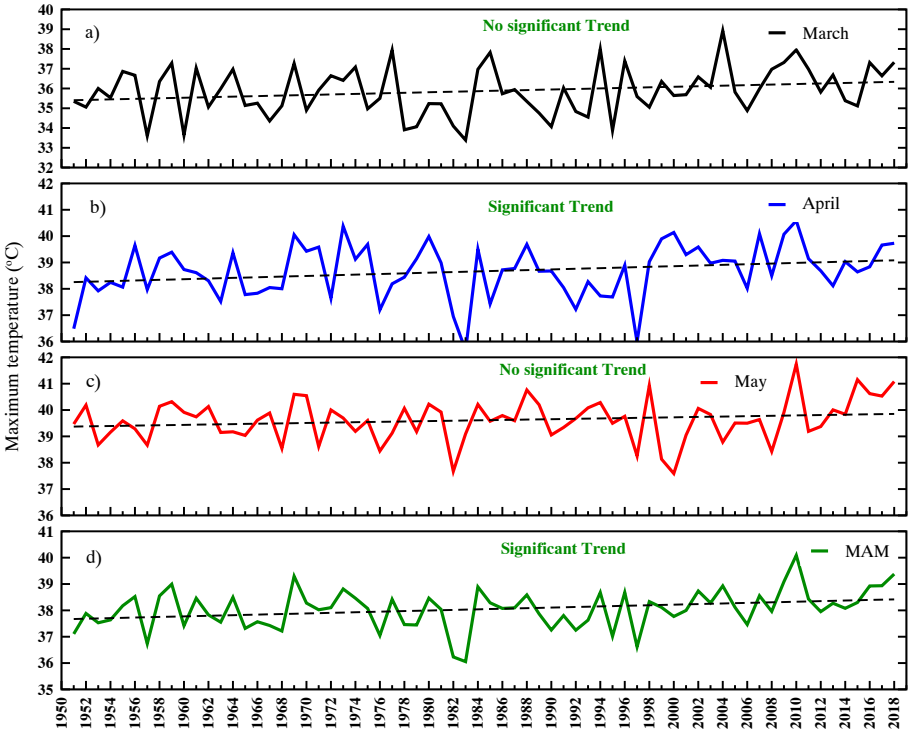


Figure 14: Inter-annual variability of maximum temperature (°C) over Ahmedabad for 1951-2018

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

Similar increasing trend is observed in the mean percentage of warm days

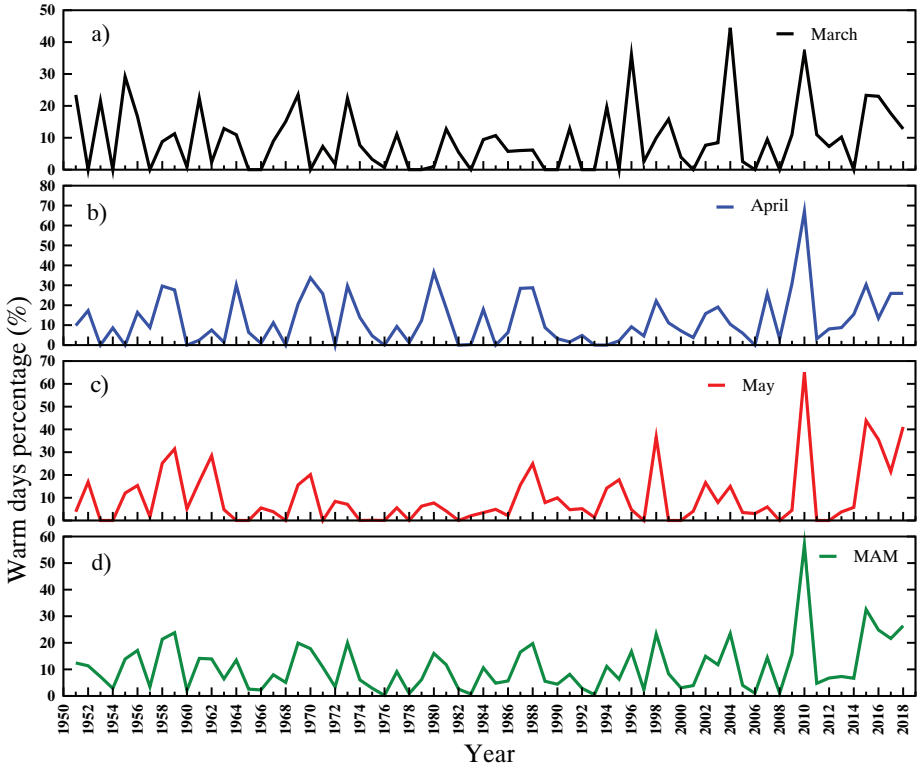
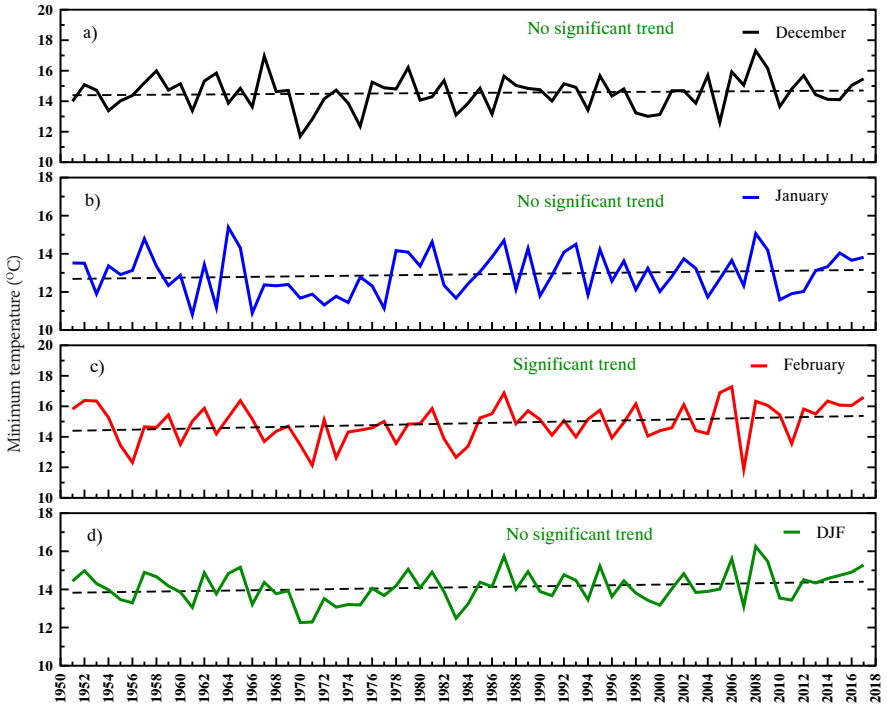


Figure 15: Inter-annual variability of warm days over Ahmedabad for 1951-2018

In winter, temperatures (December, January and February) range between 12.1°C and 14.5°C with January being the coldest month. The year-to-year variability of minimum temperature (figure 16) indicates an increase in the mean minimum temperature during the last few decades. The mean percentage of cold days show a decreasing trend in recent decades (figure 17).[7] An analysis shows a steady warming trend in both the minimum and maximum temperatures of the district.



Mean minimum temperature has increased during the last few decades

Figure 16: Inter-annual variability of minimum temperature (°C) over Ahmedabad for 1951-2018

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

Cold days are decreasing in recent decades

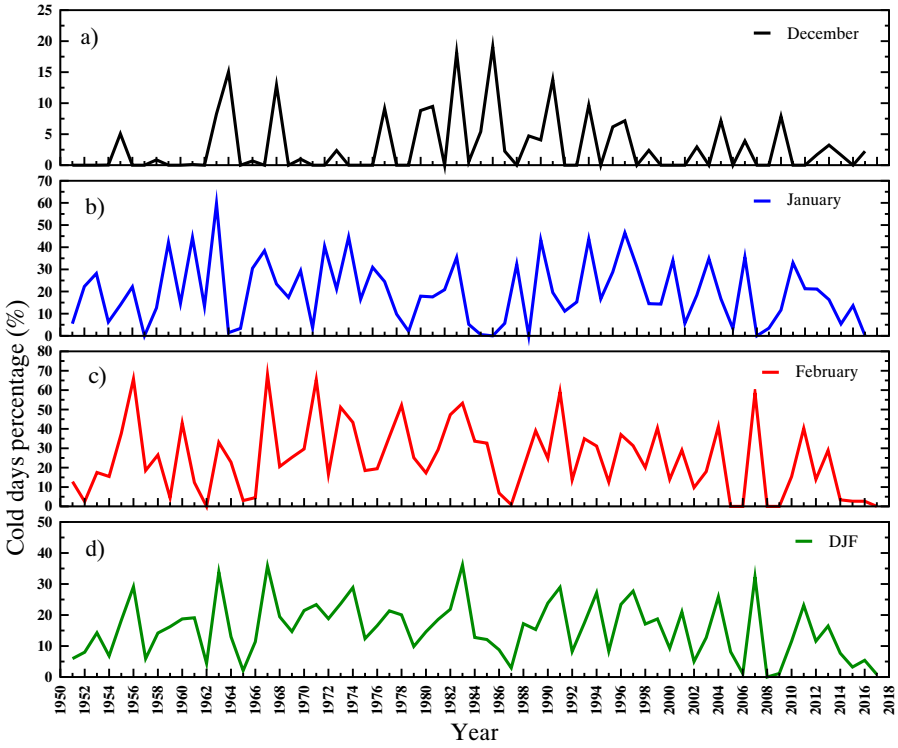


Figure 17: Inter-annual variability of cold days over Ahmedabad for 1951-2018

2.2 Future climate projections for Ahmedabad district

Precipitation and temperature for the 1986 to 2005 period have been simulated using the multi-model mean (MMM) ensemble. The district may experience a projected increase in the quantum of rainfall in the monsoon months and the season as a whole in different epochs (2021-2040, 2041- 2060, 2061-2080 and 2081-2100) under medium (RCP4.5) and high (RCP8.5) emission scenarios. There may be an increase in precipitation by 8 to 19 percent under RCP4.5 and 13 to 42 percent under RCP8.5 emission scenarios respectively (Table 5). The number of rainy days is also projected to increase during the monsoon season, particularly during July and August (Table 6).

Table 5: Observed (1986-2005), simulated (1986-2005) and projected mean monthly and seasonal rainfall (mm) for Ahmedabad district

Rainfall (mm)	June	July	August	September	JJAS (total of June, July, Aug & Sept)
Observed	114	234	184	98	629
Simulated	74	224	178	124	602
RCP4.5					
2030s (2021-2040)	86	223	187	155	651
2050s (2041-2060)	76	217	195	164	653
2070s (2061-2080)	80	236	216	182	713
2090s (2081-2100)	82	236	224	173	714
RCP8.5					
2030s	88	231	216	146	682
2050s	83	242	232	177	734
2070s	85	275	224	183	767
2090s	90	262	276	220	852

Table 6: Observed (1986-2005), simulated (1986-2005) and projected mean monthly and seasonal rainy days (rainfall >2.5 mm) for Ahmedabad district

Rainy days	June	July	August	September	JJAS (total of June, July, Aug & Sept)
Observed	5	12	10	6	33
Simulated	5	13	12	7	36
RCP4.5					
2030s (2021-2040)	6	13	12	7	38
2050s (2041-2060)	5	12	12	8	37
2070s (2061-2080)	5	13	12	8	38
2090s (2081-2100)	5	13	12	8	38
RCP8.5					
2030s	5	13	12	7	37
2050s	5	13	12	8	38
2070s	5	13	13	8	39
2090s	6	12	13	9	40

The projected changes in maximum and minimum temperatures were analysed on a monthly scale during the summer and winter season. The projections for different time epochs indicate the maximum temperatures may increase by 1.2°C to 2.4°C under RCP4.5 and 1.4°C to 4.5°C under RCP8.5, particularly during the month of May (Table 7). The percentage of warm days is also projected to increase by the end of the century (Table 8). In winter, the minimum temperatures show an increasing trend with the percentage of cold days decreasing in all epochs under changing climate conditions. A clear increase in the temperature towards the end of the century can also be seen (Table 9).

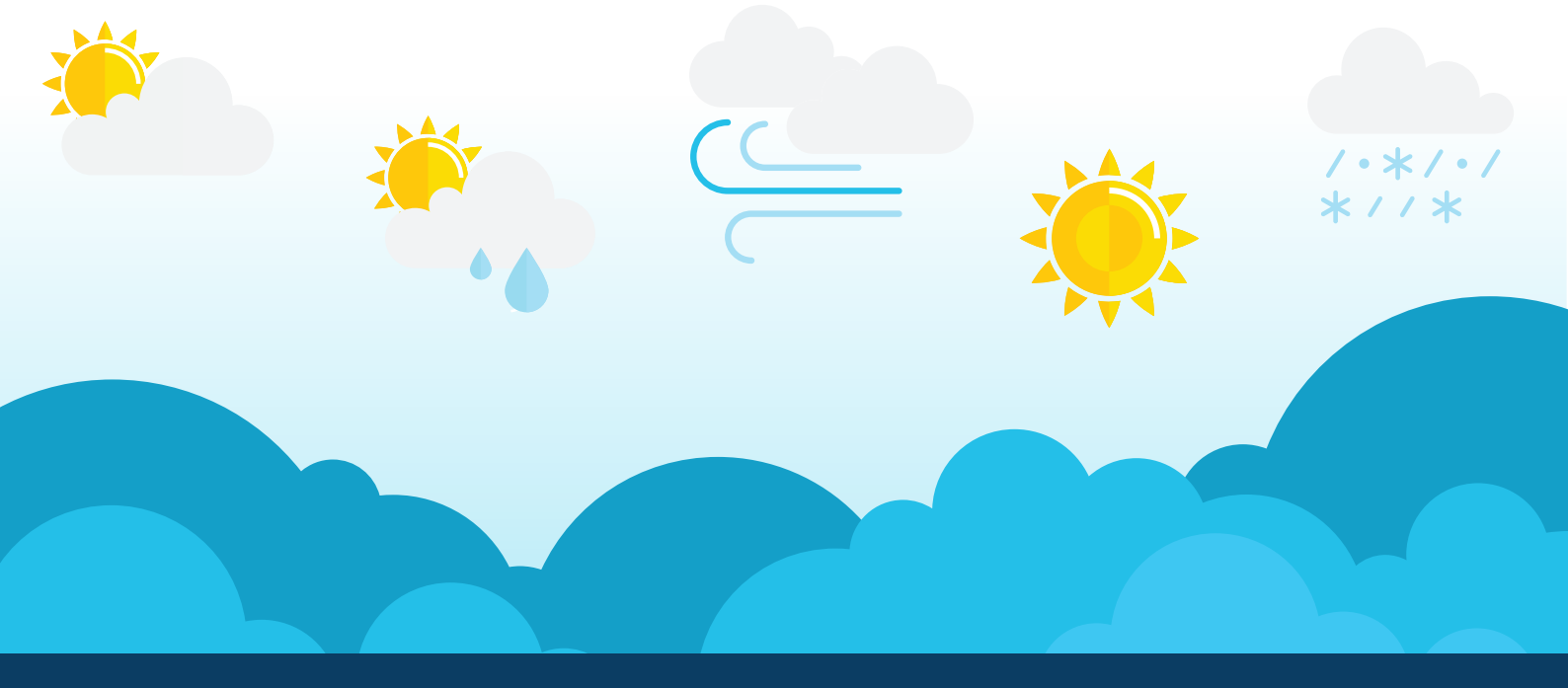


Table 7: Characteristics of simulated monthly and seasonal maximum temperature (°C) for Ahmedabad district (baseline and RCP 4.5 and RCP 8.5 emission scenarios)

Temp. max (°C)	March	April	May	MAM (average of March, April and May)
Observed	35.8	38.7	39.6	38
Simulated	35.4	39	40.8	38.4
RCP4.5				
2030s	36.8	40.2	41.8	39.6
2050s	37.4	40.8	42.5	40.7
2070s	37.7	41.3	42.9	40.6
2090s	38.1	41.5	43	40.8
RCP8.5				
2030s	36.9	40.3	42.1	39.8
2050s	37.9	41.3	42.8	40.9
2070s	39.2	42.3	43.9	41.8
2090s	40.2	43.6	44.9	42.9

Table 8: Characteristics of simulated monthly and seasonal warm days (%) with respect to baseline for Ahmedabad district (baseline and RCP 4.5 and RCP 8.5 emission scenarios)

Warm days (%)	March	April	May	MAM (average of March, April and May)
Observed	9	10	10	10
Simulated	10	10	9	10
RCP4.5				
2030s	34	40	42	39
2050s	48	56	62	56
2070s	55	68	69	65
2090s	64	71	75	70
RCP8.5				
2030s	39	45	52	42
2050s	60	69	75	68
2070s	80	87	91	86
2090s	90	95	97	93

Table 9: Characteristics of simulated monthly and seasonal minimum temperature (°C) for Ahmedabad district (baseline and RCP 4.5 and RCP 8.5 emission scenarios)

Temp. min (°C)	Dec	Jan	Feb	DJF (average of Dec, Jan and Feb)
Observed	14.5	12.9	14.9	14.1
Simulated	13.1	11.9	13.9	12.9
RCP4.5				
2030s	14.4	13.2	15.1	14.2
2050s	15.2	13.9	15.8	14.9
2070s	15.7	14.5	16.3	15.5
2090s	15.8	14.7	16.5	15.6
RCP8.5				
2030s	14.8	13.4	15.4	14.5
2050s	15.7	14.6	16.5	15.5
2070s	17.3	15.9	17.9	17.0
2090s	18.6	17.3	19.0	18.3

Table 10: Characteristics of simulated monthly and seasonal cold days (%) with respect to baseline for Ahmedabad district (baseline and RCP4.5 and RCP8.5 emission scenarios)

Cold days (%)	Dec	Jan	Feb	DJF (average of Dec, Jan and Feb)
Observed	4	22	24	16
Simulated	5	16	36	19
RCP4.5				
2030s	1	2	17	7
2050s	0	2	11	14
2070s	0	1	7	3
2090s	0	1	5	2
RCP8.5				
2030s	1	5	15	7
2050s	0	2	6	3
2070s	0	0	2	1
2090s	0	0	1	0

2.3 Sectoral impacts of climate change

2.3.1 Heat stress in Ahmedabad

Ahmedabad – one of India's hottest cities – experiences heat stress almost every year, particularly during the pre-monsoon summer months (from March to May), when maximum temperatures average 45°C. The effects of heat stress observed are: (a) health impacts including dehydration, heat exhaustion and stroke, exacerbations of chronic cardiovascular and respiratory diseases; (b) worsening of environmental factors like water stress and deteriorating water quality; (c) outbreaks of vector-borne diseases, such as malaria, chikungunya and dengue; and (d) incidences of diarrheal diseases. Poorer communities and workers in high-risk industries like glass and metal works constitute the vulnerable groups with a higher risk of heat-related illnesses (Knowlton, et al., 2014). During a severe heat wave period in Ahmedabad in 2010, occurrence of all-cause mortality increased by 30 percent. (Tejas, Mavalankar, Azhar, Jaiswal, & Connolly, 2014).

Ahmedabad is
is one of India's hottest cities

Globally, climate change-linked extreme heat events are widespread. Mean annual temperatures across India have also increased relative to historical averages. The climate variability study conducted under the current district action plan observes a 4.9°C and 2.8°C rise in maximum average summer temperatures (March to May) by the end of the century as per high-emission pathway (RCP8.5) and medium-emission pathway (RCP4.5), respectively. Also, the number of warm days is projected to increase by 83 percent as per RCP8.5 and by 60 percent as per RCP4.5 in the district during the months of March to May. This also suggests that more frequent and intense heat waves are likely to occur, making it a critical issue for climate action plans. The same is already reflected in the record decade-high temperature even during the lockdown in April 2020 and an average of 38.7 percent increase in heat-related emergencies handled by Emergency Management and Research Institute (Project 108) in Gujarat.

Heat Action Plan (HAP), a first of its kind coordinated action in South Asia, was developed for Ahmedabad

A Heat Action Plan (HAP), first of its kind coordinated action in South Asia, was developed for Ahmedabad by a coalition of academic, health and environmental groups in 2013, and is being updated periodically. The HAP intends to prepare local communities for extreme heat periods, prevent health effects of heat stress and provide an early warning system through a framework for the implementation, coordination and evaluation of extreme heat response activities in Ahmedabad.

Key strategies of HAP are as follows:

- To build public awareness and community outreach to communicate the risks of heat waves and implement practices to prevent heat-related deaths and illnesses.
- To initiate an early warning system and inter-agency coordination to alert residents of predicted extreme temperatures. AMC has created formal communication channels to alert government agencies, health officials and hospitals, emergency responders, local community groups and media outlets of extreme temperatures forecasted by the Indian Meteorological Department's (IMD) Meteorological Centre located in Ahmedabad.
- To build capacity among healthcare professionals (focusing on primary medical officers, paramedical staff and community health staff) in order to recognise and respond to heat-related illnesses, particularly during extreme heat events.
- To reduce heat exposure and promote adaptive measures by launching new efforts, including a draft city-wide cool roofs programme.

The HAP has colour-coded signals for a heat alert based on different temperature thresholds and a communication plan to activate the alert through the nodal officer. It also has key actions listed for all responsible departments in the communication plan. It has the Ahmedabad Cool Roof programme, along with heat illness treatment protocols and a checklist for all agency actions (ULB administration and press officer, medical colleges, labour department, emergency service department) and department-wise activities during heatwave days.

While the HAP effectively addresses all immediate concerns to minimise the impacts and considers a long-term cool roof planning, several other critical aspects remain untouched. These are addressed in Chapter 6.

2.3.2 Agriculture and allied sectors

The trends of change in rainfall and temperature across Ahmedabad indicate greater impacts on *kharif* season as compared to *rabi*. It is predicted that climate change would severely affect the yields of wheat crop, followed by maize, paddy and groundnut during *kharif* season (Pandey, et al., 2015).

A study on the impact of climate change on rice growth and yield found that in Ahmedabad district, the changing climate will not only impact the flowering and maturity of the crop, but also reduce the grain yield by 29.7 percent and the biomass yield by 33 percent (Patel, et al., 2013). Additionally, decrease in biomass production will negatively impact livestock rearing. The projected heat stress will decrease cattle productivity and yield, particularly dairy. It will also impact the reproduction of these animals, while also increasing health issues.

According to a Gujarat Institute of Desert Ecology (GUIDE) study (2019), extended monsoon, unseasonal rain, hailstorms and cyclonic storms will become more intense and frequent along the coasts of Gujarat, compelling farmers to change their cropping patterns and timings. The coastal regions of the districts are projected to lose up to 40 percent of their coconut yield. This can be attributed to the summer temperatures that are projected to increase relatively more in the west coast region. Some studies suggest that agriculture is likely to be affected in the coastal regions as these areas are vulnerable to inundation and salinisation. Moreover, standing crops are more likely to be damaged due to cyclonic activity.

Increasing temperatures and extreme events like cyclones will also adversely impact marine fisheries.

2.3.3 Water resources

In Gujarat, agricultural activities consume 80 percent of the available water resource, of which irrigation is a major part. Various scientific assessments show that climate change will have a significant impact on Gujarat's freshwater resources. The river basins of Aji, Mahi, Pennar, Sabarmati and Tapi are likely to experience water scarcities (GoG, 2014).

In Gujarat, droughts have occurred with unfailing regularity. Longer periods of drought affect the ground water and river flows. The frequency of extreme drought is higher for north Gujarat agroclimatic zone, which includes the Ahmedabad district. Projections indicate that in the future, though droughts might occur less frequently, they will have a longer duration (Shete & Patel, 2013).

Given the changing climate in the coastal regions of the district, a rise in sea level is inevitable. This will have a far-reaching impact across sectors such as agriculture, habitat and industries.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SECTORAL GREENHOUSE GAS EMISSIONS PROFILE

Cooling towers of a thermal power plant, Ahmedabad

3. SECTORAL GREENHOUSE GAS EMISSIONS PROFILE: CLIMATE CHANGE DRIVERS

This section estimates greenhouse gas (GHG) emissions for Ahmedabad district using the guidelines laid down by the Intergovernmental Panel on Climate Change (IPCC).[8] Estimates have been provided for 13 categories covering three major sectors – energy; agriculture, forestry and other land use (AFOLU) and waste – for the period 2005 to 2019.[9] Though Ahmedabad has some industrial units that fall under the industrial processes and product use (IPPU) sector, emissions from the IPPU sector could not be taken into account due to unavailability of activity data (industry-wise production details). However, energy used in industries and the corresponding emissions are reported in the energy sector.

The activity data was sourced from government-approved datasets for all the sectors and wherever possible, country-specific emission factors were used in place of default-emission factors.[10]

3.1 Direct emission estimates

3.1.1 Economy-wide emissions

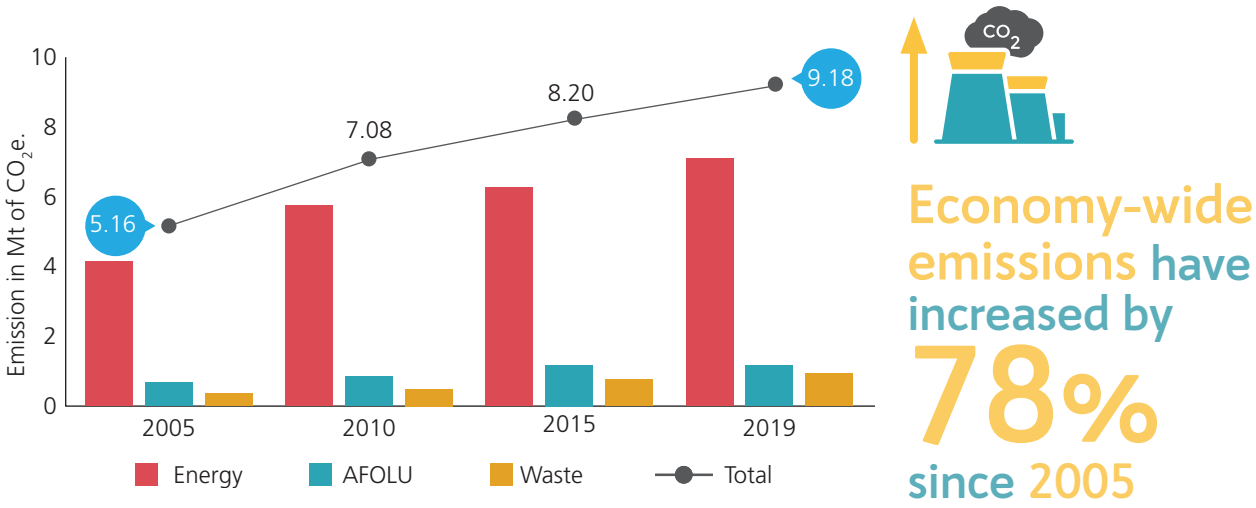


Figure 18: Economywide emissions of Ahmedabad district (million tonnes of CO_2e.)

Table 11: Sectoral contribution and growth in emissions

Sector	Growth in emissions CAGR (2005-19)	% share in total emissions (2019)
Energy	3.92%	77.22%
AFOLU	4.02%	12.53%
Waste	7.06%	10.24%
Total emissions	4.20%	-

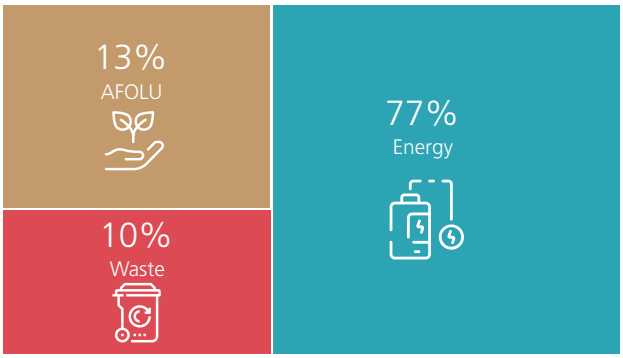


Figure 19: Percentage share of sectors in total emissions (2019)

8 To the extent possible, the 2006 IPCC guidelines were followed; and for a very few categories, the 1996 IPCC guidelines were referred to. Background note on GHG inventorisation and its significance is given in Annexure 3.1

9 Estimates for 2017, 2018 and 2019 have been obtained by applying CAGR on the latest possible GHG calculations for each category (based on availability of activity data)

10 Emission category-wise activity data sources provided in Annexure 3.2

- Between 2005 and 2019, the total emissions of Ahmedabad district increased by 78 percent (from 5.16 million tonnes CO_2e in 2005 to 9.18 million tonnes CO_2e in 2019).
- Energy sector (direct fuel combustion in transport, PEG, CPP, agriculture, residential etc) is the highest contributor with 77 percent of total emission in Ahmedabad. This is followed by AFOLU (13 percent) and waste (10 percent). Ahmedabad contributed to 4.11 percent and 3.48 percent in the total emissions of Gujarat state in 2005 and 2015 respectively. Gujarat emission estimates have been sourced from the GHGPI study (GHG Platform India, 2019). It may be noted that IPPU emissions are not included in Ahmedabad estimates.
- Sectoral details and analyses are given in the following sections

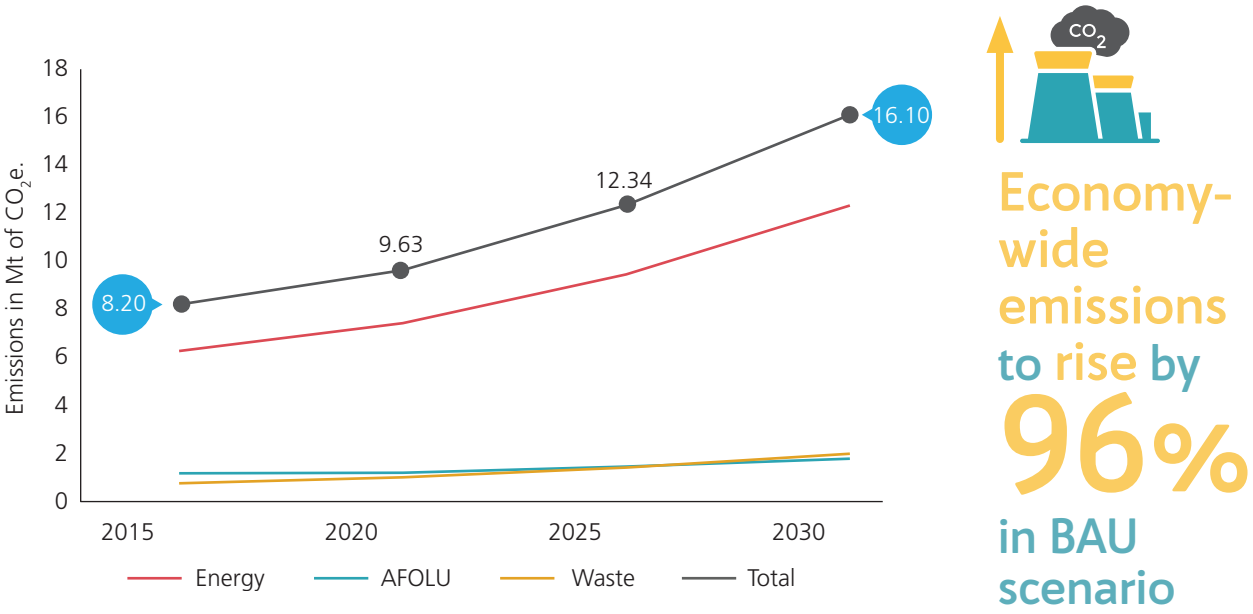


Figure 20: Projections of economy-wide emissions (BAU) for Ahmedabad district (Mt of CO_2e.)

- In the business-as-usual (BAU) scenario (i.e. no actions/policies are put in place to mitigate the emissions), the total emissions of Ahmedabad are likely to grow by 96 percent until 2030, with respect to 2015 levels.
- During the same period (2015 to 2030), emissions of Gujarat are likely to increase by 157 percent (given a CAGR of 6.5 percent).
- Overall emissions of the district can be significantly reduced if emissions from public electricity generation are curtailed.

3.1.2 Per capita emissions

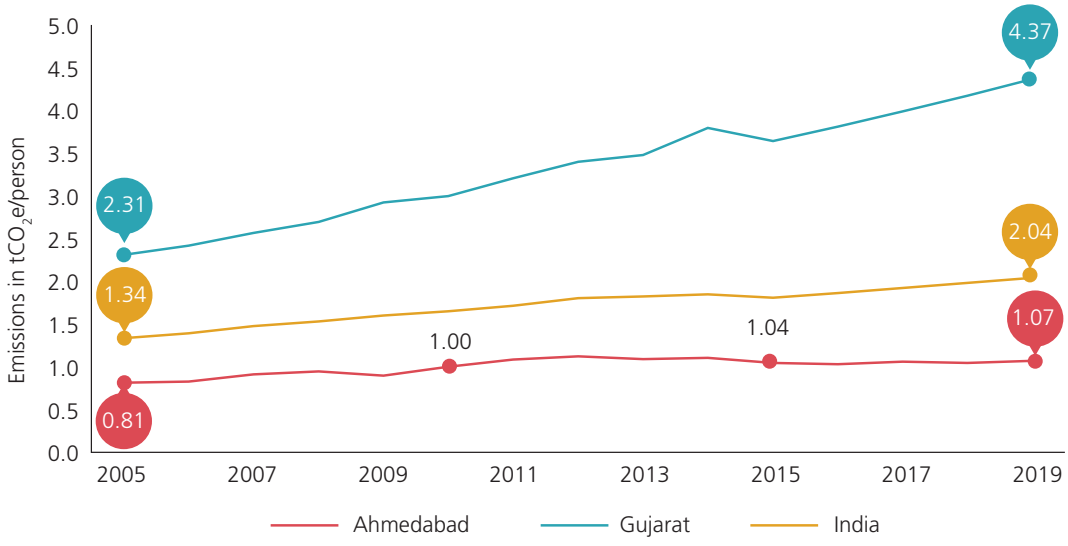


Figure 21: Per capita emissions (tCO_2e./person)-comparison

- The per capita emissions of Ahmedabad district were computed using the district's total emissions that were estimated in this analysis (therefore, it does not include emissions from IPPU).
- As per this analysis, the per capita emissions of Ahmedabad district in 2019 were around 1.07 tonne of CO_2e/person.
- National average is double that of Ahmedabad's per capita emissions; Gujarat's is 4 times higher (however, it may be noted that IPPU emissions and emissions from CNG and PNG could not be included in Ahmedabad estimates).

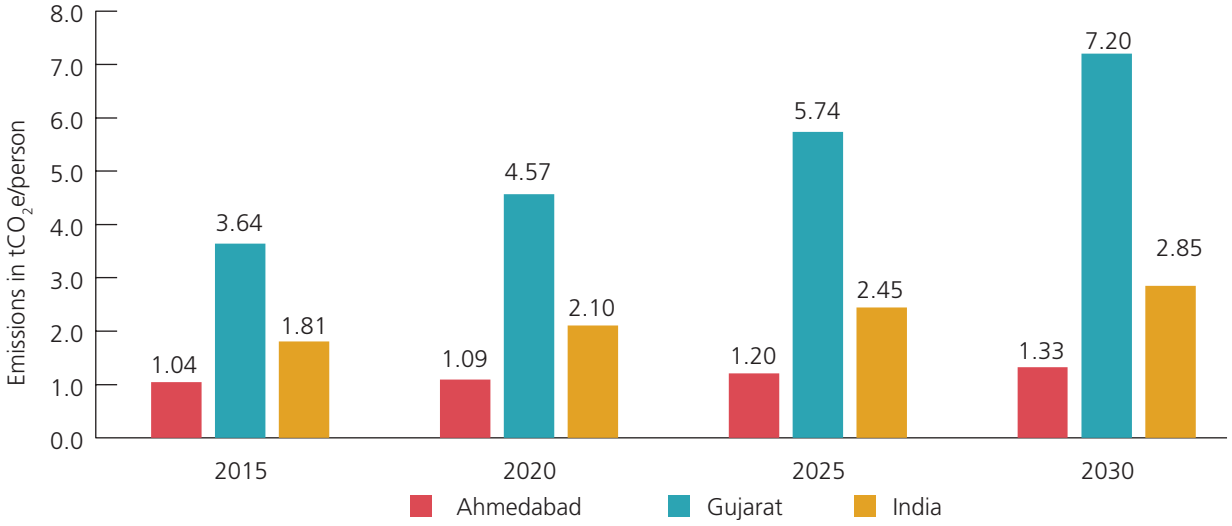


Figure 22: Projected per capita emissions (BAU)

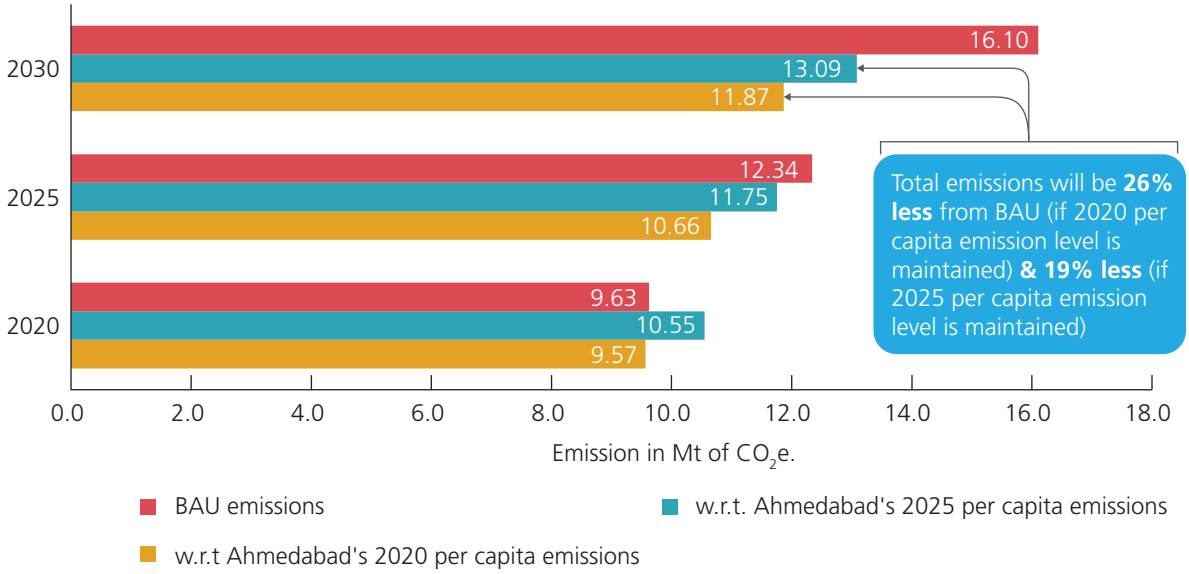


Figure 23: Projected total emissions (Mt of CO_2e) with different per capita emissions scenarios

- In the BAU scenario of per capita emissions, total emissions will increase 67 percent (between 2020 and 2030, as shown in economy-wide section as well).
- If the per capita emissions of 2020 are maintained, the overall growth in emissions would only be around 24 percent.

3.1.3 Sectoral analyses and projections

Energy sector

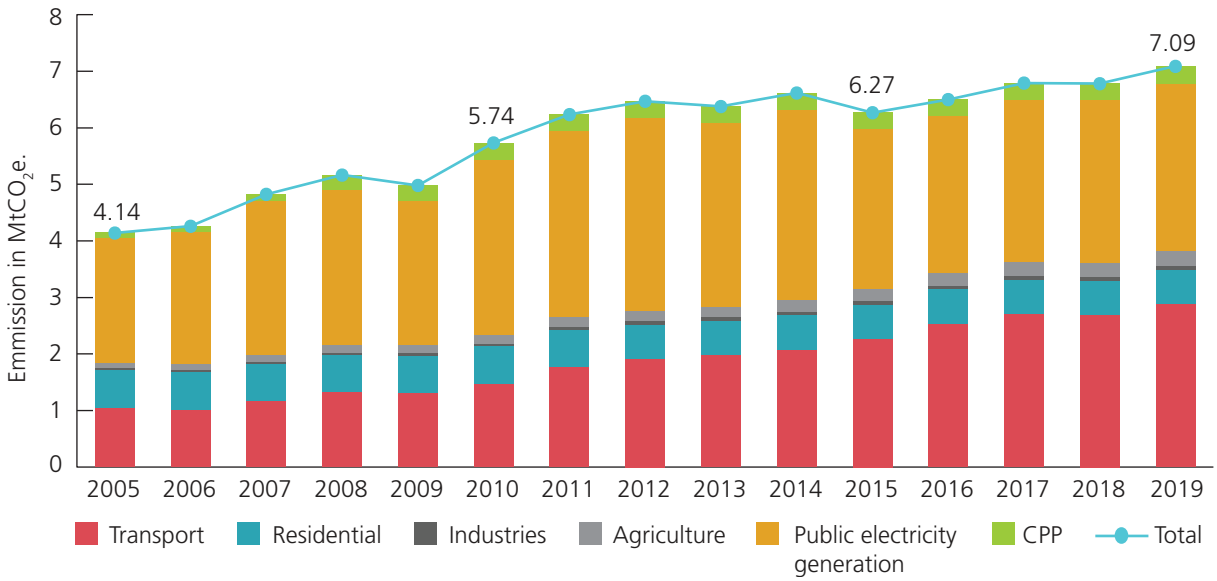


Figure 24: Energy sector emissions of Ahmedabad district (million tonnes of CO_2e.)

- This sector estimates the emissions from direct fuel consumption by various categories.
- Between 2005 and 2019, the emissions from energy sector have increased by 71.32 percent (from 4.14 Mt of CO_2e in 2005 to 7.09 Mt of CO_2e in 2019)
- Public electricity generation and transport categories are the highest contributors to total energy emissions. These are followed by residential, captive power plants (CPP), agriculture and industries.
- However, emissions of residential category have decreased over the time (w.r.t. the PPAC data that has been analysed). Ahmedabad city has seen an immense rise in PNG connections (replacing LPG). Due to unavailability of PNG data, emissions from consumption of PNG could not be computed. As a result, residential emissions are seen reducing over the years.

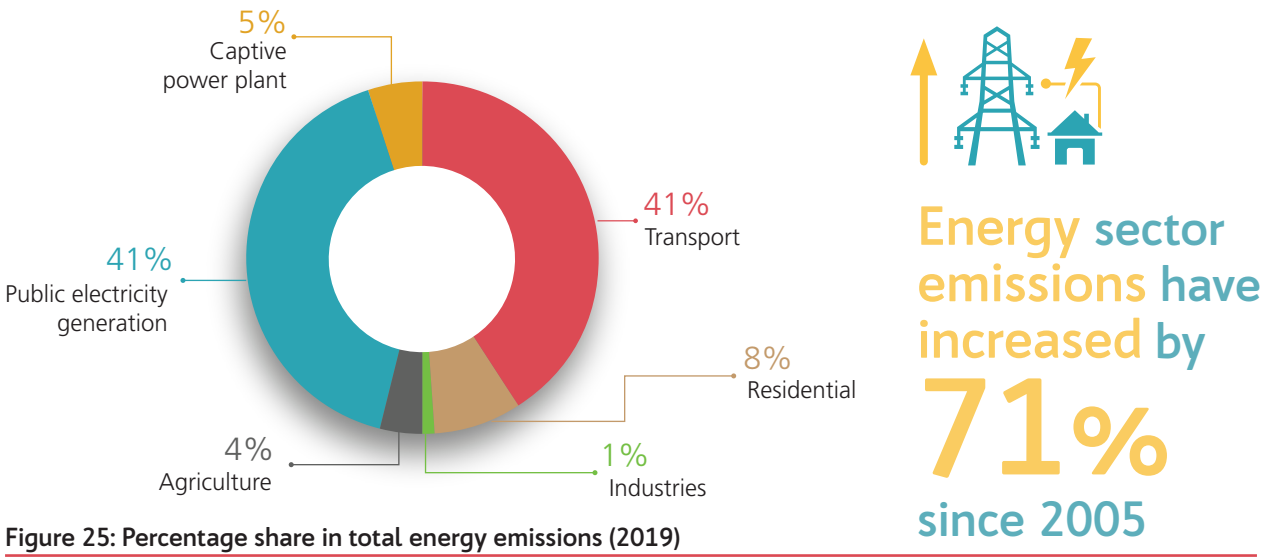


Figure 25: Percentage share in total energy emissions (2019)

Table 12: Growth in energy sector emissions

Category	Sub-category [11]	CAGR (2005-18)	% Share to energy emissions (2019)	
Public Electricity Generation (PEG)		2.1%	41.46%	
Transport (CAGR: 7.63% Share: 43.01%)	Road (77.86% transport emission)	6%	32.28%	40.81%
	Aviation (19.83%)	14.99%	1.00%	
	Railway (2.33%)	7.76%	8.21%	
Residential		9.24%	8.37%	
Captive Power Plant (CPP)		9.41%	4.47%	
Agriculture		3.81%	3.76%	
Industries		1.17%	1.13%	

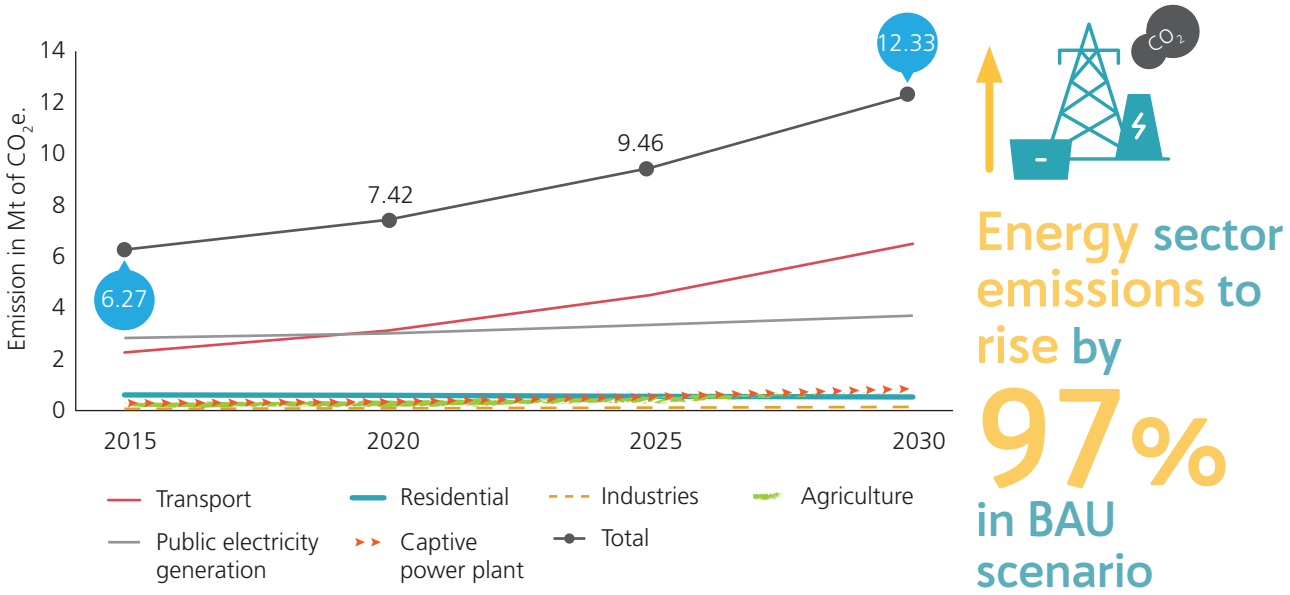


Figure 26: Projected emissions of energy sector (BAU) of Ahmedabad district in Mt of CO_2e.

- In BAU scenario, the total energy emissions of Ahmedabad district are likely to grow at a CAGR of 3.87 percent and the overall emissions will approximately double by 2030 (with respect to 2015) i.e. there will be an increase of 96.65 percent.
- If emissions from transport category are not curtailed, they are likely to overtake emissions from public electricity generation category by the end of 2020.
- As can be seen in Table 12, emissions from road transport contribute 77.86 percent to the total transport emissions. Reducing emissions from road transport (i.e. reducing direct fuel consumption) will significantly mitigate transport emissions. Modal shift in public transport and a transition to e-vehicles (powered by RE) can help attain this. Detailed recommendations are given in Chapter 6.

11 Data gap: CNG & PNG data was not available for Ahmedabad district

Agriculture, forestry and other land use (AFOLU) sector

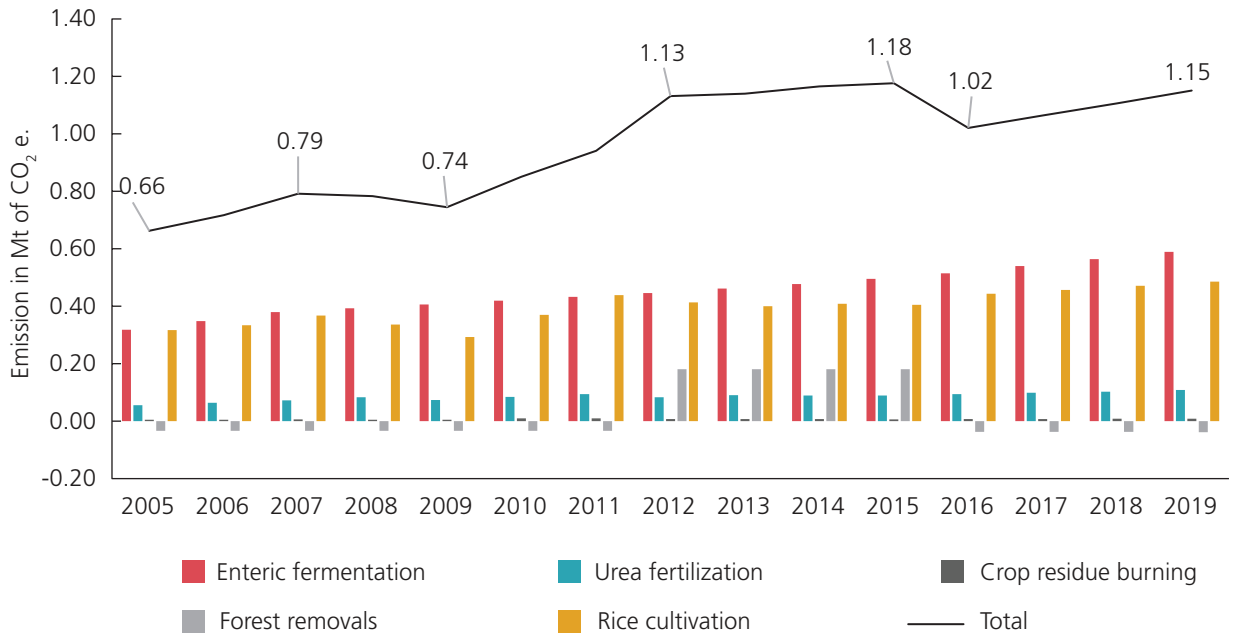


Figure 27: AFOLU sector emissions of Ahmedabad district (Mt of CO_2e.)

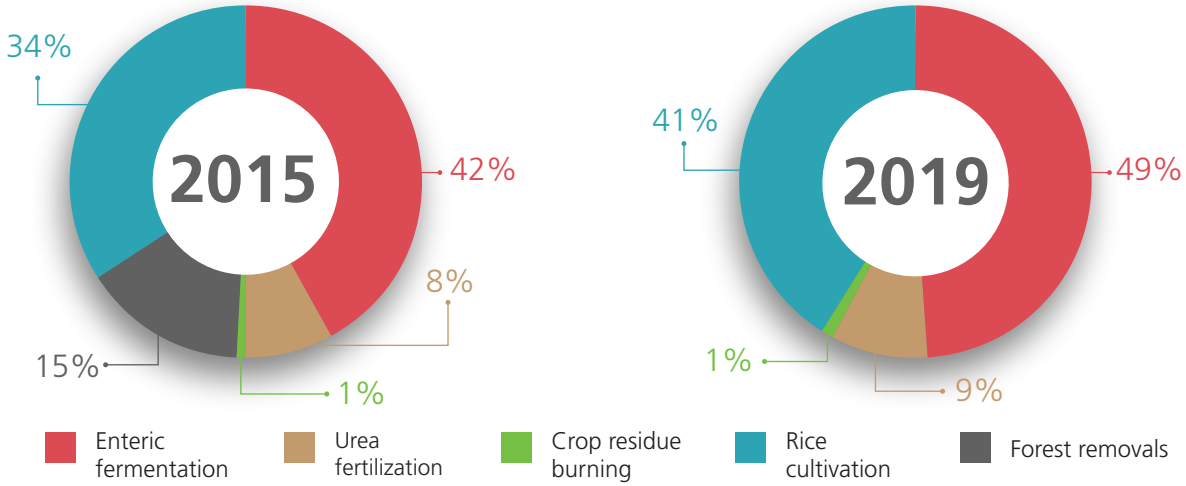


Figure 28: Percentage share of categories in total AFOLU emissions

Table 13: Growth in AFOLU emissions (2005-17) & % share

Category	CAGR (2005-17)	% share in AFOLU emissions (2015)	% share in AFOLU emissions (2019)
Enteric fermentation	4.48%	42%	49%
Forest removals	0.93%	15%	Became a sink
Urea fertilization	4.89%	8%	9%
Rice cultivation[12]	3.08%	34%	41%
Crop residue burning	3.87%	1%	1%
Total emissions	4.02%	-	-

12 For Rice cultivation and crop residue burning CAGR is calculated between 2005 to 2016

- AFOLU sector emissions increased by 73.93 percent (between 2005 and 2019).
- Forest removal category was a net sink in Ahmedabad between 2005 and 2011. It became a source of emissions from 2012 to 2015. However, with an increase in total forest cover, this category again turned into a net sink for CO_2 from 2016 onwards.
- Rice irrigation through continuous flooding (water regime) has also led to high emissions; contributing 34 percent and 41 percent in 2015 and 2019 respectively.
- Enteric fermentation in livestock is also a key source of AFOLU emissions – its share in total economywide emissions have been around 6 percent throughout the years (considered under this analysis).

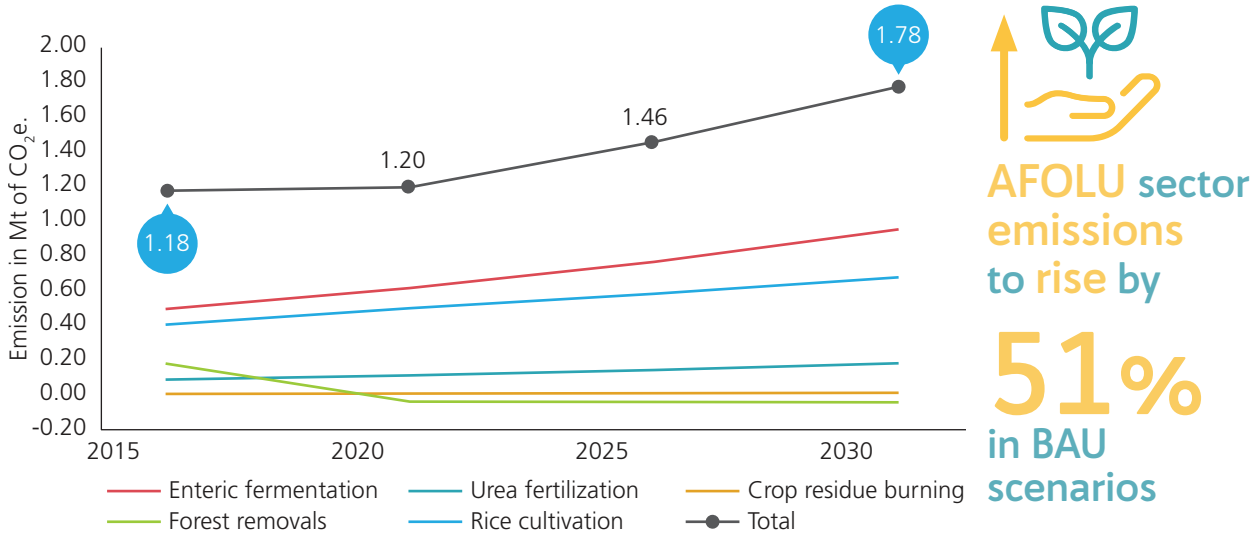


Figure 29: Projections of AFOLU sector emissions (BAU)

- In BAU scenario, AFOLU sector emissions are likely to increase by 51 percent by 2030 (as compared to 2015 levels).
- The emissions will be even higher if the current forest cover of the district is not maintained.
- Detailed recommendations to reduce emissions from rice cultivation and enteric fermentation are given in Chapter-6.

Table 14: Projections for livestock sector

Bovine population density (based on 2012 Livestock Census)	
Regions	**Cattle count/sq.km**
India 	91.23
Gujarat 	138.39
Ahmedabad 	79.24

- As per 2012 Livestock Census, density of bovine animals in Ahmedabad was 42 percent less than the state average.
- Ahmedabad is likely to reach the state average of bovine density by 2030.
- Based on this scenario, enteric fermentation calculations are done and compared with BAU projections.
- Under the new scenario, emissions will be 7.1 percent higher than the BAU projections for enteric fermentation, since the bovine density in 2030 under the BAU situation will be around 129.23 cattle count/sq. km (still lower than the current state average).

Table 15: Projected emissions for livestock sector (2005 to 2030)

Year	2005	2010	2015	2020	2025	2030
Projected population (BAU)[13]	4,70,198	6,09,647	6,96,828	7,98,225	9,14,377	10,47,430
BAU projected emissions (Mt of CO_2e.)	0.32	0.42	0.50	0.62	0.77	0.95
Projected population (keeping Ahmedabad's 2030 livestock population density equivalent to the current bovine population density of Gujarat)	4,70,198	6,09,647	6,94,434	8,14,779	9,55,980	11,21,651
Projected emissions (livestock population & emissions increase w.r.t Gujarat's livestock population density) (Mt of CO_2e.)	0.32	0.42	0.49	0.63	0.80	1.02

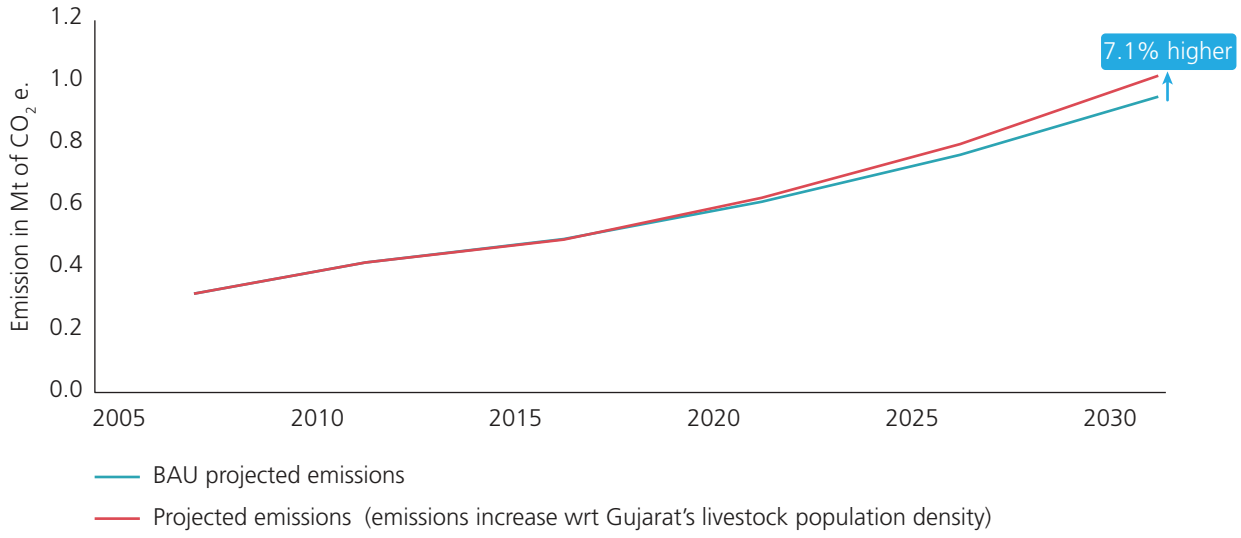


Figure 30: Projected enteric fermentation emissions- comparison

Waste sector

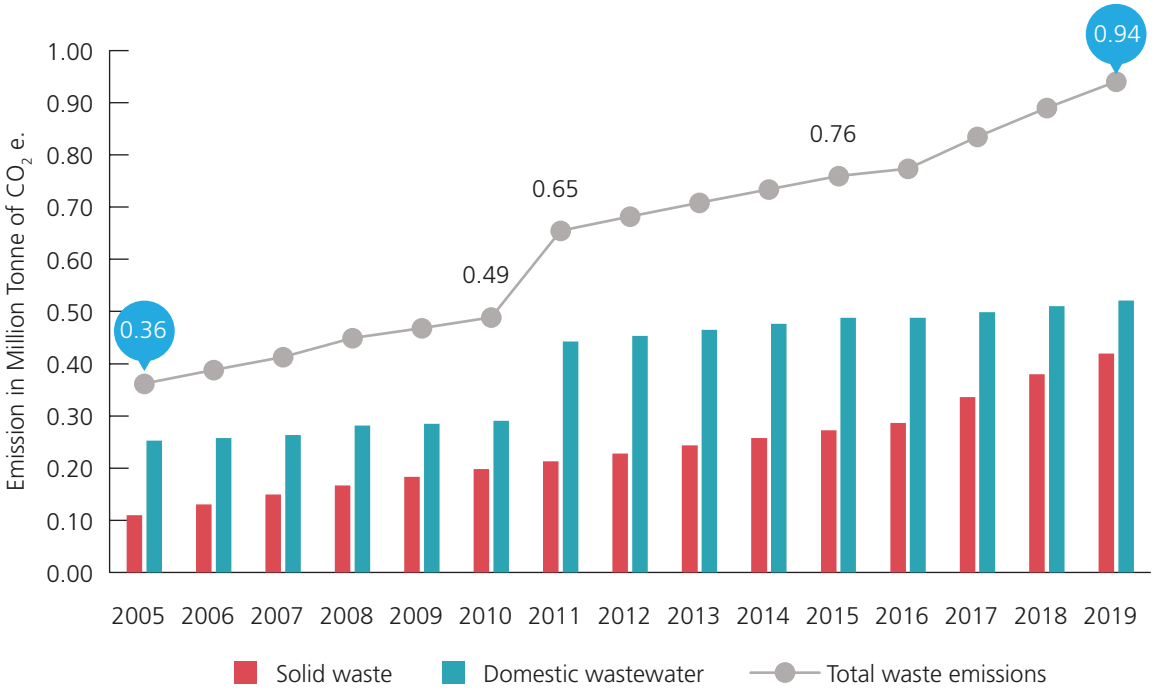


Figure 31: Waste sector emissions of Ahmedabad district. (in Mt of CO_2e.)

13 Based on 2012 Livestock Census

- Waste sector is the smallest contributor to economy-wide emissions (10 percent in 2019).
- This sector has witnessed the highest growth rate in emissions between 2005 and 2019 (CAGR of 7.06 percent).
- Total waste emissions have increased by 159.85 percent (2005-19) due to the jump in emissions from domestic wastewater from 2011 onwards.
- If emissions from the domestic wastewater are not mitigated, they are likely to increase by 89 percent by 2030 (w.r.t. 2015 levels).

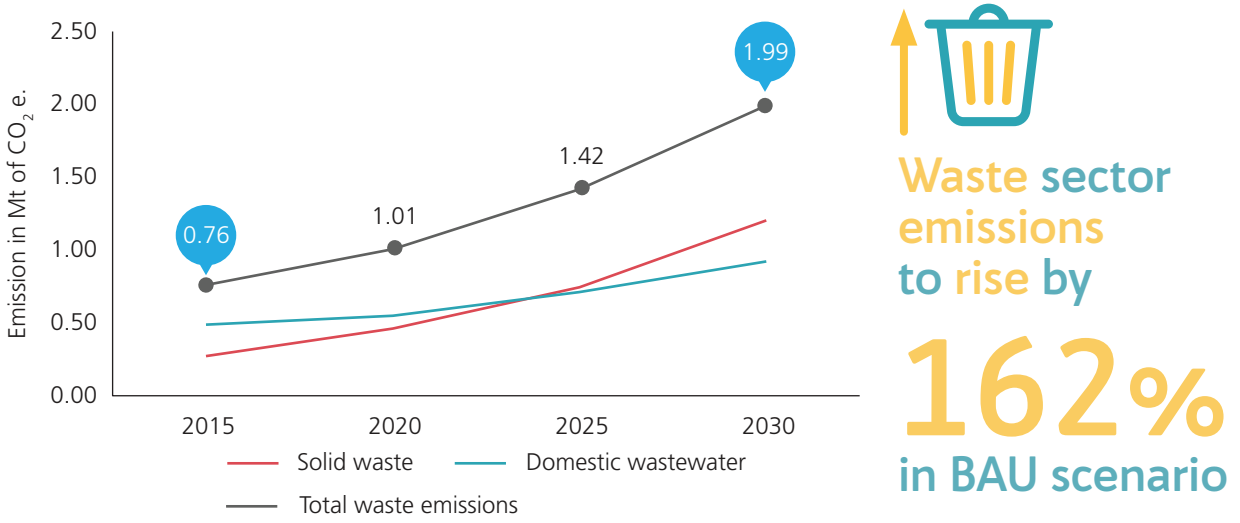
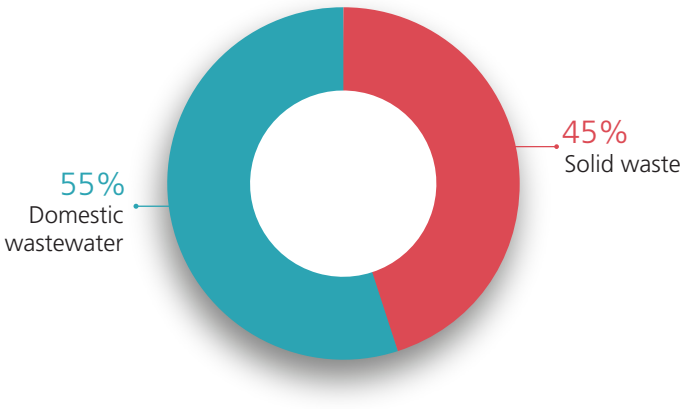


Figure 32: Projections for waste sector emissions (BAU)



Growth in emissions (2005-19) and % share		
Category	CAGR	% Share in waste emissions (2019)
Solid waste	3.24%	24%
Domestic wastewater	5.32%	76%

Figure 33: Percentage share of categories in total waste emissions (2019)

3.2 Carbon footprint of electricity consumption

- The district receives electricity from Torrent Power Ltd (private player) and Uttar Gujarat Vij Company Ltd. (UGVCL) – a government of Gujarat DISCOM.
- Projections for electricity consumption have been made on the basis of total electricity supplied by Torrent (CAGR of 5.59 percent) and UGVCL (CAGR of 15.61 percent) between 2005 and 2019.
- Contribution of coal and gas in electricity generation was determined by using the average of 10 years (from 2008-09 to 2019-20) for Torrent Power Ltd, and from FY 2019-20 for UGVCL.
- This way, carbon footprint (basically CO_2 emissions) from electricity consumption in Ahmedabad district has been ascertained.
- Emissions (from electricity consumption) are not added to the district emission profile (showcased in sections above) to avoid double counting. The IPCC methodology adopted to build the emission profile of the district clearly mentions that only emissions occurring at the source of production/generation need to be included (and not those occurring at the consumption site).

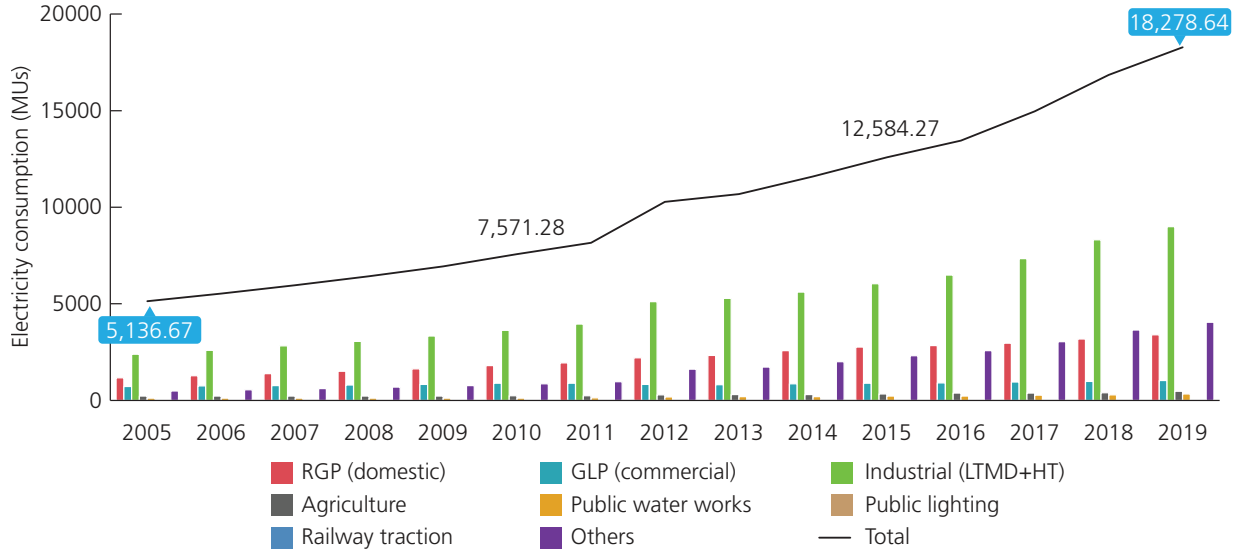


Figure 34: Electricity consumption in Ahmedabad district across categories

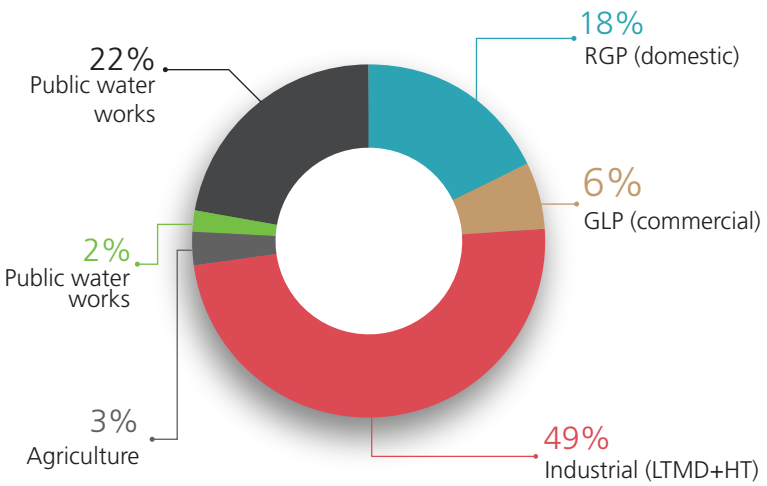


Figure 35: Sector wise share in electricity consumption of Ahmedabad district (2019)

Table 16: Estimation of emissions from electricity consumption in Ahmedabad district

Torrent Power Ltd. (TPL)							
	Units	2005	2010	2015	2020	2025	2030
Total electricity supplied	MUs	3,807.38	5,337.79	6,611.54	8,604.99	11,292.54	14,819.49
Coal based electricity (60.15%)	MUs	2,290.14	3,210.68	3,976.84	5,175.90	6,792.47	8,913.92
Gas based electricity (36.64%)	MUs	1,395.03	1,955.77	2,422.47	3,152.87	4,137.59	5,429.86
Emissions from coal[14] based electricity	Mt CO_2e.	1.97	2.76	3.42	4.45	5.84	7.67
Emissions from gas based electricity	Mt CO_2e.	0.59	0.82	1.02	1.32	1.74	2.28
Total emissions from TPL elec. supply	Mt CO_2e.	**2.56**	**3.58**	**4.44**	**5.78**	**7.58**	**9.95**
UGVCL							
	Units	2005	2010	2015	2020	2025	2030
Total electricity supplied	MUs	1,329.28	2,233.49	5,972.73	11,710.08	24,184.70	49,948.39
Coal based electricity	MUs	1,141.85	1,918.57	5,130.57	10,058.96	20,774.65	42,905.66
Gas based electricity	MUs	132.93	223.35	597.27	1171.01	2,418.47	4,994.84
Emissions from coal based electricity	Mt CO_2e.	0.98	1.65	4.41	8.65	17.87	36.90
Emissions from gas based electricity	Mt CO_2e.	0.06	0.09	0.25	0.49	1.02	2.10
Total emissions from UGVCL elec. supply	Mt CO_2e.	**1.04**	**1.74**	**4.66**	**9.14**	**18.88**	**39.00**
Total emissions from electricity consumption (Mt of CO_2e)							
	Units	2005	2010	2015	2020	2025	2030
Total emissions from electricity consumption	Mt CO_2e.	**3.59**	**5.33**	**9.10**	**14.92**	**26.46**	**48.94**

Table 17: Per capita electricity consumption in India and its cities[15]

City/Region	kWh/person
Ahmedabad	1,564
Gujarat	2,378
India	1,181
MP	1,084
Bhopal	588
Indore	724
New Delhi	1,548
Mumbai	1,121
Chennai	1,366
Bengaluru	1,074

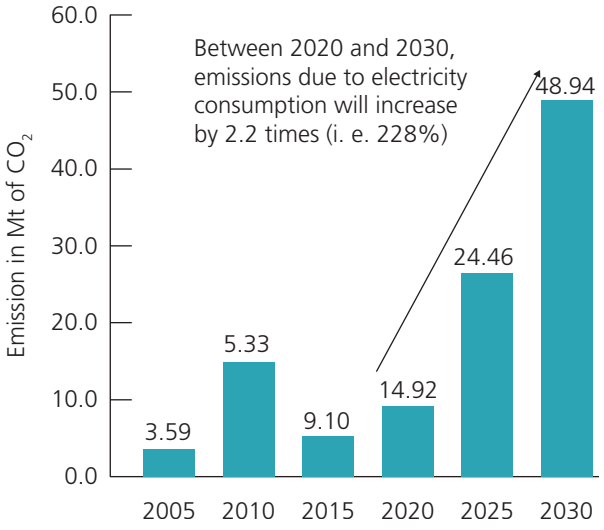


Figure 36: Carbon footprint of electricity consumption in Ahmedabad district

Ahmedabad has a higher per capita electricity consumption than Delhi & Mumbai

14 Grid emissions factor for electricity generated through Coal = 0.86 kg CO_2/kWh; and through Gas = 0.42 kg CO_2/kWh

15 For CAGR calculations, vehicle numbers uptill 2016 are considered because post separation of Bavla RTO from Ahmedabad RTO, the vehicle registrations declined at Ahmedabad RTO

3.3 Vehicular growth trends

Ahmedabad has three RTOs – RTO Ahmedabad, ARTO Vastral and ARTO Bavla. The data trend below is that of RTO Ahmedabad (Table 18, 19 and Figure 37). Operations at RTO Vastral commenced in 2012, while RTO Bavla commenced in 2017, diverting the vehicular registrations from RTO Ahmedabad (hence the decline in numbers post 2011 and 2016). Information on the number of vehicles registered at RTO Vastral and RTO Bavla is represented in Table 20 and Table 21.

Table 18: Trend of vehicular registrations over the years in Ahmedabad (2005 to 2019)

Number of vehicles registered in RTO Ahmedabad	Goods Vehicles	Passenger vehicles (4 wheelers and above)	Private Motor Cars	Taxi cabs	Jeeps	Auto-rickshaws	Two wheelers	Tractors	Trailors	Other	Electric Vehicles
2005	5,042	655	14,975	265	529	15,297	1,08,225	1,375	724	460	0
2006	5,560	695	18,212	311	641	14,566	1,14,270	1,531	787	528	0
2007	5,630	620	21,105	297	1,149	8,857	1,08,920	1,605	987	762	0
2008	5,026	762	24,232	461	1,340	7,152	90,995	1,828	950	850	0
2009	6,110	720	25,943	531	4,096	9,462	1,10,768	1,817	1,064	935	0
2010	8,225	881	39,839	582	1,373	11,973	1,42,020	2,354	1,099	915	0
2011	9,581	1,209	45,482	837	226	11,646	1,50,446	3,588	1,385	747	0
2012	8,699	1,093	41,634	996	268	9,441	1,34,360	1,938	1,168	631	0
2013	7,515	938	38,270	862	91	5,928	1,31,368	1,876	848	303	0
2014	7,333	819	46,631	1,449	59	6,919	1,49,916	2,811	506	235	0
2015	7,922	997	52,182	1,307	41	8,159	1,61,527	2,353	628	257	0
2016	8,318	1,288	55,640	2,595	28	8,133	1,71,937	2,265	544	274	0
2017	6,050	938	49,131	2,687	7	6,896	1,55,939	875	184	239	0
2018	5,167	852	38,557	2,219	0	7,083	1,10,818	244	25	201	23
2019	5,825	494	35,791	1,999	0	8,549	1,08,847	236	23	209	196
CAGR (2010 to 2016)	0.19	6.54	5.73	28.30	-47.73	-6.25	3.24	-0.64	-11.06	-18.23	

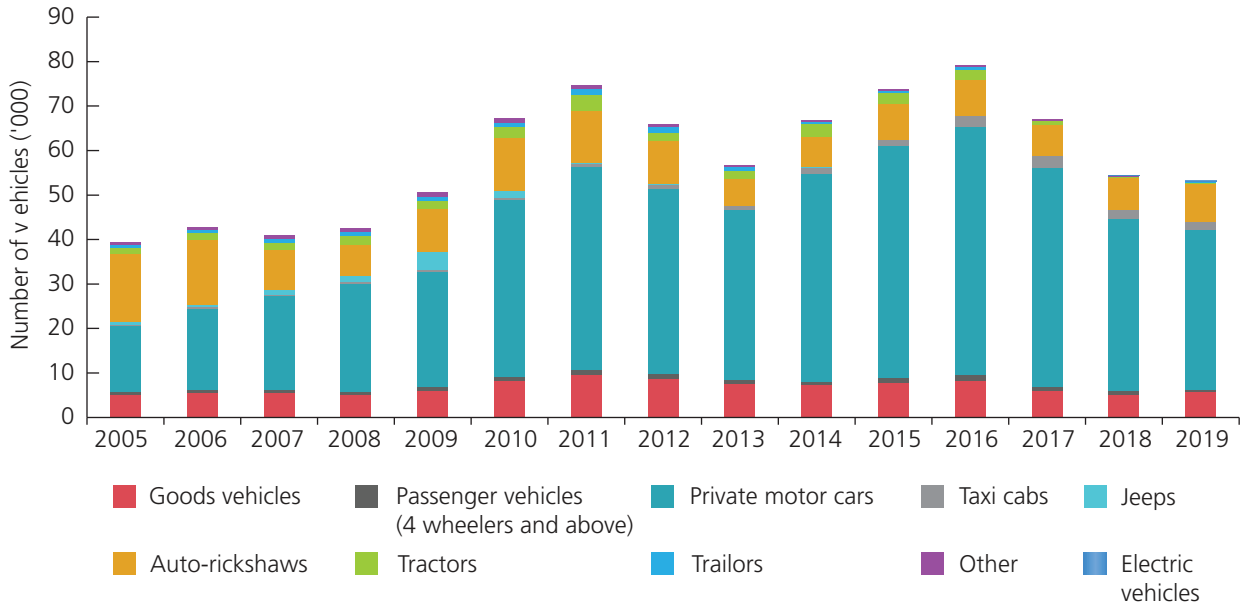


Figure 37: Trend for vehicular registrations in Ahmedabad over the years (Ahmedabad RTO)

Table 19: Projections for vehicle numbers (vehicle category wise) for Ahmedabad RTO only

Projections based on CAGR from 2010 to 2016	2005	2010	2015	2020	2025	2030
Goods vehicles	5,042	8,225	7,922	5,835	5,891	5,946
Passenger vehicles (4 wheelers and above)	655	881	997	526	722	991
Private motor cars	14,975	39,839	52,182	37,841	49,987	66,032
Taxi cabs	265	582	1,307	2,565	8,916	30,994
Jeeps	529	1,373	41	0	0	0
Auto-rickshaws	15,297	11,973	8,159	8,016	5,808	4,208
Two wheelers	1,08,225	1,42,020	1,61,527	1,12,371	1,31,776	1,54,531
Tractors	1,375	2,354	2,353	234	227	220
Trailers	724	1,099	628	20	11	6
Other	460	915	257	170	62	23
Electric vehicles	0	0	0	302	2,623	22,778

Year-on-year data on vehicular registrations was not available for ARTOs Vastral and Bavla. However, cumulative vehicular registration data is available since inception of the ARTOs, and have been represented below:

Table 20: Total vehicular registrations at ARTO Vastral (since 2012)

Number of vehicles registered	Cumulative data (from 2012 to 23/03/2021)
Goods vehicles	36,654
Passenger vehicles (4 wheelers and above)	565
Private motor cars	1,10,785
Taxi cabs	4,467
Jeeps	0
Auto-rickshaws	32,944
Two wheelers	6,18,041
Tractors	993
Trailors	365
Other	824
Electric vehicles	0
Vehicles for agricultural use	2,844
Construction equipment vehicle	732
Industrial equipment vehicle	525
e-Rickshaws	13

Table 21: Total vehicular registrations at ARTO Bawla (since 01/05/2017)

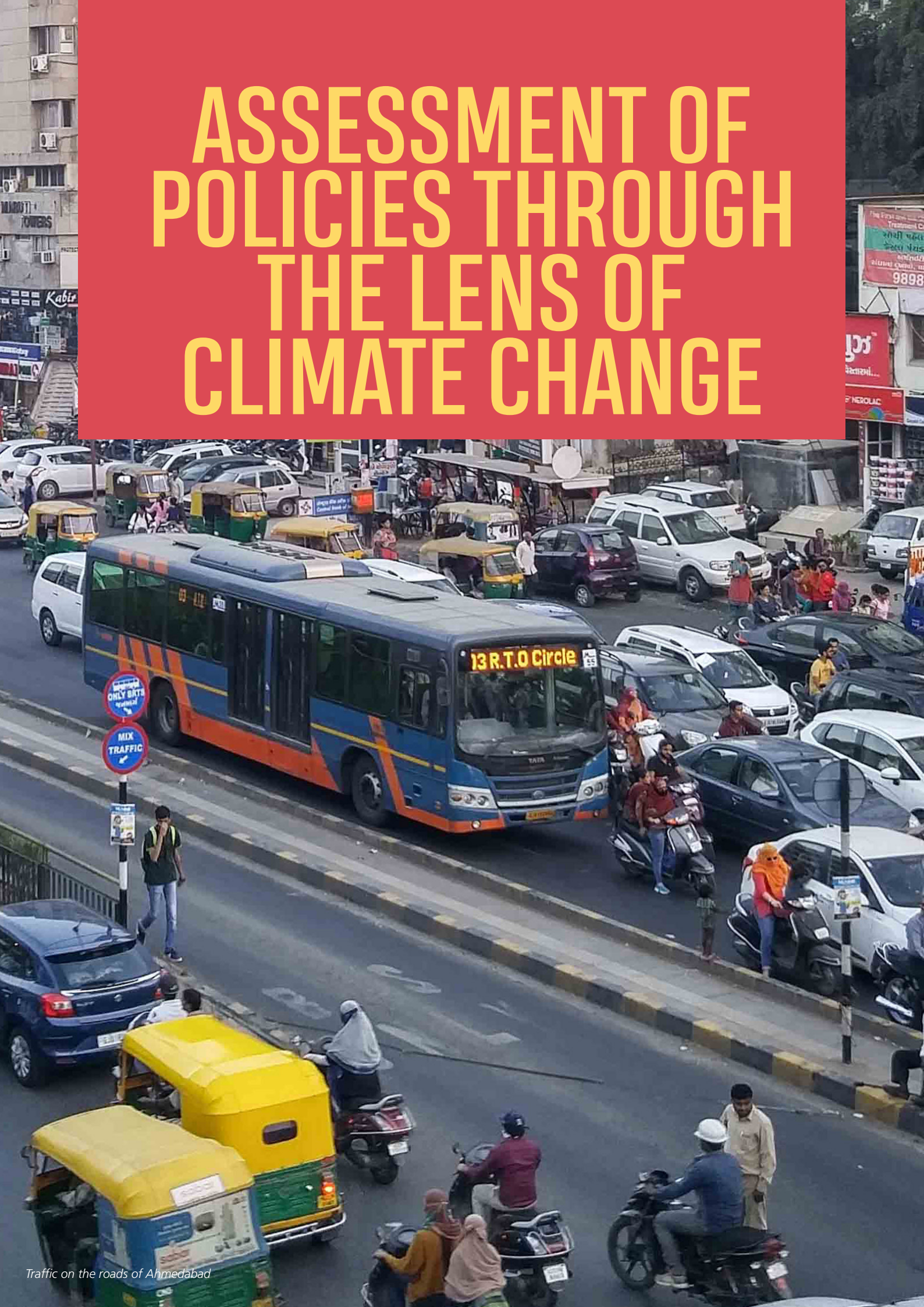
Number of vehicles registered	Cumulative data (from 01/05/2017 to 06/04/2021)
Goods vehicles	5,855
Passenger vehicles(4 wheelers and above)	331
Private motor cars	24,236
Taxi cabs	709
Jeeps	0
Auto-rickshaws	5,148
Two wheelers	74,307
Tractors	542
Trailors	20
Other	171
Electric vehicles	0
Vehicles for agricultural use	7,330
Construction equipment vehicle	502
Industrial equipment vehicle	65
E-rickshaws	4

Private motor cars & taxi cabs have seen significant growth (Ahmedabad RTO) with a CAGR of

5.73% & 28.3%

respectively

ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE



Traffic on the roads of Ahmedabad

4. ASSESSMENT OF POLICIES THROUGH THE LENS OF CLIMATE CHANGE

This section uses a climate change mitigation perspective to evaluate the impact of national and state level policies and programmes being implemented in the district. A total of 40 policies have been evaluated for the sectors of energy, AFOLU and waste.

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

4.1 Sector-wise policy impact analysis

4.1.1 Power and energy sector[16]

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

List of policies evaluated

Clean Energy

1) Gujarat Solar Policy, 2021; 2) Surya Urja Rooftop Yojana; 3) Solar Power Policy, 2015; 4) Policy for development of small-scale distributed solar projects, 2019; 5) Waste to Energy, 2016.

Energy Efficiency in buildings, public infrastructure and industrial processes

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

Transport

1) BRTS Ahmedabad.

Emissions evaluation

Amongst the policies evaluated,

- Clean energy-related policies and programmes resulted in avoiding 96,000 tonnes of CO_2e emissions (policies on solar energy – 71,000 tCO_2e and Waste to Energy – 25,000 tCO_2e).
- Policies and programmes related to enhancing energy efficiency in buildings and processes have led to avoiding 83,31,667 tonnes of CO_2e emissions (UJALA Scheme – 2,47,668 tCO_2e; SLNP – 8,569 tCO_2e; IPDS, R-APDRP, UDAY – 70,87,085 tCO_2e; PAT Scheme – 9,88,345 tCO_2e).
- Interventions in transport resulted in avoidance of 3,64,361 tonnes of CO_2e emissions.

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

Information gaps

1) Policies pertaining to renewable energy:
   - Year-on-year data is not available for Ahmedabad since inception of the policies considered here.
   - Data on electricity generation from the solar plants is not available.
2) Energy efficiency: Year-on-year data on the number of UJALA LEDs distributed and the number of LED streetlamps installed in the district are not available.
3) Transport:
   - Latest modal share of transport is required for the district.
   - Annual utilisation factor of vehicles is required for the district. For the current analysis, national values have been used.

4.1.2 Agriculture, forestry and other land use (AFOLU) and cross-cutting[17]

Policies, programmes and schemes pertaining to agriculture, animal husbandry, livestock rearing, and forestry have been grouped together under AFOLU sector initiatives in order to understand their impact on climate mitigation.

List of policies evaluated

A total of 10 policies and programmes under AFOLU sector and two programmes under cross-cutting (nexus of agriculture and energy) have been considered for this evaluation.

Agriculture

(1) Soil Health Card Scheme; (2) National Food Security Mission; (3) Soil and Moisture Conservation (SMC); and (4) Saradar Sarovar Project on Narmada.

Livestock

(1) Cattle and Buffalo Development Programme; and (2) Feed and Fodder Development Programme.

Forestry

(1) Wildlife Protection Act, 1972; (2) Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980; (3) Social Forestry Scheme; and (4) National Agroforestry Policy 2014.

Cross-cutting (agriculture and energy)

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

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

Emissions evaluation

An attempt has been made to quantify GHG emissions avoided/added by each initiative. However, for a few policies and programmes, it could not be computed due to lack of information. This exercise helped identify the following:

- Forestry policies helped in avoiding 16,12,544.27 tonnes of CO_2e emissions.
- Policies pertaining to livestock proved to be beneficial for climate action by avoiding 598.97 tonnes of CO_2e.
- In the agricultural sub-sector, impact of only one policy could be computed – the National Food Security Mission added 11,515 tonne of CO_2e.
- Under the cross-cutting sector, the National Mission on Micro Irrigation resulted in avoiding 1,140 tonnes of CO_2e emissions (from reduction in use of fertiliser). Additionally, the Pradhan Mantri Ujjwala Yojana has helped mitigate 6,78,546 tonnes of CO_2e.

Information gaps

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

1. Specific number of livestock in Ahmedabad that can be attributed to 'Cattle & Buffalo Development Programme'.
2. Information pertaining to the 'Feed & Fodder Development Programme' like the quantity of feed additives added to fodder, size of target population etc.
3. Percentage of wheat and pulses production in Ahmedabad that can be attributed to National Food Security Mission.
4. Area covered under Soil Health Card Scheme.
5. Reduction in chemical fertiliser use due to recommendations (followed by farmers), given in the soil health cards.
6. Percentage of rice production that can be attributed to improved irrigation with availability of Narmada canal water.

4.1.3 Waste management [18]

Waste sector policies implemented in the district of Ahmedabad were categorised into sanitation, waste management (solid waste, biomedical waste, and hazardous waste) and wastewater management (domestic and industrial).

List of policies evaluated

A total of 15 national and state-level policies and programmes were analysed to evaluate their role in mitigating emissions.

Sanitation

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

Waste management

1) Solid Waste Management Rules, 2016 & Amendment 2018; 2) Bio-medical Waste Management Rules, 2016 & Amendment 2018; 3) Hazardous & Other Wastes (Management and Transboundary Movement) Rules, 2016.

Domestic and industrial wastewater

1) National River Conservation Plan; 2) Jawaharlal Nehru National Urban Renewal Mission on Urban Infrastructure and Governance; 3) Atal Mission for Rejuvenation and Urban Transformation (AMRUT); 4) Common Effluent Treatment Plant (CETP) for medium- and small-scale industries; 5) Online Continuous Emission Monitoring System (OCEMS).

18 The detailed impact analysis of policies and programmes (giving information on input indicators, calculation methodology etc.) for Waste is given in Annexure 4.4

Emissions evaluation

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

- Emission of 86,325 tCO_2e from individual household latrines (IHHL: two pit latrine) and 1,42,890 tCO_2e from community latrines (septic tank) constructed under sanitation programmes/policies;
- Mitigation of 3,977 tCO_2e emissions from biological treatment (composting) of MSW;
- Emission of 4,99,332 tCO_2e for STPs constructed under sewerage connection programmes. The implementation of these activities has avoided an annual average emission (w.r.t. baseline[19]) of 50,254 tCO_2, 5,188 tCO_2 and 39,630 tCO_2 by sanitation, solid waste and liquid waste management developmental/policy initiatives respectively in the district.

Information gaps

1) Waste: District-level BMW generation and incineration data and hazardous waste incineration data is not available
2) Domestic wastewater (sanitation): For old and completed policies, there is a gap in availability of data on the number of sanitation infrastructure constructed. In most cases, district-level data was not available;
3) Domestic wastewater: Policy-wise data is not available;
4) Industrial wastewater: Industry-wise wastewater discharge and treatment data is not in public domain.

Gaps in policy and implementation

Power and energy sector

Gujarat ranks fourth in total installed solar capacity and first in solar rooftop installed capacity at the national level. Gujarat's current total solar installed capacity stands at 4.05 GW (as on Jan 31, 2021), 77.3 percent of which is ground-mounted and 22.7 percent is solar rooftop (MNRE). It is noteworthy that GoG has lifted the capacity ceiling for setting up solar plants and has a subsidy provision of ₹ 10,000/kW for domestic consumers and up to 40 percent of the installation cost for government, commercial and industrial buildings, in addition to the 30 percent provided by the central government (to both domestic and non-domestic consumers). Despite these efforts, the state is deficient by around 4 GW in achieving its '8 GW of installed solar capacity' target by 2022. The state needs to enhance its endeavours in implementing the solar projects in the state, in order to cover this lag in due time. The completion of the proposed hybrid RE power plant in Kachchh, with the proposed capacity of 30GW by 2022, would help the state in achieving its target. Ahmedabad also has a huge potential for solar rooftop installations.

Gujarat's current total solar installed capacity stands at 4.05 GW (as on Jan 31, 2021),

77.3 % of which is ground-mounted and

22.7 % is solar rooftop (MNRE)

Through Surya Shakti Kisan Yojana (SKY), the Gujarat government aims at benefitting 12,400 farmers across 33 districts, by helping them generate solar energy for captive consumption and sell the surplus to the grid. However, the progress report for this scheme is not available. In addition, the Solar Pump Scheme in tandem with PM KUSUM Yojana was launched to provide solar pumps to farmers to reduce grid dependence for irrigation. However, no solar plant or stand-alone solar pumps have been installed in the state under PM KUSUM Yojana (GUVNL)[20]. Enhanced endeavours of the state in implementing and capturing mass attention towards SKY and PM-KUSUM Yojana would help the state strengthen its RE infrastructure.

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

20 https://pmkusum.guvnl.com/achive.html

ECBC Compliance: The draft Energy Conservation Building Code (ECBC) was published in 2017. However, the code is yet to be notified and implemented in the building byelaws for Gujarat.

Transport sector policies:

- The current modal share of public transport is low – at around 11 percent – indicating a weak public transport network. Policy interventions need to be undertaken to overhaul the existing public transport system and increase its popularity and usability.
- Policy-level intervention is needed to improve BRTS and other public transport modes in terms of robustness, reliability, frequency and reach in the district.
- There is need for green transportation policies or programmes in the district.

AFOLU sector

- To address high emissions emanating from continuous flooding undertaken for rice cultivations, policy level interventions are needed to promote techniques and practices that lower emissions. These include measures such as use of aerators (single or multiple) in rice fields, popularising intermittent flooding, and promotion of high yield rice crop.
- Increase in cattle count with low productivity is a key contributor to AFOLU sector emissions due to enteric fermentation. At present, there are a few policies in place which can be enhanced to curtail emissions arising from enteric fermentation in livestock. Sectoral experts can suggest relevant changes in 'Feed and Fodder Development Programme' and 'Cattle & Buffalo Development Programme' to bring quantifiable reduction in emissions from livestock.
- With rapid urbanisation and development, Ahmedabad is susceptible to losing its already sparse forest cover. Stringent policy measures are needed to ensure that Ahmedabad's forest cover is not only maintained, but also enhanced. This will ensure several benefits, such as: (a) act as a sink for the district's GHG emissions; (b) reduce urban heat-island effect; (c) strengthen ground water resources etc.

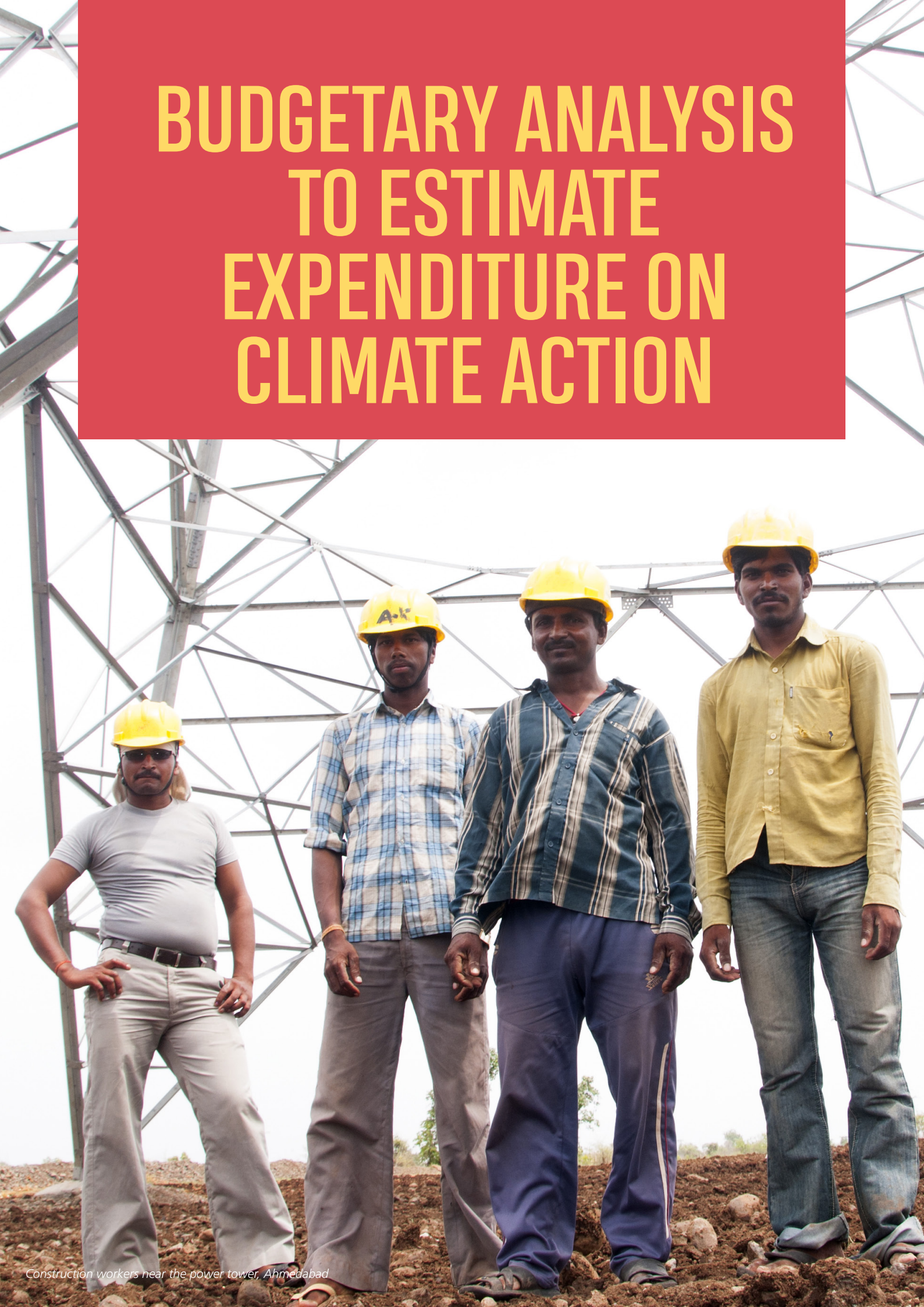
With rapid urbanisation and development, Ahmedabad is susceptible to losing its already sparse forest cover

- Policy level interventions can break the unhealthy nexus between power and agriculture. Activities such as non-judicious irrigation practices, lead to high electricity consumption patterns. Policies pertaining to electricity pricing, subsidies and collection of tariffs need to be revised.

Waste management

- State-level reporting of waste generation and treatment data is mandatory. However, barring BMW, there is no policy that mandates reporting and maintenance of district-wise data on the type of waste treatment undertaken.
- Even for BMW, such data is not being recorded and maintained at the district level (and/or the information is not in public domain).
- There are no policies for data maintenance and availability of domestic and industrial waste water (industry-wise) generation, treatment and discharge pathways.
- Waste management policies do not suggest gas management/capture facilities for composting and incineration units to dispose waste.
- Reduction of waste transportation emissions is not addressed in the waste management policies.
- Though the Solid Waste Management Rules, 2016 suggest producer take back mechanisms for disposables in municipal solid waste, there are no guidelines for monitoring and reporting the same.
- E-waste Management Rules, 2016 recommends states to maintain an e-waste inventory. Though GEMI has an e-waste inventory, it does not reflect the total waste electrical and electronic equipment (WEEE) generation from the district, as it does not consider all categories of electricals and electronics.

BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION



Construction workers near the power tower, Ahmedabad

5. BUDGETARY ANALYSIS TO ESTIMATE EXPENDITURE ON CLIMATE ACTION

5.1 Introduction to budgetary analysis

Annual district budgets and schemes are analysed using a methodology derived from UNDP's 'The Climate Public Expenditure and Institutional Review (CPEIR)' methodology. The CPEIR is a systematic qualitative and quantitative analysis of public expenditures and how they relate to climate change. Since 2011, CPEIRs have been conducted in many countries in the Asia-Pacific, including Bangladesh, Indonesia, Nepal, Thailand and Vietnam among others at both national and sub-national levels.

This section analyses select flagship schemes at district level. A total of 38 schemes were reviewed to identify those with climate resilience and mitigation relevance. Of these, based on the availability of information across districts as well as relevance to climate actions, five schemes were selected for further analysis.

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

5.2 Analysis and findings of flagship schemes

5.2.1 Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)[21]

2018-19

- District annual budgetary expenditure: ₹ 1,39009 lakh
- Allocation to climate action: 14%
- Majority of climate action works: drought proofing

2019-20

- District annual budgetary expenditure: ₹ 1,097.77 lakh
- Allocation to climate action: 14%
- Majority of climate action works: drought proofing

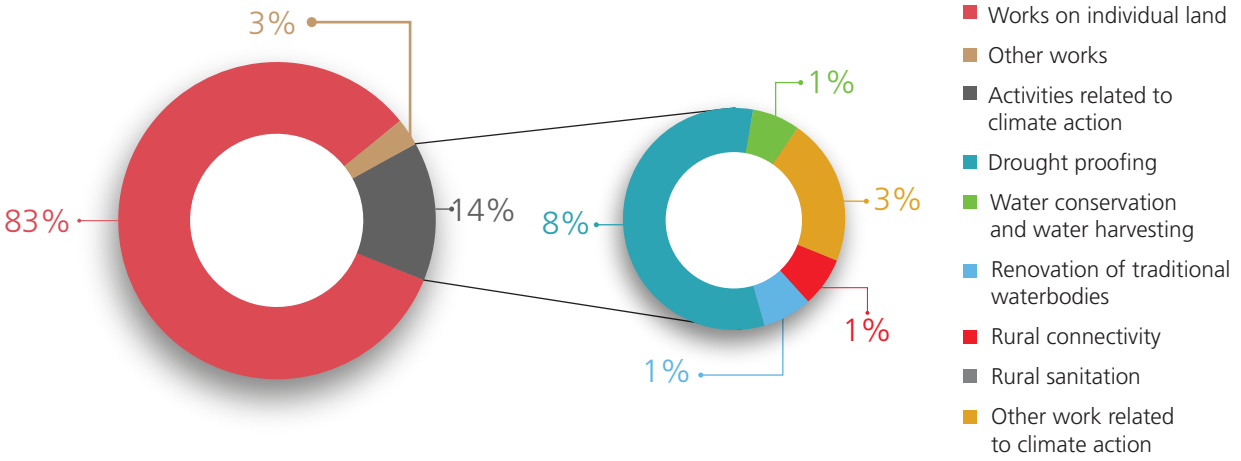


Figure 38: MGNREGS expenditure in Ahmedabad district (2018-19)

21 Ministry of Rural Development (MoRD) lists 17 major activities under MGNREGS. Out of these, 11 can be attributed to be acting on Climate Change, categorised as mitigation specific, resilience specific or both, refer annexure 5.3 for details.

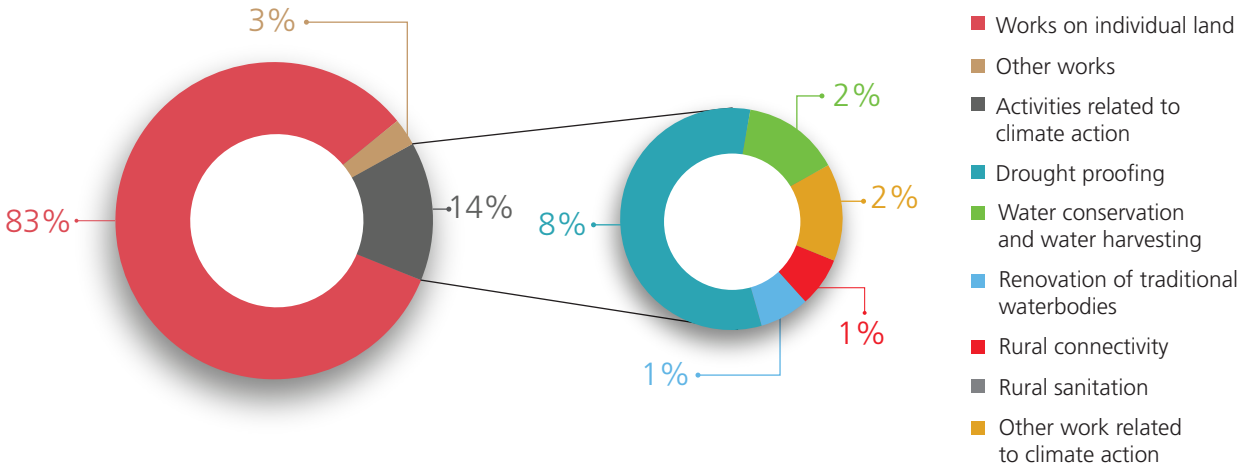


Figure 39: MGNREGS expenditure in Ahmedabad district (2019-20)

Annual expenditure (₹ lakh)

	Drought proofing	Renovation of traditional water bodies	Rural connectivity	Water conservation and water harvesting	Other works related to climate action
2018-19	107.69	19.96	16.67	19.30	36.63
2019-20	82.80	16.52	12.76	17.15	26.77

Figure 40: Comparing annual expenditures (in ₹ lakh) under MGNREGS in Ahmedabad between 2018-19 and 2019-20

5.2.2 Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

The micro-irrigation techniques employed in the district under this scheme are: 1) Drip irrigation and 2) Sprinkler irrigation. Other works include building of community ponds, tanks, check dams and earth dams. Table 22 summarises the budgetary spending and allocation to climate action under the scheme in the district.

Table 22: Budgetary allocation to PMKSY in Ahmedabad district

Budget allocations	2016-17	2019-20
Budgetary spending on micro-irrigation activities (₹ lakh)	641	206
Budget attributed to climate action (₹ lakh) (see annexure 5.3 for methodology)	442.29	142.14
State budget for PMKSY micro-irrigation (₹ lakh)	25,000	24,000
% attributed to climate action (micro-irrigation budget under PMKSY) given to district w.r.t state budget	1.77	0.59

5.2.3 Green India Mission (GIM)

For Ahmedabad district, the Department of Forests provides a five-year plan for the expenditure on the six sub-missions[22] under GIM. Figures 41 and 42 detail the fund allocation in Ahmedabad district under GIM. As observed, the major activities under the mission have enhanced the quality of forest cover and improved ecosystem services, i.e., sub-mission 1 under the GIM.

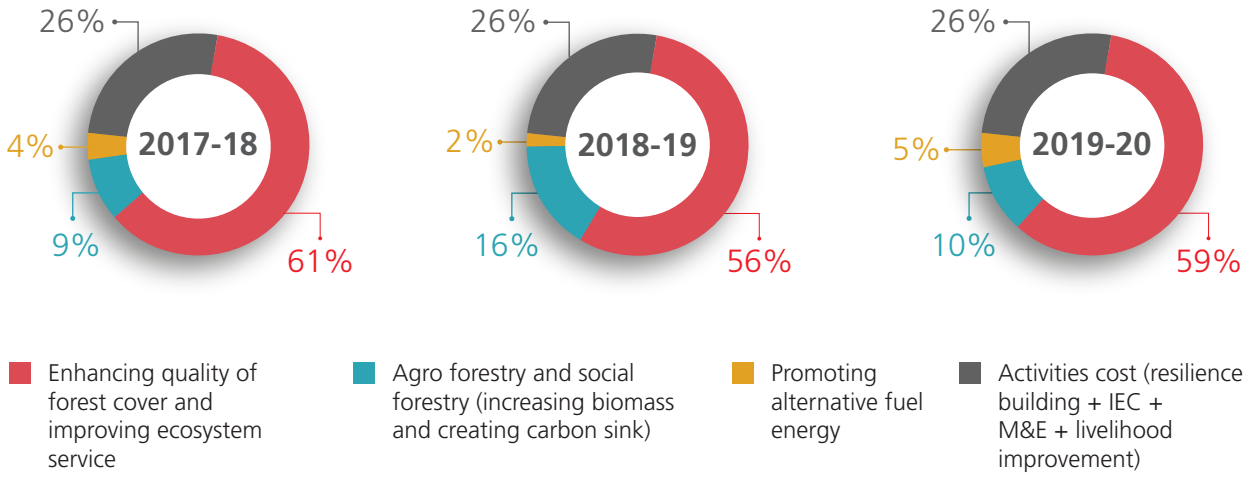


Figure 41: Distribution of budgetary targets for activities targets under GIM in Ahmedabad 2017-18, 2018-19 and 2019-20

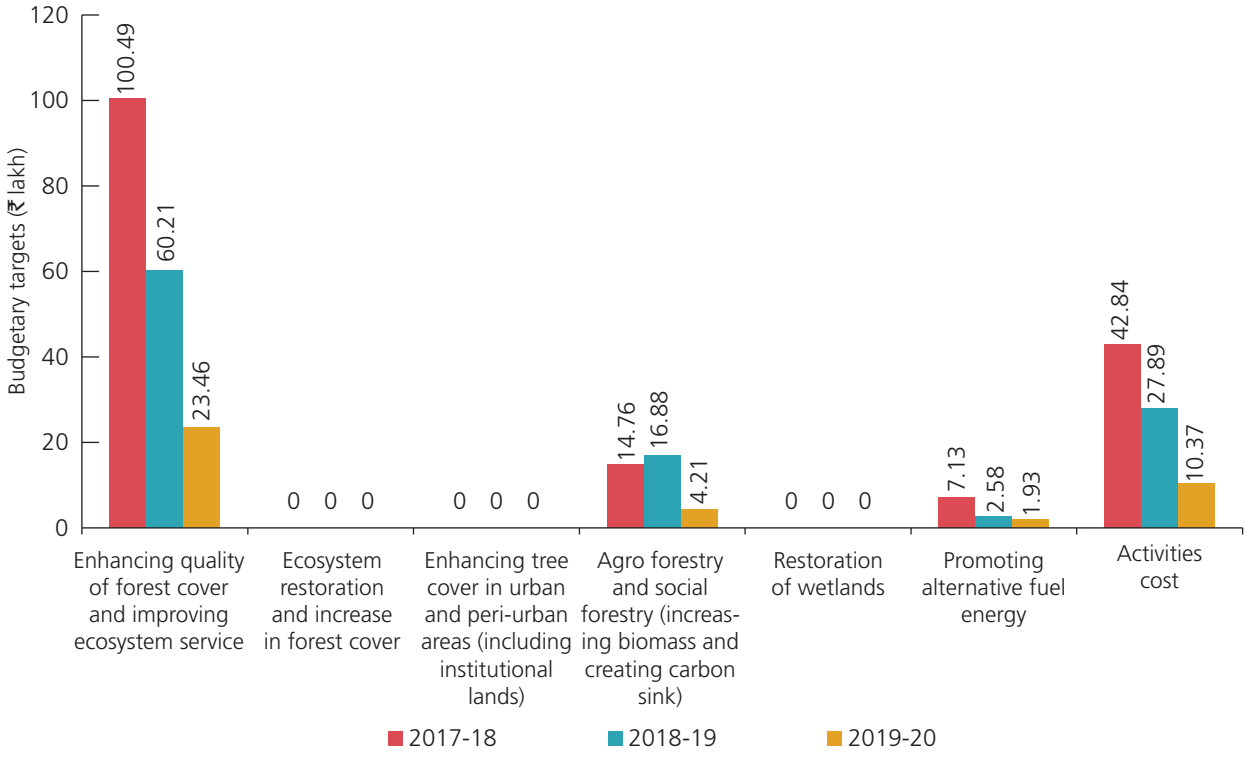


Figure 42: Comparison of the budgetary targets for various activities under GIM in Ahmedabad for 2017-18, 2018-19 and 2019-20

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

5.2.4 Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[23]

Based on the methodology and assumptions mentioned in Annexure 5.2, amounts of ₹ 4,282 lakh and ₹ 6,342 lakh can be attributed to climate action under the scheme for Ahmedabad district in FY 2015-16 and FY 2016-17, respectively (See Figure 44 for budget distribution). Further, Figure 43 gives a distribution of budgetary allocations between years 2015 and 2020 in Ahmedabad district, with the total allocation during this period being ₹ 46,723 lakh.

Total budget allocated under AMRUT (₹ crore)

	Water supply	Sewage and septage management	Parks and gardens	Urban transport
2015-16	0	42.53	0.28	0
2016-17	43.46	16.55	1.05	2.37
2017-20	48.81	101.20	1.75	0

Figure 43: Comparison of budgetary expenditure on climate related activities under AMRUT scheme in Ahmedabad district

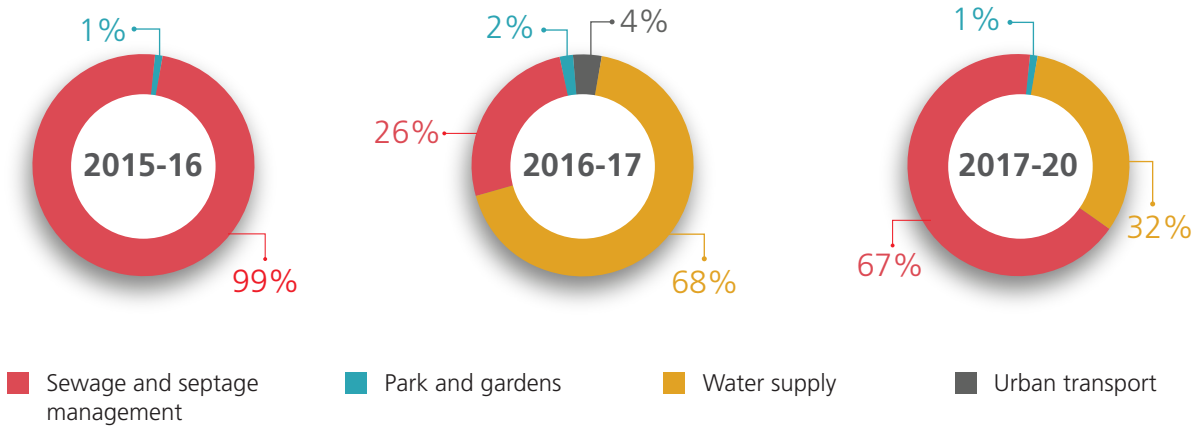


Figure 44: Distribution of climate relevant budgetary expenditure on activities under AMRUT scheme in Ahmedabad for 2015-16, 2016-17 and 2017-20

5.2.5 Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY) and Saubhagya Scheme[24]

Till April 30, 2020, an amount of ₹ 2,035 lakh has been released to carry out the activities under Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY) and Saubhagya Scheme. Hence, based on the methodology, an amount of ₹ 1,017.5 lakh can be attributed towards climate action for the Ahmedabad district (see Annexure 5.3 for methodology and assumptions).

23 The activities performed under the mission can be broadly categorized into five sectors: Water Supply; Sewage and septage management; Stormwater drainage; Green space development; Urban transport

24 Major activities carried out under DDUGJY and Saubhagya Yojana by the Ministry of Power, GoI include: installing new substations, augmenting existing substations, installing DTRs, laying LT lines, installing feeders, feeder segregation among others. Of 11 activities under the scheme, 6 were concluded to directly support climate action.


AMDA BIKE
Smart City AHMEDABAD
BRTS થી ઓફિસ
કે BRTS થી ઘર
હવે MYBYK પર
Drop & Pick at any Hub
MYBYK HUB
MYBYK HUB
MYBYK BIKESHARE
DOWNLOAD, UNLOCK & RIDE
GET IT ON Google Play
Download on the App Store
TO KNOW MORE 7043 987 987
MYBYK
MYBYK
greenpedal

RECOMMENDATIONS

Bicycle rental station, Ahmedabad

6. RECOMMENDATIONS

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

- Recommendations are grouped under four broad categories – energy, agriculture, forestry and other land use (AFOLU), waste, and district specific environmental issues.
- Actions under each category on which recommendations can be made by the district collector/committee to the relevant state departments as well as inputs on innovative financing have been identified.
- These recommendations are based on district-specific ground realities and situations.
- The state and district vision documents were factored in while developing the recommendations.
- Information provided on timeframe and framework for implementation would enable the district authorities and concerned departments to prioritise actions.
- List of existing policies, programmes and schemes that can help streamline actions is provided along with the concerned primary and supporting departments in a separate table following each sectoral recommendation matrix.
- Additionally, this section provides information on SDGs and other co-benefits that can be addressed through the mentioned recommendations in this action plan.
- Sector-wise potential GHG mitigation of CCEAP recommendations for Ahmedabad district are:
  a. 30,54,254 tCO_2e from Energy recommendations (including power, habitats, transport and industries),
  b. 13,66,129 tCO_2e from AFOLU recommendations (agriculture, forestry and livestock),
  c. 5,85,044 tCO_2e from waste sector recommendations.
- 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

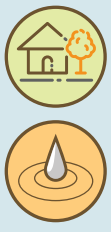
6.1 Sector specific recommendations

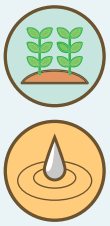
6.1.1 Electricity and energy: Recommendations, cross-cutting sectors, qualifying priority and district scenario

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 create awareness in residential sector	India has a target of 40 GW for solar rooftop (2022). As of February 28, 2021, only 4.32GW has been achieved. Gujarat has only 0.94GW (as of February 2021) of solar rooftop capacity. Case example calculation: a) Just the government schools in Ahmedabad district, if equipped with solar rooftops, can generate 118 MUs of electricity, thereby avoiding 0.102 $MtCO_2e$ emissions, annually. b) Further, if 50% households are equipped with solar rooftops, total installed capacity will be 4,185 MW, which can help avoid 2.44 Mt CO_2e emissions, annually. Meeting the solar rooftop targets can be fast-paced by making it mandatory for hospitality industry/new construction (having a built-up area greater than 20,000 sq. ft) / private healthcare infrastructure (above certain bed-capacity). Ground mounted solar: The current installed capacity of ground mounted solar in Gujarat stands at 3.11 GW (as of February 2021). Ahmedabad district has a huge potential for solar power generation (rooftop and ground mounted). In the highly urbanised and industrialised Ahmedabad city, solar rooftop installation can be promoted. For the remaining district, ground-mounted solar installations can be more viable.
Aggressively promote battery storage for RE.		Short to medium-term	Additional financial support can be created	Case example: Maharashtra Energy Development Agency has installed 650 Ah batteries for a few solar projects and has proposed hybrid inverters for RE projects across Maharashtra. Hybrid inverters take power from battery/RE installation up to a particular load, and on increased demand, they switch to the grid supply. Similar initiatives can be taken up in the district by GEDA.

Recommen-dations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
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 create awareness	By 2030, the electricity demand for Ahmedabad district is expected to be approximately 30,000 MUs annually. If all of this electricity demand were to be met from coal, it would cause around 25 Mt CO_2e emissions, annually. Decentralised renewable energy (DRE) setups can power small/cottage industries, which in turn can play an important role in providing livelihoods in rural areas. Such setups would create new jobs and empower rural entrepreneurs. Cold storage and other rural non farm productive use appliances across the district can be powered by DRE. Such set-ups could also be used for reliable storage of vaccines besides farm produce.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
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	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. SLNP had a national target of replacing 1.34 crore conventional street lamps with LED ones by March 2020. Till date, only 1.18 crore LED lamps have been installed. Replacement of the existing 1,31,281 conventional lamps in Ahmedabad district with LED lamps under SLNP can potentially avoid 64,286 tCO_2e emissions, annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Advanced metering infrastructure: Expedite installation of smart meters in collaboration with GUVNL in an effort to develop advanced metering Infrastructure (AMI). 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 like: (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 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 hours, etc.		Short to medium-term	Policy framework and targets exist (section 6.1.1.1) Need to create awareness	Implemented by EESL (BEE), Smart Meter National Programme aims to replace 250 million conventional meters across the country with smart meters. However, under this programme no smart meter has been installed in Gujarat as of now. In Naroda (Ahmedabad), smart meters are being installed under the National Smart Grid Mission pilot project through UGVCL. This pilot project aims to cover 22,230 consumers.
Replace/upgrade existing inefficient pumping infrastructure with energy-efficient pumps/ solar pumps for supply of piped drinking water in both rural and urban pockets.		Short to medium-term	Relevant schemes and programmes can help achieve this (section 6.1.1.1) Inter-departmental collaboration.	GUDC has been designated as the nodal agency for the Municipal Energy Efficiency Programme (MEEP). This programme aims to improve the energy efficiency of pumping stations in 139 municipalities across Gujarat through detailed energy auditing. All the ULBs in Ahmedabad, in co-ordination with the relevant departments, can avail of the financial assistance/benefits under the scheme to make their systems energy-efficient.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
In agricultural sector, promote use of energy-efficient water pumps (provided by EESL), and solar pumps (through PM-KUSUM and SKY).		Short to medium-term	Policy framework exists (section 6.1.1.1)	According to BEE, agriculture can save 30-40% energy by adoptiing energy-efficient star-labelled pump sets. Converting 50% of existing electricity/ diesel operated tube-wells to solar can potentially reduce 24,288 tCO_2e emissions annually.
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	BSES Yamuna Power Ltd. (BYPL) launched an AC replacement scheme in Delhi with the objective of promoting energy efficiency among households. Under the programme, upfront rebate per air conditioner (BEE 5-star rated/ inverter) was offered by BYPL to the consumer in exchange of their old non-star rated air conditioner. UGVCL can implement a similar scheme in its area of supply. The unutilised funds from the District Mineral Foundation (DMF) can render much-needed financial support (for subsidies to mining affected communities) to implement the scheme.

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

Sub-sectors	Policies and programmes[25] that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Increase RE share in electricity generation	1) Gujarat Solar Power Policy, 2021 2) Surya Urja Rooftop Yojana 3) Policy for Development of Small-scale distributed solar projects, 2019 4) Waste to Energy Policy, 2016 5) National Solar Mission 6) i-SMART Project 7) PM KUSUM 8) Surya-Shakti Kisan Yojana (SKY)	1) GEDA, GoG 2) Energy and Petrochemicals Department, GoG	3) ALL ULBs 4) Gujarat Electricity Regulatory Commission 5) Rural Development Department, GoG 6) Urban Development Department, GoG 7) Climate Change Department, GoG 8) Commissionerate of Cottage and Rural Industries 9) GUVNL-UGVCL, GoG 10) Department of Agriculture, GoG 11) Proposed District level Committee on Climate Change and Environment

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

Sub-sectors	Policies and programmes[25] that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Energy demand-side management (DSM) and energy efficiency	1) Smart Meter National Programme (SMNP) 2) National Smart Grid Mission 3) Streetlight National Programme (SLNP), 2015 4) UJALA Scheme, 2015 5) Standards and Labelling Programme 6) Sustainable Habitat Mission 7) Smart Cities Mission 8) National Mission for Enhanced Energy Efficiency 9) Municipal Energy Efficiency Programme (MEEP) 10) PM KUSUM 11) Surya-Shakti Kisan Yojana (SKY) 12) Gujarat Solar Power Policy, 2021 13) Policy for Development of Small-scale distributed solar projects, 2019	1) BEE (EESL) 2) GEDA, GoG 3) All ULBs 4) Panchayati Raj Institutions (PRIs) 5) Energy and Petrochemicals Department, GoG	1) Climate Change Department GoG 2) Department of Agriculture, GoG 3) District Mineral Foundation (DMF) 4) AUDA 5) Smart City Ahmedabad Development Limited (SCADL) 6) Proposed District level Committee on Climate Change and Environment

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

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Energy efficiency in buildings				
Energy Conservation Building Code (ECBC) to be incorporated in the building by-laws for all ULBs, 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 Capital incentives/ relevant exemptions over and above the existing provisions from the district administration are required	The residential and commercial sectors in Ahmedabad contribute around 24% of the total electricity consumed in the district. GEDA is working with the Urban Development Department and the Climate Change Department to incorporate ECBC into building compliance systems.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
District administration, in collaboration with the ULBs can implement the India Cooling Action Plan (ICAP) and achieve its objectives, in tandem with the District Heat Action Plan. 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 to have a Cooling Action Plan, which seeks to: (a) Reduce cooling demand across sectors by 20% to 25% by 2037-38 (b) Reduce refrigerant demand by 25% to 30% by 2037-38 (c) Reduce cooling energy requirements by 25-40% by 2037-38 (d) Recognise "cooling and related areas" as a thrust area of research under national S&T programme (e) Training and certification of 100,000 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. The district cooling system in the Gujarat International Finance Tec-City (GiFT City) in Gandhinagar provides reliable cooling to residential, commercial and industrial buildings. The system, regulated by advanced metering and supervisory control and data acquisition (SCADA) systems, is expected to consume 60-85% of the energy used in conventional air conditioning.
Replace diesel-powered backup with RE-powered backup in a phased manner. This can essentially be promoted in government / commercial / institutional buildings with built-up area >20,000 sqft.		Short to medium-term (govt. 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 Paris targets Needs inter-departmental collaboration	186 entities in Ahmedabad district use DG sets as power backup, If 50% of the DG sets are replaced with solar-powered backup of the same capacity, 43,680 tCO_2e emissions can be averted annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promoting formulation of energy communities in existing RWAs/other residential committees where residents have ownership over their energy supply. Energy communities can host wind and solar generation installations, or a self-sufficient system functioning as a microgrid/undergrid-minigrid. These committees can make agreements between the community, the private developer and the utility company. Digitalisation can create innovative billing mechanisms and generating data that will provide important investment information to the energy market.		Medium-term	Deploying public funding schemes like feed-in tariffs, leverage national and international funds Providing digital upskilling opportunities to citizens can help promoting the initiative.	
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 needs to be mandated by building bye-laws	Ahmedabad district can implement initiatives similar to the one in Lucknow, where the municipal corporation has said it would set up 200 solar-powered bus stops.
Encourage fast penetration of UJALA scheme in every household of Ahmedabad 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. By 2030, the UJALA scheme can potentially avoid emissions of 0.38 $MtCO_2e$ annually.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Energy-efficient vertical urban development should be promoted instead of horizontal development to conserve green cover..		Medium to long-term	Policy-level intervention required	Vertical urban growth not only provides accommodation to more people per sq. m of space, but also averts loss of agricultural land and open spaces. It makes transport mechanism far more efficient.
Enhance public awareness towards energy-efficient BEE star-labelled home appliances.		Short-term and continuous	Needs collaborations and awareness	
Demand side management				
Promote and subsidise good practices for all ULBs, such as installing rainwater harvesting setups in buildings that can considerably reduce energy dependence on submersible motors for groundwater pumping.		Short-term	Schemes and programmes exist (section 6.1.2.1) Awareness generation required	According to the Comprehensive General Development Plan (2017) of AUDA, rainwater harvesting is mandatory for all buildings with ground coverage of 80 sq. m and above.
Implement individual water metering in residential sector to reduce water wastage, thereby bringing down energy consumption.		Medium-term	Policy intervention is required Need to create awareness	In many cities, drinking water and wastewater plants are municipally owned and are among the largest municipal energy consumers, often accounting for 30% to 40% of total municipal energy consumption. By incorporating energy efficiency measures into their water and wastewater plants, municipalities can save 15% to 30% of their municipal budgets. Since 2016, around 2,800 'building use' permissions have been given in Ahmedabad to societies on the condition that they install water meters. Sixteen apartments in Mantri Residency, Bengaluru, installed with water meters, are consuming 25-30% less water every year.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Encourage residential societies to adopt solar-thermal water heaters.		Short-term and continuous	Schemes and programmes exist (section 6.1.2.1) Inter-departmental collaboration required Scheme to be implemented as a part of green buildings	Multi-storey (up to 12 storeys) residential buildings can meet around 70% of the annual electricity requirement for water heating (BEE) through community solar water heating systems (assuming utilisation of 60% roof area).
Promote installation of automatic/smart water pumps to control overflowing of tanks.		Short-term	Need to create awareness	
Water cess by municipal corporation to be revised and gradually increased.		Medium-term	Policy framework to be revised	
Digital tools, like, GIS, remote sensing can be used to identify opportunities to reduce energy demand as well as where energy efficiency interventions hold the most value, and where and how to set up mixed-use zones to flatten demand curves. Energy demands (for cooling) of the district can be mapped, combining weather data with demand data, to identify where efficiency interventions are needed. Digital tools can also help to identify where energy efficiency interventions hold the most value, and where and how to set up mixed-use zones to flatten demand curves. Energy demands (for cooling) of the district can be mapped, combining weather data with demand data, to identify where efficiency interventions are needed.		Medium to long-term	Needs policy intervention and infrastructural development	By identifying optimal locations for water features or vegetation, Ahmedabad can counteract on heat islands through tree plantations that provide shade and reduce the power demand for cooling in buildings.

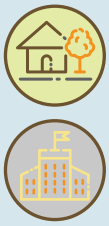
6.1.2.1 Habitat: Policy framework and concerned departments/agencies

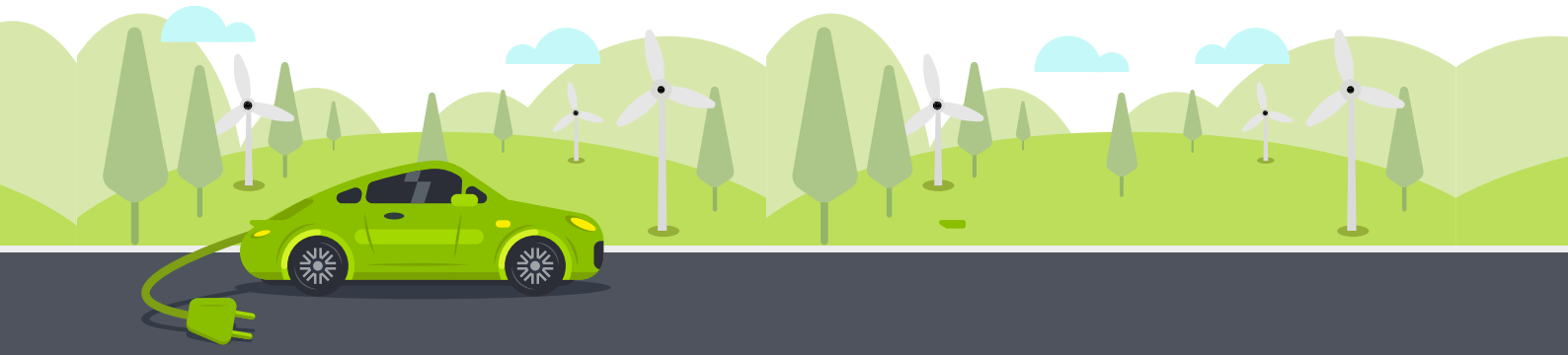
Sub-sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/ agencies
Energy efficiency in buildings	1) ECBC 2017 2) India Cooling Action Plan, 2019 3) UJALA Scheme, 2015 4) Gujarat Solar Power Policy, 2021 5) Surya Urja Rooftop Yojana 6) Policy for Development of Small-scale distributed solar projects, 2019 7) Smart Cities Mission 8) Sustainable Habitat Mission	1) Urban Development and Urban Housing Department, GoG 2) All ULBs 3) Smart City Ahmedabad Development Limited. 4) Panchayati Raj Institutions (PRIs)	1) GEDA, GoG 2) BEE (EESL) 3) Rural Development Department 4) Road and Building Department 5) Ports and Transport Department/GSRTC 6) Proposed District level Committee on Climate Change and Environment
Demand-side management	1) Gujarat Domestic Water Supply Protection Bill, 2019 2) ECBC 3) Building by laws 4) Comprehensive General Development Control Regulations, Urban Development and Urban Housing Development, Government of Gujarat.	1) Urban Development and Urban Housing Department, GoG 2) All ULBs 3) Rural Development Department 4) Panchayati Raj Institutions (PRIs)	1) AUDA 2) Gujarat Water Supply and Sewerage Board. 3) Smart City Ahmedabad Development Limited 4) Proposed district-level committee on climate change and environment

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

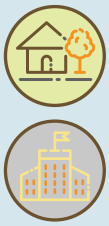
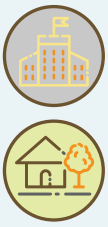
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote e-mobility				
Generate awareness and disseminate information to encourage adoption of electric vehicles.		Short-term and continuous	Inter-departmental collaboration and dedicated long-running campaigns required	
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) Budgetary provisions can be made available through various schemes	In January 2020, the Gujarat government announced it will be installing charging stations at multi-level parking lots and public places across the state.
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	Ahmedabad aims to become the first Indian city to convert its entire fleet of public transport buses into e-vehicles. The first phase of this endeavour was launched with the procurement of 19 EVs. In 2019, Gujarat announced that 500 electric buses will be procured in Ahmedabad. Till March 2019, Ahmedabad had procured 350 e-buses.

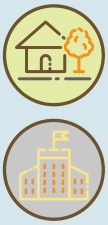
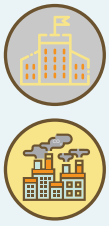
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Similarly, initiate transition of intermediate public transport (IPT) vehicles to electric by incentivising IPT operators through: a) subsidies 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 (section 6.1.3.1)	At present, subsidies are being provided in Gujarat for Li-ion battery-operated rickshaw of ₹ 10,000, bringing the cost to approximately ₹ 40,000. However, lead-acid battery-based vehicles are still cheaper, costing around ₹ 30,000.
District administration, ULBs (for office use and 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	Needs policy backing	The Gujarat EV Policy 2021 has recommended all government office parking areas to mandate installation of charging infrastructure for both employees and visitors. The district can take advantage of this provision and build on the same to encourage government departments to transition their fleets to EV-based vehicles.
Develop robust and widespread charging infrastructure. a) Charging infrastructure to be created at strategic locations – commercial hubs, public parking, airports and railway stations etc, preferably RE powered. b) Adoption of relevant policies. c) Prioritise land acquisition for setting up charging infrastructure. d) Dedicated parking spaces for EVs should be introduced with charging facilities. e) Restaurants and commercial spaces on highways can be incentivised to install charging infrastructure for e-vehicles to make long journeys with e-vehicles hassle-free. f) As a cost effective solution to reduce street clutter and to open acess (particularly for those without garagaes), integrated EV charging points into lampposts can be evaluated as a trail solution for further implementation possibilities.		Medium-term	Policy framework exists (section 6.1.3.1) Inter-departmental collaboration required	Energy Efficiency Services Limited (EESL) and Ahmedabad Municipal Corporation (AMC) have partnered to establish infrastructure for electric vehicles (EV) in Ahmedabad city over a 10-year period. They plan to establish 100 charging stations to promote renting and purchase of electric vehicles. AMC is expected to save over 4.46 tonnes of CO_2 emissions per EV per year.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
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) continuation of the existing subsidy scheme for women and students		Short-term	Some policy framework exists, needs to be enhanced towards holistic integration of e-vehicles in the district transport regime	The government of Gujarat is already providing subsidies of up to ₹ 12,000 (to students and women) to purchase electric two-wheeler, and a subsidy of ₹ 42,000 for e-autos.
Promote fast registration of EVs at RTO		Short-term	Existing policy framework can be enhanced	Gujarat EV Policy, 2021 has provisions to incentivize adoption of EVs in the state. Further enhancing the policy, by including other market mechanisms as incentives, can promote faster registration.
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	Needs policy backing and PP models to be explored	In Dec 2019, AMC made 500 electric scooters available for rent for limited hours in various parts of the city.
Encourage and promote adoption of EVs for all delivery operations within the district		Short to medium-term	Policy framework is required	Currently, most delivery partners for food, courier and other kinds of services rely on self-owned fossil fuel-based two- or four-wheelers. In cities like Delhi, Mumbai and Bengaluru, e-commerce food delivery companies such as Zomato are working towards developing an EV fleet. Others can follow in suit.
Range anxiety is a key barrier to EV adoption. Mobile applications (local app, google map, etc) with real-time data availability of charging points and the cost of charging at various locations will be critical to ensure the popularity of EV by allowing the EV users to plan routes that identify charging points.		Medium to long-term	Needs support for digitalisation	



Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Smart lampposts can radically improve electrical efficiency and enable a number of new services, like, being equipped with PV modules to harvest and store solar energy during the day to power lighting at night and with sensors and communication technologies that can adjust their output according to ambient light levels, monitor traffic, noise and air pollution, seismic activity and increase coverage of cellular and Wi-Fi networks.		Medium to long-term	Needs technological, infrastructural and policy interventions	
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 works across all transport modes (IPT, cycle hire, etc) and tourist sites b) Integrating smart mobility applications with real-time service updates across modes, including car hire, public transit and shared micromobility schemes c) Increasing fleet strength d) Increasing frequency of PT e) Adding more stops f) Enhanced reach to low or non-serviced areas of peri-urban and rural areas g) Developing dedicated parking spaces for IPT.		Medium to long-term	Existing policy framework can be enhanced Interdepartmental collaboration required	Janmitra Card has been introduced by AMC for BRTS, AMTS, some tourist site entries, parking, property tax payments etc. Peri-urban areas are currently connected through GSRTC services. The frequency of services can be enhanced, as well as AMTS services can also be expanded to these areas. AMTS bus network covers 549 km, 187 routes, covering 92% of the city. BRTS network covers 19% of the city through its 12 routes, spanning 89 km. Metro network is currently operational for 6.5 km. Phase I stretch is planned to be 40.03 km, while Phase II is planned to be 28.26 km. The IPT sector is predominantly informal and connectivity is limited to certain popular routes. The informal IPT modes operating in the peri-urban areas include shared autos, omni vans and jeeps. Residents in city outskirts/ peri-urban areas still 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 framework based on research and interdepartmental cooperation	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Implement policy measures to discourage use of private vehicles a) Parking policy for vehicle ownership b) No car days on certain roads c) Parking allowed only in dedicated areas.		Short to medium-term	Policy framework required Needs research and interdepartmental collaboration	Sikkim Parking Policy, 2010 mandates that only houses with parking slots can procure vehicles.
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) Stricter implementation required	
Awareness campaigns to popularise PT and IPT modes.		Short-term and continuous	Dedicated awareness campaigns required	
Augment non-motorised transport (NMT)				
Improve infrastructure to increase modal share of NMT transport in urban areas, such as by introduction of segregated cycle lanes.		Medium-term	Requires policy based on research and inter-departmental cooperation	Current modal split in Ahmedabad indicates that the share of NMT is approximately 34%. However, over the years, there has been a downward trend. Efforts need to made to make NMT a preferred and viable option.
Regular O&M of NMT infrastructure: a) Developing and maintaining well-lit, clean and safe pathways for pedestrians and cyclists. b) Consulting and engaging local experts and community for development and maintenance. c) remove encroachments.		Short-term and continuous	Policy framework exists (section 6.1.3.1) Requires inter-departmental cooperation	
Promote cycle hire services in key locations across the district.		Short-term	Policy framework needs to be enhanced Further, PPP models can be explored for successful implementation.	'Amdabike' is SCADL's flagship project of public bike share system for Ahmedabad city. The services will be available at all BRTS bus stops in the western part of the city and will be connected to various colleges, offices and residential complexes, malls, lakes, gardens, etc within the vicinity. Currently, there are 30 hubs and a fleet of 500 bicycles with a plan of 500 additional bicycles and 30 more hubs.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
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 formulation, research, multi-stakeholder and inter-departmental cooperation	Ahmedabad district can adopt the following best practices to minimise congestion at peak hours. In 2019, the Delhi government decided to stagger working hours of its offices during the implementation of the 12-day odd-even scheme, a move aimed at reducing traffic congestion and pollution in the city. Similar shifts have been planned in Bangalore.
a) Create additional dedicated parking zones for vehicles to deter encroachment of road space and pavements. b) Encourage business/corporate centres to have mandatory private parking with sufficient slots to avoid parking in public spaces.		a) Medium-term b) Short-term and continuous	Policy framework exists Multi stakeholder and inter-departmental cooperation is required	Ahmedabad has multi-level parking spaces. However, since awareness is low, utilisation is poor. Municipal corporations and district authorities need to work towards building awareness and encouraging use of parking facilities.
Develop dedicated areas for street vendors in order to deter encroachment of pavements by them and avoid traffic congestion on roadsides.		Short to medium-term	While the policy framework exists, implementation is irregular and for short timeframes Multi-stakeholder and inter-departmental cooperation is required	There are regular drives by the AMC and the city plans to clear encroachments. However, these affect the livelihoods of the street vendors.
Regular maintenance of roads to ensure smooth flow of traffic as it 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 Multi-stakeholder and inter-departmental cooperation are required	

6.1.3.1 Transport: Policy framework and concerned departments/agencies

Sub-sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Promoting e-mobility	1) FAME II 2) Gujarat EV Policy, 2021 3) JNNURM 4) National Electric Mobility Mission Plan 5) Smart Cities Mission 6) AMRUT 7) Proposed e-vehicle Policy (as per 2021-22 union budget) 8) National Urban Transport Policy, 2006	1) All ULBs 2) RTOs (Ahmedabad, Bavala and Vastral) 3) EESL	1) Urban Development and Urban Housing Department, GoG 2) GEDA 3) Transport Department GoG 4) Roads and Buildings Department, GoG 5) Climate Change Department, GoG 6) Rural Development Department GoG 7) Proposed district-level committee on climate change and environment 8) AUDA 9) Smart City Ahmedabad Development Limited 10) PRIs 11) Airport Authority 12) Western Railways – Ahmedabad Division
Public transport and intermediate public transport	1) BRTS 2) JNNURM 3) ECBC 4) Smart Cities Mission 5) AMRUT 6) National Urban Transport Policy, 2006	1) All ULBs 2) Smart City Ahmedabad Develop Limited 3) GSRTC 4) GMRC	1) Urban Development and Urban Housing Department, GoG; 2) Transport Department, GoG 3) RTOs (Ahmedabad, Bavala and Vastral) 4) Roads and Buildings Department, GoG 5) Climate Change Department, GoG 6) Rural Development Department, GoG 7) GEDA 8) AUDA 9) Proposed District level Committee on Climate Change and Environment
Augment non-motorised transport	1) Smart Cities Mission 2) AMRUT 3) National Urban Transport Policy, 2006	1) All ULBs 2) AUDA 3) Smart City Ahmedabad Develop Limited;	1) Urban Development & Urban Housing Department, GoG; 2) Roads and Buildings Department, GoG; 3) Climate Change Department, GoG 4) Rural Development Department, GoG 5) Proposed District level Committee on Climate Change and Environment 6) PRIs 7) GEDA 8) Police Department
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) AUDA 3) Smart City Ahmedabad Develop Limited 4) RTOs	1) Urban Development & Urban Housing Department, GoG; 2) Roads and Buildings Department, GoG; 3) Gujarat Infrastructure Development Board (GIDB) 4) Climate Change Department, GoG 5) Rural Development Department, GoG 6) Proposed District level Committee on Climate Change and Environment 7) Police Department 8) Department of Industries 9) PRIs 10) GIDC

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

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
District can develop an incentive system, similar to a 'cap-and-trade' system at district level for enhancing energy efficiency of MSMEs, in coordination with the state energy department.		Medium-term	Requires policy framework, based on research and inter-departmental cooperation.	
Promote combined heat and power (CHP)/ co-generation for running captive power plants.		Medium-term	Policy framework exists Inter-departmental collaboration required Need to create awareness to popularize the initiative	CHP systems can achieve system efficiencies close to 80% as compared to around 60% by conventional technologies.
Optimise equipment efficiency. Equipment that are not usually turned off during downtime, 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)	Gujarat Industrial Policy 2020 focusses on: a) Strengthening the regulation and environmental compliance. b) Implementation of cleaner production technology in place of existing processes, such as substitution. and optimisation of raw material, reduction in water consumption or energy consumption or waste generation. For implementation of cleaner production technologies, MSMEs can get assistance of up to 35% of cost of plant and machinery, with a ceiling of ₹ 35 lakh during the operative period of the scheme. Similarly, purchase of new equipment/system related safety, occupational health or for environment compliances for common use of industries located in cluster also get assistance up to 35% of cost of equipment, up to a maximum of ₹ 35 lakh. c) Encouraging green practices and environmental audit of MSMEs by exempting up to 75% of fees of audit services (up to a maximum of ₹ 50,000). d) Industrial buildings with green rating under Indian Green Building Council to be granted 50% exemption on consulting charges (up to ₹ 2.5 lakh) e) Encouraging existing industries to shift their units outside the urban agglomerations
Invest in green projects, such as plantation drives and afforestation activities within and around industrial areas in the district.	 	Short-term	Policy framework exists Improved monitoring and evaluation will give recommendation a further push	
Target better M&E of energy audits to improve accountability.		Short to medium-term	Policy framework already exists Inter-departmental collaboration is required for successful implementation	
Create appropriate district-level rules to enable and 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 responsible agencies and departments	

6.1.4.1 Industry: Policy framework and concerned departments/agencies

Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Industry	1) Gujarat Industrial Policy, 2020 2) Gujarat Solar Policy, 2021 3) National Mission on Enhanced Energy Efficiency 4) Reuse of Treated Waste Water Policy, 2018 (GoG)	1) Industries and Mines Department, GoG	1) Industries Commissionerate 2) Gujarat Industrial Development Corporation 3) Gujarat Industrial Investment Corporation 4) Energy and Petrochemicals Department, GoG 5) District Industries Centre 6) GIDC 7) BEE 8) GEDA 9) GUVNL-UGVCL 10) Proposed District level Committee on Climate Change and Environment

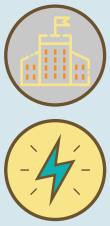
6.1.5 Agriculture, forestry and other land use (AFOLU): Recommendations, cross-cutting sectors, qualifying priority and district scenario

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
AFOLU: Agriculture				
Promote sustainable farming 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) Budgetary provisions are available	In 2017-18, Ahmedabad used approximately 1.3 lakh tonnes of urea in agriculture. Replacement of 10% of this current urea consumption with non-chemical fertilisers can help avoid 9,832 tonnes of CO_2e emissions/ annum. This initiative will also contribute to: a) cutting down compostable solid waste from landfilling/dumping and converting it to organic waste that can further be used to make organic fertilisers (thereby, reducing emission from waste sector) b) lessen harmful agricultural run-off, thereby, reducing water pollution and eutrophication.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote adoption of alternative ways of managing crop residue, other than burning. Promote adoption of improved harvesting practices, like 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 such as paper, cardboard, furniture, organic fertiliser and animal fodder, which will act as an alternative source of income for the farmers.		Short to medium-term	Policy framework required Collaboration required Farmers to have easy access to markets/industries that would take crop residue/ stubble This also helps meet the following targets of SDG#8 (Decent Work and Economic Growth): 8.2; and SDG#12 (Responsible Consumption and Production): 12.5, 12. a	Improved harvesting practices, such as the use of Happy Seeder, has the capacity to eliminate 78% of the GHG emissions (from crop residue burning). It can potentially increase farmers' profits by at least 10%. 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 burn rice stubble, thereby reducing air pollution. Other feasibility studies or projects can be initiated. Such as the development of biofuel pellets from crop residue.
Farmers should be encouraged to follow the recommendation given in Soil Health Card Scheme.		Short to medium-term	Can be implemented by generating awareness	According to the 'Soil Health Card' portal, 16,84,207 samples have been tested in Cycle-II in Gujarat. In Ahmedabad, 83% of the soil samples tested have reported very low nitrogen and 24% of them have reported very low phosphorus and potassium, as per the Soil Health Card information shared by the GoI.
Promotion of 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 The district may consider to provide additional subsidies	Currently, Gujarat holds 12% of the total area under micro irrigation in India.[26] In Gujarat, all farmers – irrespective of social status, landholding, crops, and geographical location – are entitled to a subsidy of 50% of capital cost of MI or 60,000/ha (whichever is lower), of which, 40% is provided by the national government, and the state government bears the remaining 10%. In addition, more subsidy is provided to dark-zone blocks and tribal blocks (talukas) as well as to SC/ST farmers. In March 2015, additional subsidy was announced for small and marginal farmers, however, it varies for non-dark zone and dark zone blocks.[27] According to PMKSY Achievement Report, 924 ha of land was covered under MI in Ahmedabad during 2019-20, which should have led to avoidance of approximately 781 tonnes of CO_2 emissions (due to savings in electricity consumption)

26 A. Suresh and Manoj P. Samuel, Current Science, 'Micro-irrigation development in India: challenges and strategies'

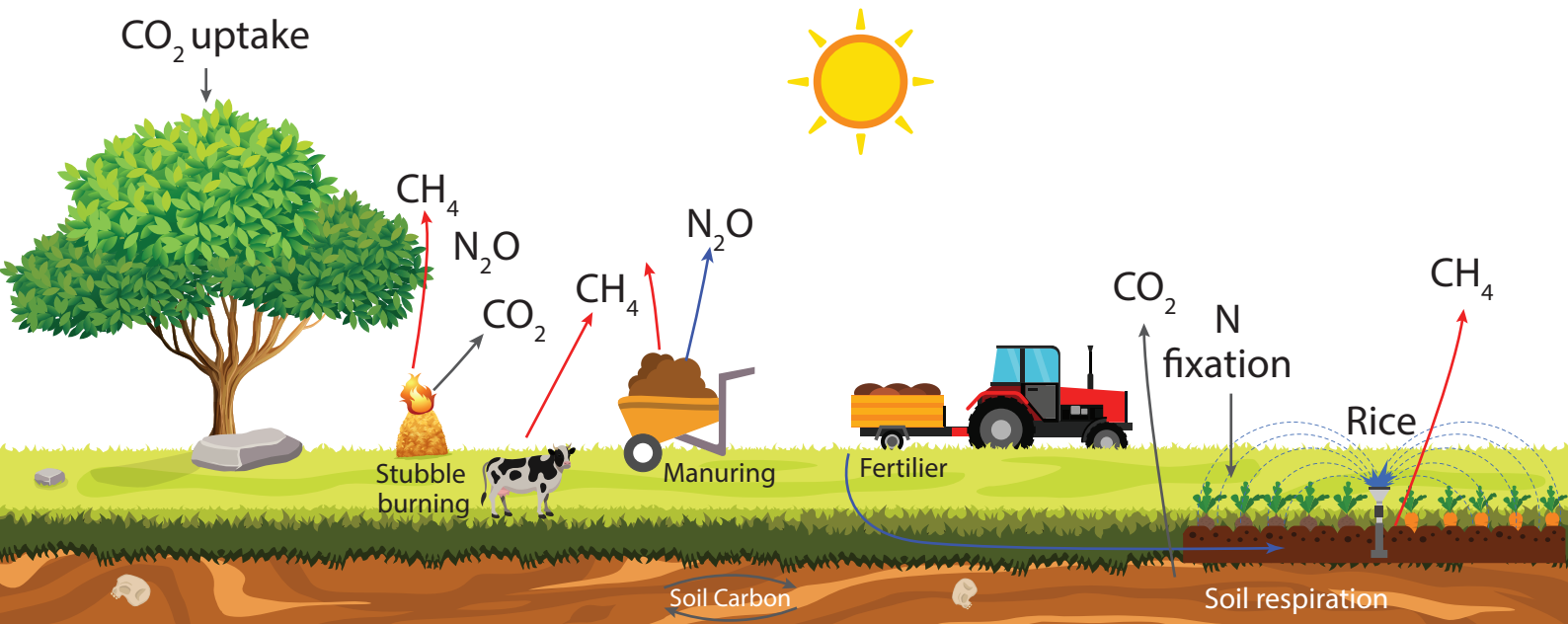
27 Chandra Sekhar Bahinipati and P.K. Viswanathan, Adoption and Diffusion of Micro-irrigation Technologies in Gujarat, Western India: Do Institutions and Policies Matter?

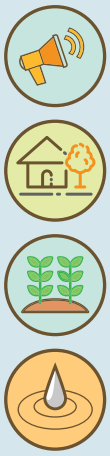
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Encourage adoption of latest technologies, like: a) Solar pumps (under PM KUSUM Yojana and SKY) b) Star-rated energy efficient pump system (EEPS) c) Smart control panels and internet of things-based systems for optimum resource utilisation (water and energy).		Short to medium-term	Policy framework is available (section 6.1.5.1) Capital investment support, over and above the existing policy, can be considered	In 2018, GoG launched Suryashakti Kisan Yojana (SKY) with the objective of dodoubling farmers' income by generating their own power and selling the surplus back to the state. Replacement of 1 lakh diesel pumps with solar pumps, over a period of five years, can cut 900 million litres of diesel consumption over the lifecycle of solar pumps, which can potentially save ₹ 840 crore of diesel subsidy and 2.53 million tonnes of CO_2 emissions. 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 initiate a gradual shift to RE-powered cold storages.		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	Under PMKSY, 969 cold storage facilities with a capacity of 38,22,112 tonnes are proposed for Gujarat to avoid post-harvest losses. These new cold storages can be solar-powered.
AFOLU: Livestock				
Promote grasslands and cultivation of cattle feedstock for good quality forage and to manage fodder scarcity.		Short to medium-term	Policy framework exists (section 6.1.5.1) Research inputs required Collaboration between different communities (farming and pastoral) is needed.	Intensive cultivation of *Sesbania grandiflora*, which produces about 7.8 kg/tree/year or 93.6 MT/year/ha when fed to lactating crossbred cows, leads to an increase in milk yield by 11.97%.[28] Straws from millets, corn and maize have better feeding quality than straws from rice, barley and wheat. This change in quality of forage specie leads to better productivity and 30% reduction in emission. 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 Ahmedabad at the district level.[29]

28 Earagariyanna M.Y. et. al., 2017, Fodder Resource Management in India-Critical Analysis

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

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote cattle breeds with higher productivity. Productivity of indigenous cattle should also be improved (e.g. through provision of Nand Ghars). However, the balance between resilience and productivity should be maintained. Currently, in most areas flock sizes are negatively impacting the climate and ecology.		Medium to long-term	Policy framework exists (section 6.1.5.1) Research collaboration required (to ensure biodiversity of the region is not impacted) Awareness generation Monetary support to the pastoral community required	These initiatives will help meet growing demand of milk, while keeping the livestock headcount low. In Ahmedabad, a 10% decrease in the number of indigenous cattle over a period of five years, the loss in milk production will be 30 lakh litres and 1,86,752 tonnes of CO_2e emission will be avoided. To compensate for this loss in milk production, a total of 1,88,518 new crossbreed cattle would be needed, which will lead to 1,70,268 tonnes CO_2e emissions. The net emissions avoided per year would be approximately 3,296.92 tonnes CO_2e.
Promote use of waste from livestock and poultry as an important source of organic manure for various crops, such as, sugarcane, potato etc. for enhancing crop production.		Short to medium-term	Collaboration between different communities (farming and pastoral) is needed Policy framework is available (section 6.1.5.1)	Poultry manure fertiliser is rich in nitrogen and contains all 13 essentials nutrients required for crop production. In comparison to cow manure, it is two to three times richer in inorganic fertiliser content.
AFOLU: Forestry and green spaces				
Ensure minimum diversion of forest land for any activity or project and promote compensatory afforestation (of the same species) from the funds given by the user agency. Funds for continuous tree improvement and tree breeding programmes can be ensured through CAMPA.		Short to medium-term	Policy framework and budget provisions exist (section 6.1.5.1) Policy implementation required Stringent monitoring and evaluation	In 2019, Gujarat received ₹ 1,484.60 crore from the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), which aims to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses.



Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Measures to increase trees outside forest area and green spaces in Ahmedabad 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) Initiate afforestation activities on wastelands and fallow lands f) Plantation along village roads can be taken up under MGNREGS g) Development of green belt along the major terrain roads and surrounding the industrial areas h) Making the Tree Census data available to the public.		Medium to long-term	Policy framework is available (section 6.1.5.1) Requires capital investment Research collaboration and inter-departmental cooperation are required	As per the FSI report 2019, Gujarat has 11,984 sq km of 'trees outside the forest', which includes forest cover outside the recorded forest area/ green wash and tree cover. Miyawaki Urban Forestry method has reported 15% faster growth per year compared to other reforestation methods. Oxygen Park has been developed by adopting Miyawaki method in the Science City on Ahmedabad-Gandhinagar highway. Green belts help mitigate air pollution, increase urban green cover, thereby leading to carbon sequestration. The Tree Census reports of Gujarat are in public domain only till 2013.
Enhance forest cover by promoting agro-forestry and social forestry to increase forest biomass and soil moisture. a) Control illegal timber trade b) Carry out mapping of agroforestry area to monitor the coverage c) Create provisions of financial instruments/ relaxation in other taxes (over and above the existing schemes) to encourage farming community to adopt agroforestry 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. to aid increase of tree density.		Medium to long-term	Policy framework and budget is available, implementation is required Stringent monitoring and evaluation are necessary	Currently, the forest area in Ahmedabad district is only 1.62% of its total geographical area. If 7% of its geographical area (equivalent to state average forest cover) is converted to green cover, over a period of 10 years, 8.47 million tonnes of CO_2 emissions can be avoided. Ahmedabad has 'poor tree density' i.e., below 10 trees/ha as the tree cover has not improved due to development works.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Ensure ULBs regularly monitor survival of the trees, post plantation. 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 is needed	The current survival ratio of the plantation drives is 30-40% within AMC and is lower outside the AMC limits.
Promote regeneration of degraded and open forest areas by developing awareness among locals on the importance of green spaces.		Long-term	Strengthen the existing policy framework Needs collaboration among different stakeholders	In Ahmedabad circle, 1,181 ha area is under Concentrated Regeneration (as per the Annual Administration Report, Forest Dept., GoG)
Various aspects of joint forest management (JFM) need to be promoted a) Capacity building and skill development of JFM committees in tribal and non-tribal areas by conducting workshops and training b) Initiate participatory forest management programs at micro scale.		Short to medium-term	Exclusive communication strategy and information, education and communication (IEC) material to be developed and used Provisions of monetary support	

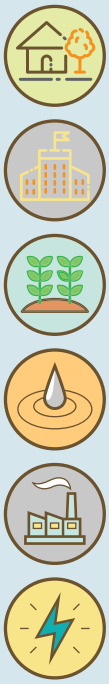
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Prevent invasion of non-indigenous species a) Develop a database and update information on invasive species and their management b) Raise awareness at regional levels c) Strengthen and maintain institutions to coordinate invasive species programmes.		Medium to long-term	Undertake research on flora specific to the region Exclusive communication strategy and IEC materials to be developed and used Requires funding, monitoring and evaluation, stakeholder collaboration	*Prosopis juliflora, Lantana camara, Parthenium hysterophorus* are some major invasive species in Gujarat. 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. [30]
Develop participatory forest fire management strategies such as: a) Collecting baseline forest fire data in respect to perceptions, beliefs, expectations and behaviour of local people with regard to forest fires b) Training local communities to tackle forest fires c) Organising awareness programmes in local schools d) Building capacities to develop an early warning system.		Medium to long-term	Provisions of monetary support Exclusive communication strategy and Information, Education and Communication (IEC) material to be developed and used Monitoring and evaluation required Requires collaboration among different stakeholders	According to FSI Report, 2019, about 6.39% of the total forest cover in Gujarat is categorised as high to extremely fire prone.

30 Solanki H.A, 2018, Checklist of invasive plants of Gujarat and some most insidious plants of Gujarat, their hazards, its management and public perspective.

6.1.5.1 AFOLU: Policy framework and concerned departments/agencies

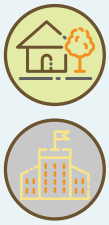
Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/agencies
Agriculture	1) Rashtriya Krishi Vikas Yojana: Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RAFTAAR) 2) National Mission for Sustainable Agriculture 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) Price Support Scheme 9) AGR 2 (Farm Mechanisation) scheme of farmers other than SC/ST 10) National Policy for Crop Residue Management 11) Suryashakti Kisan Yojana 12) Dinkar Yojana	Agriculture, Farmers' Welfare and Co-operation Department, Government of Gujarat	1) Gujarat Green Revolution Company (GGRC) 2) Rural Development Department, GoG 3) Irrigation Department, GoG 4) Energy and Petrochemicals Department, GoG 5) GEDA 6) Animal Husbandry Co-operation 7) Gujarat Water Resource Development Corporation (GWRDC) 8) Climate Change Department (for reporting), GoG 9) Forests and Environment Department, GoG 10) GNFC, GSFC 11) Commissionerate for Cottage and Rural Industries 12) Gujarat Agro Industries Corporation (GAIC) 13) Anand Agriculture University 14) APMCs 15) Proposed District level Committee on Climate Change and Environment 16) Gujarat Urja Vikas Nigam Limited (GUVNL)
Livestock	1) National Livestock Mission 2) Rashtriya 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) National Mission on Food Security 9) Rashtriya Krishi Vikas Yojana	Animal Husbandry Department, GoG	1) Forests and Environment Department, GoG 2) Agriculture, Farmers' Welfare and Co-operation Department, GoG 3) Climate Change Department, GoG
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	Gujarat Forest & Environment Department, GoG	1) Agriculture, Farmers' Welfare and Co-operation Department, GoG 2) Climate Change Department, GoG 3) All ULBs (AMC + other Municipalities) 4) AUDA 5) Industries & Mines Department, GoG 6) UDD & RDD 7) All PRIs

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

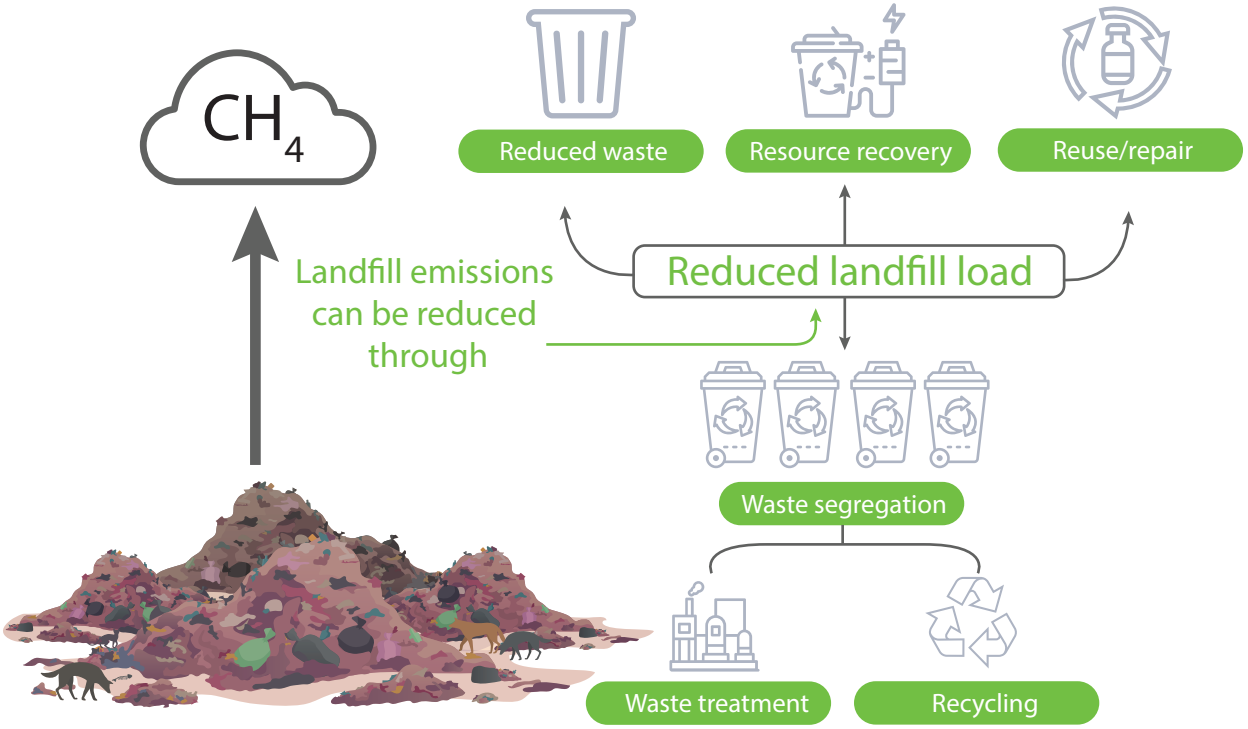
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Solid waste				
Waste prevention: Reducing landfilling				
Minimise landfill waste disposal by: a) Promoting waste reduction at source through measures such as product reuse, lifetime extension (maximum use of resources) and putting in place consumers' right to repair b) Ensuring efficient and 100% segregated waste collection from across the district (both urban and rural) by distributing colour-coded bins, monitoring waste collected from household and penalising households that do not segregate waste c) Ensuring and maximising recycling, recovery, optimum resources utilisation throughout the product lifecycle and treatment d) Promoting resource efficiency and circular economy practices across sectors.		a) Medium to long- term b) Short to medium-term c) Medium-term d) Long-term	a) Needs policy intervention, awareness generation, incentivisation b) Policy framework exists (section 6.1.6.1); c) and d) Need policy intervention and execution (Resource Efficiency Policy drafted by NITI Aayog but not implemented as of now)	Landfills are one of the largest anthropogenic source of methane emissions contributing to 11% of all global CH_4 emissions. Hence, reducing landfill load and emissions is critical in achieving India's NDCs. Here are some initiatives adopted by Ahmedabad (mostly the city area) which can be undertaken for the district as well: Waste collection efficiency is reported to be 100% within AMC. AMC has an SWM Master Plan (2031) for becoming a 'zero waste' city. AMC has a waste to energy (W2E) plant functioning with 1000 TPD waste to 14 MW energy capacity, another W2E plant is coming up at Pirana with a capacity of converting 1000 TPD waste to 11 MW energy. AMC has initiated a biomining project at the Pirana dumping ground with 36 trommels installed currently, each having 300 TPD waste processing capacity since 2019. This will reduce the landfill legacy waste and emissions. A compressed biogas plant is also being set up in Ahmedabad.

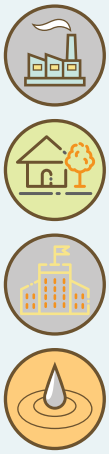
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Minimise single use plastic (SUP): detailed information and recommendations on SUP are given in section 6.1.6.2.		Short to medium-term	Already a national priority Policy framework exists (section 6.1.6.2)	Disposable SW take-back has not been implemented in Gujarat as of now. 25% of the total waste generated in Ahmedabad is inert waste and 23% is paper waste, and much of this can be treated/ recycled, resulting in a huge landfill waste reduction. Currently, 300 TPD construction and demolition (C&D) waste is being treated in AMC. One material recycling facility (MRF) is coming up in Gyaspur (100 TPD).
Implementing producers (manufacturer/brand owners, etc). take-back mechanism (SWM Rules, 2016) either through financial assistance by the producers or a defined collection system facilitated by the producers for disposables, like tin, glass, plastics packaging, sanitary napkins and diapers, for efficient management of these waste materials, thereby reducing landfill inert waste load.		Short to medium-term	Mandated by the MSW Rules (2016) District level policy formulation and interventions required	
Ensure 100% recycling of recyclables at landfill through material recycling facilities (MRFs), refuse derived fuel (RDF), waste to energy, etc. Encourage use of LDPE and HDPE plastic waste in road construction.[31]		Short to medium-term	Capacity enhancement of existing facilities	
Management of construction and demolition (C&D) waste: a) Ensure segregation, collection, transport and proper management b) Facilitate processing and recycling facility 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 SWM Rules CPCB guidelines exist (section 6.1.6.1) Implementation and enforcement required Investment in infrastructure required	
Increasing consumer awareness and access to recycling facilities and repair options within the district.		Short to medium-term	Dedicated campaign required	
Education and awareness drives for 100% at source segregation of biodegradable, non-biodegradable, domestic hazardous and household biomedical wastes		Short-term	Dedicated campaign required	Segregation of domestic hazardous waste and household waste is not practiced in the district.

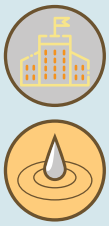
31 Guidelines given by Indian Roads Congress in this regard can be followed. https://pibgov.in/PressReleasePage.aspx?PRID=1736774

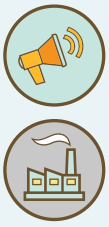
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Introduce fiscal instruments to encourage waste reduction, such as, mandatory carry bag charges, pay-per-bin schemes (charging residents for each community refuse bin).		Short-term	Needs district-level scheme/ notification and community participation	About 10-15 percent of global GHG emissions could 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.
Conduct behavioural change communication workshops targeting corporates, educational institutes, PSUs, government offices to influence behaviour at both individual and organisational level to better manage resources and reduce waste generation. For example, conducting weekly workshops at all public schools for waste reduction and recovery. These workshops can also address issues such as, energy efficiency and water conservation.		Short-term and continuous	Needs sustained campaign for the target groups	
Consumer awareness for demand-side management of product choices with: a) sustainable packaging, b) displayed higher product lifespan, c) displayed recycling/resource recovery efforts and information.		Short-term and continuous	Dedicated campaign required	
Conduct waste audits at household level, corporate offices, institutes etc. to identify scope of waste minimisation and promote the same as an evidence-based practice.		Short to medium-term	Needs research collaboration	
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	Sanitary waste segregation and treatment is currently not practiced in the district.

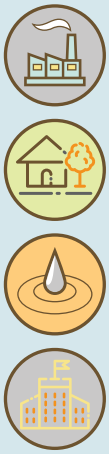
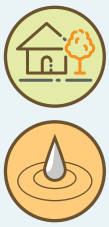
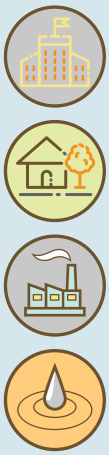
Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Transitioning the district to a Green Market approach by: a) promoting local circular business models b) mainstreaming alternative sustainable business models for the consumers to have a basket of choices.		Medium-term and continuous	Needs alternative business models, collaborations and awareness	
Reduce 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	AMC has 1,500 vehicles/ equipment engaged in SWM. Out of this, 600 small vehicles and 130 heavy vehicles used for primary and secondary transport of SW with significant transport emission potential can be converted to ZEVs. Though several specifications exist for CBWTF vehicles to ensure efficient management and monitoring of BMW, it does not consider emissions reduction from transport.



Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Waste treatment - composting				
Ensure 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	Organic treatment of compostable waste initially leads to emissions but reduces GHG emissions drastically in the long run as compared to landfill emissions. It takes at least three decades of landfill emissions to balance with those from aerobic composting. Several best practices and technologies are available for reducing GHG emissions from composting. Even in the absence of a gas management system, composting is a more environmentally sustainable practice as opposed to methane capturing from landfilling of organic waste. Composting also avoids multi-layered pollution potentials and reduces landfill loads. Composting emission potential (for 39.5 TPD reported by GPCB AR): 1,211 tCO_2e/year No gas management system at composting units. Composting with gas management of 100% organic waste going to landfill can reduce emission by 46,081 tCO_2e./year in Ahmedabad.
Develop composting facilities at ULB level in addition to cluster level to: a) avoid loss of carbon content in long route organic waste transport; and b) reduce emissions from waste transport vehicles.		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, Needs district level capital investment Research collaboration required	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Emission profiling and reduction				
Facilitating research and documentation on characteristics and percentage share of waste, moisture content, localised BODs for domestic wastewater and industrial wastewater, etc. is important for accurately estimating city or district level emissions 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				
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 common bio-medical waste treatment facilities (CBWTFs) and upgradation of the existing ones 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	Incineration is not recommended due to its emission potential. However, to prevent manual scavenging and further contamination from certain kinds of infectious waste (particularly the anatomical, contaminated waste, discarded medicines and chemical waste), incineration is the recommended practice in India. TSDFs within the Ahmedabad district are shut and have been shifted out of the district. However, hazardous waste from the district gets incinerated elsewhere.
Strict monitoring of adherence to recommended incineration technologies and practices through regular monitoring by District Bio-medical Waste Management Monitoring Committee.		Short-term and continuous	Mandated by the BMWM 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 with CBWTFs.		Short-term and continuous	Mandated by the BMWM Rules (section 6.1.6.1)	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Waste electrical and electronic equipment (WEEE)				
As per the provisions of the E-waste Management Rules, 2016, a state level e-waste inventory with district level category-wise e-waste generation information needs to be developed. For Ahmedabad district, the existing inventory (by GEMI for Ahmedabad city) can be extrapolated with inclusion of fluorescent and mercury containing lamps.		Short to medium-term	Mandated by the rules (section 6.1.6.1) Research collaboration required	About 95% of e-waste in India is processed informally (including rudimentary operations like open burning, acid wash, open smelting, etc.) City-based studies show efficient management and recycling of electrical and electronic waste (WEEE) can significantly contribute to emission reduction targets.
Ensure stringent policy implementation: Trace informal routing, ensure copper 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	Mandated by the rules (section 6.1.6.1) Needs monitoring manufacturer collaboration and consumer 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 producers/ recyclers/ producer responsibility organisations (PROs)	According to an e-waste inventory prepared by GEMI, Ahmedabad city is projected to generate an annual WEEE amount of 17,004 MT from consumers and 11,213 MT from bulk consumers by 2025. However, this inventory estimation does not consider all categories of WEEE. Most of the current e-waste generated in the district is routed informally. There are three formal e-waste recycling industries in Ahmedabad.
Improve consumer awareness on responsible e-waste disposal and make information available on e-waste collection points, recyclers, producers (manufacturer), producer responsibility organisations or e-waste collection drives at the district level.		Short-term and continuous	Mandated by the rules for the producers (section 6.1.6.1). Dedicated campaign required, can be achieved through collaborating with producers	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Formulation of district level e-waste management programmes.		Short to medium-term	Needs inter-departmental collaboration	
Wastewater: Domestic and industrial				
Achieve 100% domestic wastewater treatment through: a) In both urban and rural areas of the district set up 100% closed and underground sewer collection network. b) Shift 100% domestic wastewater treatment (STP) to aerobic setups by having only aerobic STPs for new constructions and transitioning of old anaerobic STPs to aerobic setup c) 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. Open sewers (being stagnant and subject to heating cause), anaerobic conditions to emit CH_4. Closed underground sewers are an insignificant source of CH_4. AMC has 9 STPs (3 anaerobic, 6 aerobic with capacity of 1075 MLD), 45 sewage pumping stations and 2,500 km sewerage network accounting for 60% to 70% of the AMC area. The Comprehensive Development Plan for 2021 by AUDA proposes to cover the entire AMC along with fringe areas to meet an estimated requirement of 1627 MLD by 2031 through 2 new STPs, 22 new sewage pumping stations and an additional sewerage network of 154.21 sq km within AMC, 106 sq km within AUC and 55 sq km within growth centres.
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 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	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/ case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Implement and operationalise the guidelines and regulations of the 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	Extension of network coverage and STPs of combined capacity of 20.9 MLD are under installation (AUDA-GWSSB) in Dhandhuka, Kharej, Viramgan and Babla. No information is available on rural sewerage coverage and treatment. 100% closed and underground sewer connection and centralised aerobic well-managed STPs can potentially reduce 538,963 tCO_2e emissions from STPs to negligible in Ahmedabad. AMC 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.
Develop a policy mandate for data transparency and availability of waste and wastewater generation, treatment and discharge information for the industrial sector.		Medium to long-term	Needs policy intervention Inter-departmental collaboration required	
Encourage data transparency by the industries for wastewater generation, treatment and discharge information including those of CETPs.		Short to medium-term	Needs collaborative efforts	Data transparency on wastewater generation by industries is key to reducing water pollution, which can be achieved through ratings based on emission and effluent discharge and the treatment done by them. 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.

6.1.6.1 Waste management: Policy framework and concerned departments/agencies

Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/ agencies
Solid waste	1) Solid Waste Management Rules, 2016 & Amendment, 2018 2) Plastic Waste Management Rules, 2016 and Ammendment Rules, 2021 3) Construction & Demolition Waste Management Rules, 2016 4) Integrated Solid Waste Management Project 5) Swachh Bharat Mission - Urban & Rural 6) Ahmedabad District Urban Development Plan, 2021 7) Ahmedabad Smart Cities Mission 8) National Resource Efficiency Policy (draft) 9) Guidelines on Environmental Management of C&D Waste Management in India, CPCB 10) GPCB Annual Report	1) Urban Development and Urban Housing Department, GoG 2) All ULBs, 3) Panchayats, Rural Housing & Rural Development Department, GoG 4) All Gram Panchayats 5) Gujarat Pollution Control Board (GPCB)	1) Ahmedabad District Administration & the proposed District Level Climate Change & Environment Committee 2) Gujarat Urban Development Company Ltd (GUDC) 3) Climate Change Department, GoG 4) Forest and Environment Department, GoG 5) Ahmedabad Urban Development Agency (AUDA) 6) District Rural Development Agency (DRDA) – Ahmedabad 7) 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) GPCB 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 Forest and Environment, GoG, Climate Change Department, GoG, GPCB, etc.[32]	1) GPCB 2) Ahmedabad district administration and the proposed District Level Climate Change and Environment Committee 3) Healthcare facilities 4) CBWTF
Waste-electrical and electronic (WEE)	1) E-waste Management Rules, 2016 2) Implementation Guidelines for 3) E-Waste (Management) Rules, 2016, CPCB	Only implementation, monitoring and research needs resources which can be obtained from the Department of Forest and Environment, GoG, Climate Change Department, GoG, GPCB, etc.[33]	1) GPCB 2) Ahmedabad district administration and the proposed District Level Climate Change and Environment Committee 3) Electronic and electrical manufacturers/brand owners, producer responsibility organisations

32 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

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

Sectors	Policies and programmes that can push forward the recommendation	Primary departments/ agencies	Supporting departments/ agencies
Wastewater: Domestic	1) Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 2) Jawaharlal Nehru National Urban Renewal Mission (JNNURM) 3) National River Conservation Plan 4) Integrated Urban Sanitation Programme 5) Swachh Bharat Mission (Urban) – Gujarat 6) Swachh Bharat Mission (Rural) – Gujarat 7) Ahmedabad Smart City Mission 8) Ahmedabad District Development Plan	1) Urban Development and Urban Housing Department, GoG 2) Gujarat Urban Development Company Limited (GUDC) 3) Gujarat Water Supply & Sewerage Board 4) All ULBs 5) Panchayats, Rural Housing & Rural Development Department, GoG	1) AUDA 2) Commissionerate of Rural Development 3) District Rural Development Agency (DRDA) 4) Ahmedabad Smart City Development Corporation 5) All gram panchayats
Wastewater: Industrial	1) Common Effluent Treatment Plant System 2) Online Continuous Emission Monitoring System 3) GPCB Annual Report	1) Gujarat Pollution Control Board (GPCB) 2) Gujarat Industrial Development Corporation (GIDC)	1) Industries and Mines Department

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.

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	**Glass** • Pros: Inert, infinitely recyclable, no toxic chemical additives, low manufacturing carbon footprint • Cons: Fragile, higher cost, injury and health risk, weight **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 **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 **Bioplastics** • 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 **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 **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 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	
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	
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	
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	
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	
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: a) Introduces EPR for manufacturers or brand owners of disposable products (including plastic packaging, sanitary napkins and diapers) to provide financial assistance to local authorities for waste management system and to set up a collection/take back system for packaging waste.
- Different policy frameworks for SUP ban or restrictions (of different kind) exist in at least 23 states and five union territories of India. Gujarat does not have any policy directive at state level as of now. AMC has banned plastic cups, water pouches, *paan masala* polythene in 2018. AMC notified plastic waste management bylaws in December 2018.

Recommendations[34]

- 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.
- 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,

34 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

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).

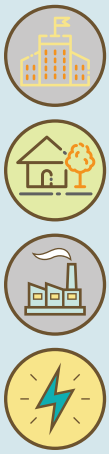
- Promote extended lifespan and reuse of products (including sustainable ones) through continued and lasting campaigns for 'No Single Use' to ensure public participation. Replacing the concept of 'single use' is critical as biodegradability or recyclability have 'time' and 'conditions' (such as energy 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
		Timeframe for the action to be accomplished	Framework for implementation	
Promote green municipal bonds to mobilise untapped investments towards green projects, such as RE infrastructure development, waste management etc.		Medium to long-term	Needs policy formulation Collaboration among various stakeholders required Create specific financial instruments	In 2019, AMC issued public bonds (five-year maturity) worth ₹ 200 crore, directed towards AMRUT for urban infrastructure development. Gaining massive attention, AMC obtained ₹ 1,085 crore worth of subscriptions, with the additional bids being rejected to retain the targeted size at ₹ 200 crore.
Voluntary carbon market mechanism can be developed for the district to motivate industries, ULBs and other sectors to lower their emission levels through monetary incentives.	All sectors	Medium-term	Need feasibility studies, research and interdepartmental and multi-stakeholder collaboration Institutional structure needs to be established for the same	Case example: In 2020, Smart City Indore collected carbon credit of around ₹ 50 lakh through the city's two bio-methanisation plants. The gas generated from these plants is used by city buses – City Bus and iBus. Through these projects, Indore has avoided emissions of 1,70,000 tCO_2 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
		Timeframe for the action to be accomplished	Framework for implementation	
Water pollution and scarcity				
Conduct assessment and mapping of zone-wise water challenges in the district.		Short-term	Stakeholder and research collaboration required	Gujarat has provided aquifer vulnerability index (AVI) information to Central Ground Water Board and identified areas for mapping.
Prepare a comprehensive district action plan for integrated water resource management with a bottom-up approach. Establish sustainable and inclusive water governance in the district to develop, implement, evaluate as well as share information on programmes for water resource management in a transparent and inclusive manner with mandatory stakeholder engagement and public participation.		Short to medium-term	Policy intervention required Stakeholder and research collaboration required	Through Water and Sanitation Management Organisation (WASMO), GoG has presence in all the villages of the state and involves community for in-village water supply network. Their programmes instill community ownership. This initiative can be scaled for urban areas and can be tapped for capacity building of the beneficiaries on efficient water management and conservation.
Implement recommendations given in the Heat Action Plan (for heat alert days), particularly: a) to settle the suspended road dust, b) provision of water for cooling, public and institutional distribution, c) promotion of micro-irrigation, d) releasing water in canals during summer, e) ensuring efficient potable water supply, f) provision of water in reserved/ protected forests, zoos for wildlife and human habitations.		Short-term and ongoing	Action plans and studies exist Policy-level interventions required	Ahmedabad is one of the first cities in India to introduce a Heat Action Plan (AMC and NRDC, 2018) to strengthen response towards heat stress conditions in the city.

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote net zero water construction and infrastructure upgradation in urban areas, in alignment with ECBC norms.		Medium-term	Policy level interventions required	
Promote rainwater conservation through: a) renovation of existing rainwater harvesting structures in the old city area (including individual harvesting cisterns) b) ensuring inclusion of rainwater harvesting in new construction of residential buildings, institutional, commercial centres, and industries in the district, as per building bye-laws c) Mandatory rainwater harvesting at the upstream to halt run-off and recharge groundwater		Short to medium-term	Policy framework exists Align with existing regulations	As per the Comprehensive Development Control Regulations, 2017, UD & UHD, GoG, rainwater harvesting is mandatory for all buildings with ground coverage 80 m^2 and above. According to the Gujarat Development Control Regulations, for buildings with area between 500 and 1,500m^2, the owner or developer shall have to undertake rainwater harvesting as per the specifications. For buildings with area between 1,500 and 4,000 m^2owner/developer has to provide percolation wells with rainwater harvesting system with one percolating well for every 4,000 m^2 or part thereof of building unit.
Ensure minimum non-revenue water (NRW), i.e., technical loss due to leakage, seepage or unauthorised use (theft).		Medium-term	Research collaboration required	The average non-revenue water (NRW) across all classes of ULBs in Gujarat ranges between 26% and 34%, indicating that nearly one-third of water is lost in distribution. One ward – Sabarmati – is losing up to 9.78 million litres of water every year. Over 42% of the water in the water supply system of Ahmedabad is unaccounted for. Reducing NRW through leakage repairs can help the district meet the national average of 20% NRW.
Water billing based on water metering rather than fixed charges.		Medium to long-term	Awareness generation and collaboration	Ahmedabad city has already put the water metering system into practice. Since 2016, 2,800 'buildings use' permissions have been given to societies on the condition that they will install water metres. In 2019, high-precision water meters were installed in two wards of the district on a pilot basis, emulating Rajasthan's Water Policy.

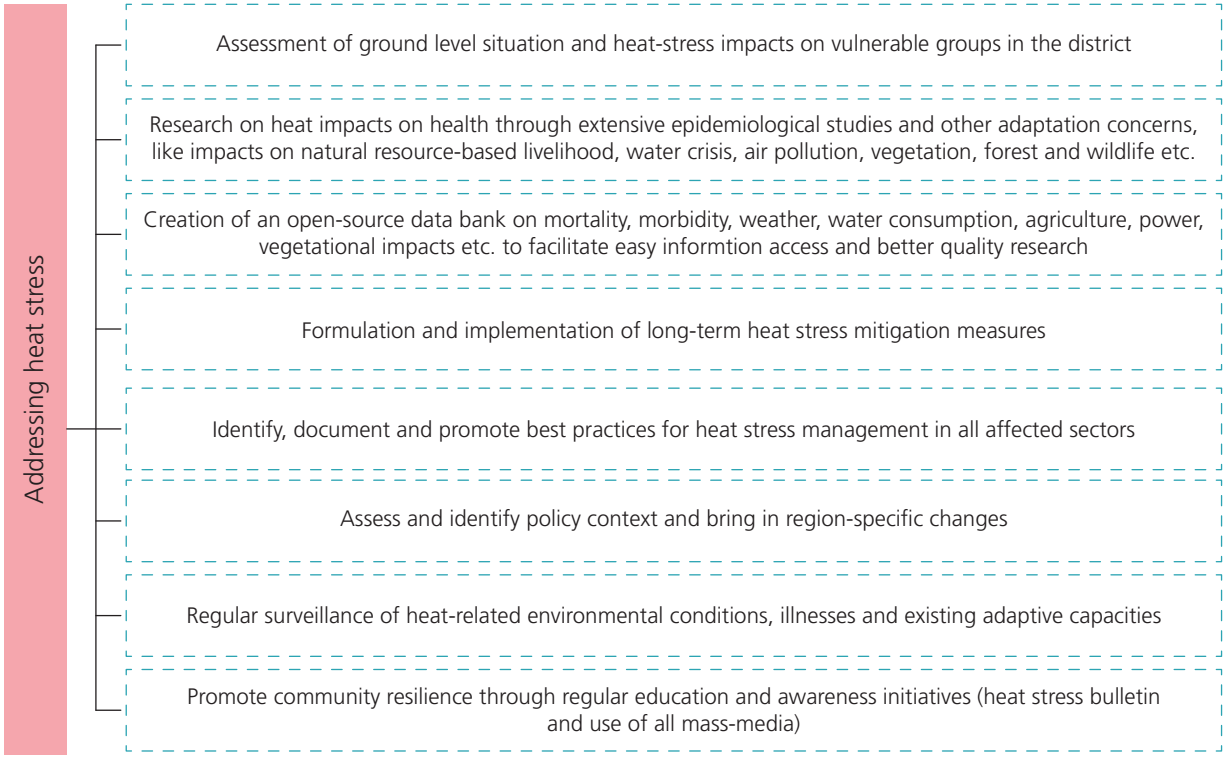
Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Promote dual-flush systems to reduce water consumption, energy consumption and waste-water generation.		Short to medium-term	Align with the existing policies Can be implemented as a part of green buildings	As a step towards this direction, UDD has implemented an amendment (through a notification dated March 31, 2018) in the Comprehensive General Development Control Regulation (CGDCR). The inclusion states: "In every water closet or toilet it shall be mandatory to provide double button cistern (dual flush tank)". For now, it is mandatory for all new constructions to install dual-flush systems. The initiative can be scaled up by retrofitting in old buildings (starting with government and public buildings).
Prevent dumping of untreated effluent from industries, commercial and residential sector into open water bodies or groundwater.		Short to medium-term	Policy framework available Strict monitoring and reporting required	Re-use of Treated Wastewater Policy, 2018 mandates that all power plants and large industries within 50 km of a sewage treatment plant must use recycled wastewater to relieve the burden on groundwater and surface water.
Nalsarovar wetland				
Promote use of RE-powered sources for recreational activities around the wetland (including lighting, electricity to stalls etc.). RE can be sourced from decentralised solar panels around the periphery of the lake.		Short to medium-term	Sector-specific policy framework is available Mandate required to ensure compliance Research and multi-stakeholder collaboration required	Nalsarovar was declared as a Ramsar site on September 24, 2012. Following practices are being undertaken as conservation measures under the Ramsar Convention: a) The staff of the sanctuary regularly patrols the area to prevent poaching b) Habitat improvement measures, eco-tourism activities and eco-development activities are undertaken c) Attempts are being made to reduce people's dependence on the wetland by providing alternatives d) Monitoring of water quality of the industry effluents has been proposed e) Preservation measures of satellite water bodies around the main wetland f) Ban on fishing, restrictions on movement of human and cattle etc. within the sanctuary area is being undertaken.
Phase out diesel-run boats and introduce RE-based options.		Medium-term		
Carrying capacity of the wetland and surrounding ecosystem must be taken into consideration before permitting any new construction / recreational activity around its periphery.		Short-term and continuous		

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Demotivate excessive ground water pumping around the wetland. Incentivise rainwater harvesting systems for the nearby resorts/ commercial areas/villages.		Short-term and continuous		
Restrict direct dumping of untreated domestic solid waste, wastewater (both domestic and industrial) and agricultural run-off in the lakes. Effective functioning of CETPs, STPs around the wetland must be ensured.		Short to medium-term and continuous		
RE-powered aerators can be installed to avoid eutrophication in different pockets of the wetlands.		Short-term		
Promote use of native species for any upcoming infrastructure development near wetland habitat to protect native biodiversity.		Short-term and continuous		
Promote more focused research on the Nalsarovar wetland biodiversity and its interactions with the habitat, hydrology, soils and landform.		Medium to long-term		
Ensure that all the principles/ wetland practices according to the Ramsar Convention are followed		Short to medium-term		

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Making brick kilns sustainable				
Adopt cleaner kiln technologies like zig-zag kilns and vertical shaft brick kiln (VSBK) to replace fixed chimney bull trench kilns (FCBTKs) and down draught kiln (DDKs).	    	Medium to long-term	Needs to be aligned with existing standards Mandate required to ensure compliance Capital investment required	Zig-zag kilns appear to be the logical replacement for FCBTKs because of low-capital investment, easy integration with the existing production process and the possibility of retrofitting FCBTKs into zig-zag firing.
Promotion of mechanised coal stoking systems in brick manufacturing.		Medium term		High particulate matter and black carbon emissions in FCBTKs occur during the period of fuel feeding. Continuous feeding of properly sized fuel, using a coal stoker in an FCBTK or a zig-zag kiln can reduce the emissions significantly.
Promote sustainable brick types (eg. clay-fly ash bricks and fly ash bricks).		Long-term	Need to generate awareness Needs to be aligned with existing policies Market/ demand needs to be generated	Preparing clay-fly ash bricks with around 30% fly ash content (when using black soil) can: a) prevent consumption of around 30-40 tonnes of alluvial soil or 100-125 tonnes of black soil per lakh bricks, thereby reducing land-degradation and retaining the carbon content in soil b) save 3-7 tonnes of coal per lakh bricks produced c) increase the strength of the brick by 30%-40%.
Promote modern RE technologies in brick-making. Also, enhance communication through media engagement and outreach, mass awareness, engaging public, health and academic institutions, stakeholder discussions, etc.		Long-term	Research collaboration needed Capital investment required	
Managing air pollution				
Increase the number of continuous ambiant air quality monitoring stations (CAAQMS) to statistically, spatially and temporally represent the mix of sources and range of pollution. Increase the number of air quality display facilities in public places.		Short to medium-term	Policy framework and budgetary provisions available	Ahmedabad has 1 CAAQMS by GPCB at Maninagar, 10 CAAQMS by SAFAR (Ministry of Earth Sciences) at Navrangpura, Pirana, Rakhiyal, Raikhad, Chandkheda, Bopal, Sattelite, Airport, Lekhwada and GIST City and 14 manual stations operated as per CPCB guidelines under National Air Quality Monitoring Programme (NAMP) and State Air Quality Monitoring Programme (SAMP). Ahmedabad is categorised as one of the 124 non-attainment cities in India for particulate matter concentration (PM10 & PM2.5) exceeding the prescribed norms by CPCB under the National Clean Air Programme (NCAP) with multiple timelines to clean air.
Increase the modal share of public and non-motorised transportation. Further, promote e-vehicles. (detailed recommendation under Transport Sector).	 	Medium to long-term	Policy framework available Need to create awareness Capital investment required Inter-departmental coordination	
Better traffic management, re-direction of traffic movement, development of multi-layered parking and ban on-street parking within specific perimeters of the multi-layered parking to ensure parking inside the facility.		Short to medium-term	Feasibility studies needed Implementation of existing rules/ policies Capital investment	

Recommendations	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
Increase/create green cover or green buffers along the major traffic corridors, roundabouts and industrial areas.		Medium to long-term	Inter-departmental coordination required Efficient maintenance and monitoring of plantation sites	Major sources for air pollution in Ahmedabad are road dust, vehicular emission, domestic fuel burning, open waste burning, construction activities and industrial emissions. GPCB has an action plan to control air pollution in Ahmedabad. A source apportionment study is currently being conducted by GEMI, sponsored by the Department of Forests and Environment. Union Budget 2020-21 (15th FC report for 2021-2026) has allocated ₹ 2,217 crore for 42 urban agglomerations (with million-plus populations) that will be provided as performance-based grants to ULBs to tackle air pollution. Ahmedabad has three multi-layered parking facilities – one each at Navrangpura (capacity: 250 cars, 350 two-wheelers), Kankaraia (capacity: 400 cars, 200 two-wheelers) and Relief Road (185 cars, 221 two-wheelers) – but operates at much lower capacity. Vehicles are often parked on-street near these facilities.
Enforcement of environmental standards and exhaust fumes for industrial sector.		Short-term and continuous	Robust monitoring and evaluation required	
Sprinkling of water (preferably recycled grey water) for road dust suspension during peak pollution episodes.		Short-term and continuous	Inter-departmental coordination required	
Open waste burning (of solid waste, biomass, plastic, horticulture waste etc.) should be regulated by the municipal corporations/nagar panchayats.		Short to medium-term	Implementation of existing regulations	
Implementation of the action plan for construction and demolition waste (as per the CPCB guidelines).		Short to medium-term	Implementation of existing regulations	
Facilitate source apportionment studies to identify the sources and take specific containment measures.		Short to Medium term	Support to enhance the ongoing study (by GEMI)	
Ensure installation and operation of air pollution control devices in industries and adhere to emission standards.		Medium to long-term	Implementation of existing rules/ regulations Robust monitoring and evaluation	

Heat stress in Ahmedabad and Heat-Health Action Plan[35]



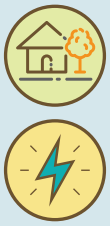
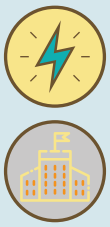
6.3.1 Recommendations based on district-specific environmental problems: Policy framework and concerned departments/agencies

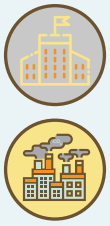
Sectors	Policies and programmes that can push forward the recommendation	Primary Departments/ Agencies	Supporting Departments/ Agencies
Water scarcity (decline of groundwater) and water pollution	1) Model Bill for the Conservation, Protection, Regulation, Management of Ground Water, 2016 2) Water Prevention and Control of Pollution Act, 1974 3) National Water Mission 4) Reuse of Treated Waste Water Policy, 2018 (GoG) 5) Gujarat Domestic Water Supply (Protection) Act, 2019 6) Comprehensive State Water Policy, 2015	1) Water Resources Department, GoG 2) Water Supply Department, GoG 3) GPCB	1) Proposed District Level Climate Change & Environment Committee 2) WASMO (Ahmedabad DWSU) 3) All ULBs 4) AUDA 5) Urban Development Department 6) Rural Development Department 7) Commerce and Industries Department 8) GIDC 9) GAIC 10) CGWB

35 District scenario about Ahmedabad's heat stress is given in Chapter-2

Sectors	Policies and programmes that can push forward the recommendation	Primary Departments/ Agencies	Supporting Departments/ Agencies
Nalsarovar wetland	1) Ramsar Convention Wetland (Conservation & Management) Rules, 2017 2) National Water Missions Wildlife (Protection) Act of 1972	1) Forest and Environment Department, GoG 2) GPCB 3) Biodiversity Board Gujarat	1) Proposed District Level Climate Change & Environment Committee 2) Urban Development Department 3) Rural Development Department, 4) Agriculture Department, GoG 5) Fisheries Department, GoG 6) Revenue Department, GoG 7) Tourism Department, GoG 8) Water Resources Department, GoG 9) All ULB 10) All PRIs
Making brick kilns sustainable	1) Energy Efficient Enterprise (E3) Certification Scheme for Burnt Clay Brick Manufacturing Industry 2) Gujarat Industrial Policy 2020 3) Environment Protection Act, 1986 – Section 6 and 25. 4) Air (Prevention and Control of Pollution) Act, 1981 – Section 18(1)(b) for the prevention and control of air pollution in different types of brick kilns	1) Industries and Mines Department, GoG	1) Proposed District Level Climate Change & Environment Committee GPCB 2) District Industries Centre 3) MSME Development Institute, Ahmedabad 4) Land and Revenue Department
Managing air pollution	1) Air (Prevention and Control of Pollution) Act- 1981 2) Environment (Protection) Act, 1986 3) National Clean Air Programme, 2020 4) Solid Waste Management Rules, 2016 & Amendment 2018 5) Construction & Demolition Waste Management Rules, 2016	1) GPCB 2) System of Air Quality and Weather Forecasting and Research (SAFAR), IMD 3) All ULBs	1) District administration and the proposed District Level Climate Change & Environment Committee 2) Department of Climate Change, GoG 3) Commissionerate of Transport, GoG 4) Energy and Petrochemicals Dept, GoG 5) RTO 6) All ULBs

6.4 Actions district authorities can recommend to state departments

Recommendations that could be pursued by the district collector/ committee at the state level	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) With optimum push, this initiative can help India align with the Paris Agreement targets	UGVCL is one of the best performing DISCOMs in the country and its AT&C losses (6.73%) are well within the international standard range of 6% to 8%. The private player DISCOM in Ahmedabad, TPL –D, can aim to do the same. The Smart Grid Pilot Project was launched by the UGVCL on Feb 25, 2019 (under the National Smart Grid Mission) for Naroda, Ahmedabad. UGVCL is the first DISCOM in India that has commissioned the Smart Grid Project.
HABITAT: Provide subsidies/ tax rebates to builders/ building owners to encourage adoption of ECBC or IGBC (such as 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). Gujarat Tourism Policy 2021-25 offers reimbursement of 50% of certification fee, with a maximum limit of ₹ 10 lakh, to hotels / wellness resorts obtaining green rating from Indian Green Building Council (IGBC).
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) Equipping electric traction rolling stock with regenerative capability and feedback 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.
TRANSPORT: District authorities while gradually rolling out EV infrastructure, can advocate to state and national governments for standardised EV cables and infrastructures for easier integration and interoperability for implementation of smart charging on a large scale.		Medium to long-term	Needs policy intervention	

Recommendations that could be pursued by the district collector/ committee at the state level	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. For example: a) Increase charges on registration of Internal combustion engines (ICE) vehicles. b) Levy congestion charges and other green taxes. c) Phase out of older, more polluting vehicles.		Short-term and continuous	Policy formulation based on research and inter-departmental cooperation needed	In January 2021, the Ministry of Road Transport and Highways announced additional taxes on old vehicles that are unfit for roads and has termed them as 'green taxes'.
TRANSPORT: Shift key commercial / business centres outside city limits to reduce traffic load.		Long-term	Requires policy backing based on research and inter-departmental cooperation	Development of areas outside AMC limits through AUDA in areas like, Bopal, South Bopal and Gota etc.
INDUSTRY: a) Ensure regular PAT compliance of DISCOMs and other designated consumers (DCs) in the district; b) Increase the number of DCs for PAT scheme in the district and ensure the compliance of targets.		a) Short-term and continuous b) Medium to long-term	Policy framework exists (section 6.4.1), but targets need to be revised gradually Ensure M&E Collaboration required	Till PAT Cycle VI (2020-21), only 12 DCs have volunteered under the scheme in Ahmedabad district. Over the years, various DCs from Ahmedabad district have helped avoid around 0.85 $MtCO_2e$ 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)	Currently, the RPO target in Gujarat for industries is 15.65%.
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 SDG#2 targets: 2.1, 2.3, 2.4	In Ahmedabad, jowar and bajra production has continuously decreased (jowar – from 9,600 tonnes in 2011-12 to 538 tonnes in 2017-18 and bajra – from 27,100 tonnes in 2011-12 to 4,569 tonnes in 2017-18).

Recommendations that could be pursued by the district collector/ committee at the state level	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
AGRICULTURE: To compensate for predicted decrease in crop productivity, initiate research on high yield, drought and temperature resilient genotypes 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 SDG#2 targets: Targets 2.1, 2.3, 2.4, 2.a	Production of cotton decreased in Gujarat. In Ahmedabad alone, it reduced from 2.7 lakh bales in 2017-18 to 1.7 lakh bales in 2018-19. However, the area under cotton cultivation has remained the same (1,05,400 ha in 2017-18 and 1,03,200 ha in 2018-19), thereby resulting in reducing the yield by 33.6%. Low rainfall can be one of the key reasons for the reduced yield. Area under rice cultivation increased in Ahmedabad from 1.47 lakh ha to 1.51 lakh ha (between 2016-17 and 2017-18) resulting in higher methane emissions. However, production reduced from 3.1 MT to 2.5 MT (between 2016-17 and 2017-18 respectively) and the yield reduced by 18%. Therefore, temperature and drought-resilient rice varieties having climate-friendly irrigation practices/ water regimes should be preferred. Moreover, avoid rice cultivation in non-traditional rice areas. Climate change impacts are likely to reduce rice yield in Ahmedabad by 29.7% and other crops will also be affected.
AGRICULTURE: For overall reduction in electricity and water consumption, subsidies can be reduced by some percentage in a phased manner.		Medium to long-term	Policy intervention needed Awareness needs to be created among the farming communities, followed by collaborations	The tariffs are as per different consumption slabs as well as the horsepower of pump being used. Currently, power tariff for farmers is at 60 to 80 paise/unit in Gujarat. Electricity tariff policies, in conjunction with large subsidies for agricultural power, have caused rapid groundwater depletion in many regions as well as massive financial losses to power utilities and governments – both state and central.[36] Flat tariffs lead to more equitable distribution between high-income and marginal consumers but fail to encourage water conservation. Metered tariffs have the potential to promote water conservation but are difficult to manage and are expensive for low-income farmers. Western states like Gujarat, with rapidly depleting aquifers, should promote tariffs to enhance water conservation.

36 Sindhu B.S. et. al., Power tariffs for groundwater irrigation in India: A comparative analysis of the environmental, equity, and economic tradeoffs

Recommendations that could be pursued by the district collector/ committee at the state level	Cross-cutting with	Qualifying priority		District scenario/case examples
		Timeframe for the action to be accomplished	Framework for implementation	
FORESTRY/GREEN SPACES: Promote regeneration of degraded and open forest areas through corporate social responsibility (or similar mandates) and encourage corporates to dedicate some percent of their profit for greening the spaces around their units/ factories.		Long-term	Needs strengthening of the existing policy framework Needs different stakeholder collaboration	In Ahmedabad circle, 1,181 ha area is under Concentrated Regeneration (as per the Annual Administration Report, Forest Dept., GoG). Green belts help mitigate air pollution, increase urban green cover, leading to carbon sequestration.
E-WASTE: Adopting green marketing approach: Promoting green products by displaying product lifespan on the label of e-products to influence purchase decisions, thereby, using the labels as behavioural intervention.		Medium to long-term	Needs policy intervention, collaborations and awareness	
WATER SCARCITY & POLLUTION: Enactment of the 'Model Bill for the Conservation, Protection, Regulation, Management of Ground Water, 2016' as 'an Act in the state and ensuring strict regulation of private groundwater abstraction		Short-term	Requires policy implementation	Gujarat is the highest performing state in the composite water management indexing (CWMI). Gujarat has a comprehensive water policy that has led to setting up of institutions like the state regulatory authority, state policy council and implementation committee, river basin organisations, water research and training institutes, integrated water data centre, etc. However, establishing a regulatory framework can help the state boost water levels in more wells (as compared to the present achievement of a rise in 33% of wells).

6.4.1. Actions district authorities can recommend to state departments: Policy framework and concerned departments/agencies

Sub-sectors	Policies and programmes that can push forward the recommendations	Primary departments	Associated departments/agencies
Power sector	1) National Smart Grid Mission 2) Smart Metering National Programme 3) Integrated Power Development Scheme (IPDS) 4) Restructured Accelerated Power Development and Reforms Programme (R-APDRP) 5) UDAY Scheme, 2015 6) National Mission on energy Efficiency, specifically PAT (Perform, Achieve and Trade) Scheme 7) Gujarat Solar Power Policy, 2021 8) Policy for Development of Small-scale distributed solar projects, 2019 9) Standards and Labelling Programme	1) GUVNL-UGVCL, GoG 2) MNRE, GoI 3) GEDA, GoG 4) BEE(EESL)	1) Proposed District Level Climate Change and Environment Committee 2) Climate Change Department, GoG 3) DMF 4) Western Railways – Ahmedabad Division
Habitat	1) ECBC 2017	1) Urban Development and Urban Housing Department, GoG 2) All ULBs 3) Smart City Ahmedabad Development Ltd.	1) Proposed District Level Climate Change and Environment Committee 2) AUDA 3) GEDA
Transport	1) ECBC 2) JNNURM 3) Smart Cities Mission and AMRUT	1) Ports and Transport Department 2) All RTOs 3) ALL ULBs	1) GSRTC 2) GEDA 3) Smart City Ahmedabad Development Limited 4) Western Railways – Ahmedabad Division
Industry	1) PAT Scheme 2) Gujarat Industrial Policy, 2020	1) Industries and Mines Department, GoG	2) Industries Commissionerate 3) District Industries Centre 4) Proposed District Level Climate Change and Environment Committee
AFOLU	1) National Mission on Food Security 2) Rashtriya Krishi Vikas Yojana: Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RAFTAAR) 3) National Mission for Sustainable Agriculture 4) Price Support Scheme 5) National Afforestation Programme (NAP) 6) Green India Mission 7) CSR Act	1) Agriculture, Farmers' Welfare and Co-operation Department, GoG 2) Gujarat Forest & Environment Department, GoG	1) Proposed District level Committee on Climate Change and Environment 2) Gujarat Agro Industries Corporation (GAIC) 3) Anand Agriculture University, Ahmedabad 4) APMCs 5) Energy and Petrochemicals Department, GoG 6) GIDC
Waste	1) E-waste Management Rules, 2016	1) Science and Technology Department, GoG	1) Proposed District Level Climate Change and Environment Committee

6.5 Sustainable Development Goals being addressed

SDGs	Targets	Sector (sub-sectors) addressing the recommendation
SDG 1: No Poverty 	Target 1.4: Ensure that all men and women, in particular the poor and the vulnerable, have access to basic services	Waste, water
SDG 2: Zero Hunger 	Target 2.1: End hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	AFOLU (agriculture)
	Target 2.3: Double agricultural productivity	AFOLU (agriculture)
	Target 2.4: Implement resilient agricultural practices that increase productivity and production	AFOLU (agriculture)
	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 & livestock)
SDG 3: Good Health & Well-being 	Target 3.3: End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	Water pollution, co-benefits from waste (through cleaner neighbourhood, better access to sanitation)
	Target 3.4: Reduce by one-third premature mortality from non-communicable diseases through prevention	Co-benefits from waste (by reducing pollution and providing better hygiene)
	Target 3.9: Substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	Waste, water scarcity and water pollution and air pollution
SDG 6: Clean Water & Sanitation 	Target 6.1: Achieve universal and equitable access to drinking water	Water scarcity and water pollution
	Target 6.3: Improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	Waste, energy (industry), water pollution
	Targe 6.4: Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals	Energy (Habitat: Demand-side management, industry), AFOLU (agriculture & green spaces) water scarcity
	Target 6.5: Implement integrated water resources management at all levels	AFOLU (agriculture & green spaces/forestry), water scarcity & pollution
	Target 6.8: Support and strengthen the participation of local communities	AFOLU (agriculture, livestock & forestry), transport, wetland
	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 & industry), wetland
	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, wetland (RE-powered recreational activities)
SDG 8: Decent Work & Economic Growth 	All targets	AFOLU (agriculture & livestock)
	Target 8.2: Achieve higher levels of economic production through diversification, upgradation and innovation	AFOLU (agriculture & livestock); energy
	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	Wetland, agriculture (forestry/ green spaces)
SDG 9: Industry, Innovation & Infrastructure 	Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure	Energy (Habitat: energy efficiency in building & transport); waste
	Target 9.2: Promote inclusive and sustainable industrialisation	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-cold chains/ water pumps etc.), waste, energy (industry), water scarcity, sustainable brick kiln
	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 & industry), 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 & Communities 	Target 11.1: Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	Waste, habitat, water
	Target 11.2: Safe, affordable, accessible and sustainable transport systems for all	Energy (transport & habitat), air pollution
	Target 11.3: Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management	Waste, energy (power & habitat: energy-efficient building), all district specific sectors
	Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage	AFOLU (forestry/green spaces), wetlands, water scarcity
	Target 11.6: Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	Waste, energy (power; habitat, transport, industry), sustainable brick kiln and air pollution
	Target 11.7: Provide universal access to safe, inclusive and accessible, green and public spaces	AFOLU (green spaces), habitat, 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)
	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 & Production 	Target 12.1: Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	Energy, waste
	Target 12.2: Achieve the sustainable management and efficient use of natural resources	Energy, AFOLU, waste, air pollution and water pollution
	Target 12.3: Halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	AFOLU, waste
	Target 12.4: Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil	AFOLU, waste, air pollution, water pollution
	Target 12.5: Substantially reduce waste generation through prevention, reduction, recycling and reuse	Waste, habitat, industry
	Target 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	Waste, industry
	Target 12.8: Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	Individual action and behavioural change communication
	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 & livestock)
SDG 13: Climate Action 	All targets	All sectors and sub-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, water pollution and wetland
	Target 15.2: Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation	AFOLU (forestry/green spaces)
	Target 15.3: Combat desertification, restore degraded land and soil	AFOLU (forestry/green spaces)
	Target 15.5: Take urgent and significant action to reduce degradation of natural habitats, halt loss of biodiversity	Wetland, AFOLU (forestry)
	Target 15.9: Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies	AFOLU (agriculture, livestock & forestry), water
	Target 15.a and 15.b: Mobilise and significantly increase financial resources from all sources to conserve and sustainably use biodiversity, ecosystems and sustainable forest management	AFOLU (agriculture, livestock & forestry), wetland, water
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, air pollution, wetlands, heat stress, individual action & behavioural change communication
	Target 17.16: Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilise and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries	Energy, AFOLU, Waste

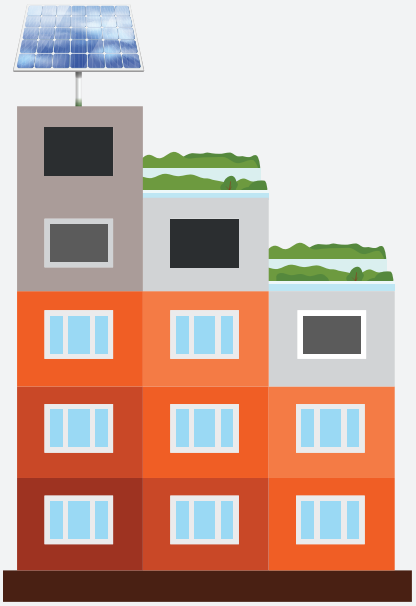
6.6 Promoting voluntary individual climate action

Waste management

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

Housing

1. Insulate the building as much as possible, ensure proper sealing of doors and windows to avoid cooling/heating leakage
2. Develop and maintain provision for Rain Water 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

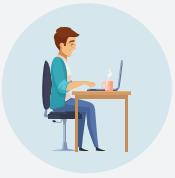
1. When cooking on gas stove, use moderate flame setting to conserve LPG
2. Prefer the use of pressure cookers
3. Keep the burner clean
4. Use lids to cover the pan while cooking
5. Use flat bottomed pan on electric stove
6. Turn off electric stove several minutes before the specified cooking time

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.

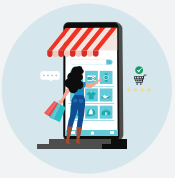
Carry your own water bottle, adopt minimalist lifestyle to reduce overconsumption of resource, purchase only when necessary

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



If possible then opt for work from home options for a few days in a week

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



Choose Standard Shipping when ordering online

Buy locally available produces especially food/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

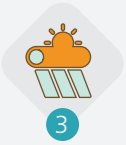
Buy local and organic food items not only for health but also to cut down emissions from transport and chemical fertilizers

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)



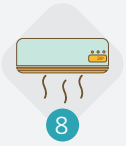
3. Replace electric water heater with a solar water heater, if feasible

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

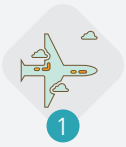
6. Proper maintenance of air conditioners helps to increase efficiency

7. Do not overload the refrigerator



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

Transport



1. Choose direct flights to reduce carbon footprint

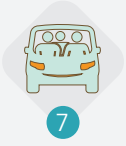
2. Travel light to reduce carbon emissions

3. Strictly abide by pollution norms

4. Put on your shoes for short trips

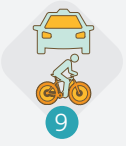
5. Ensure regular maintenance of vehicles

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



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

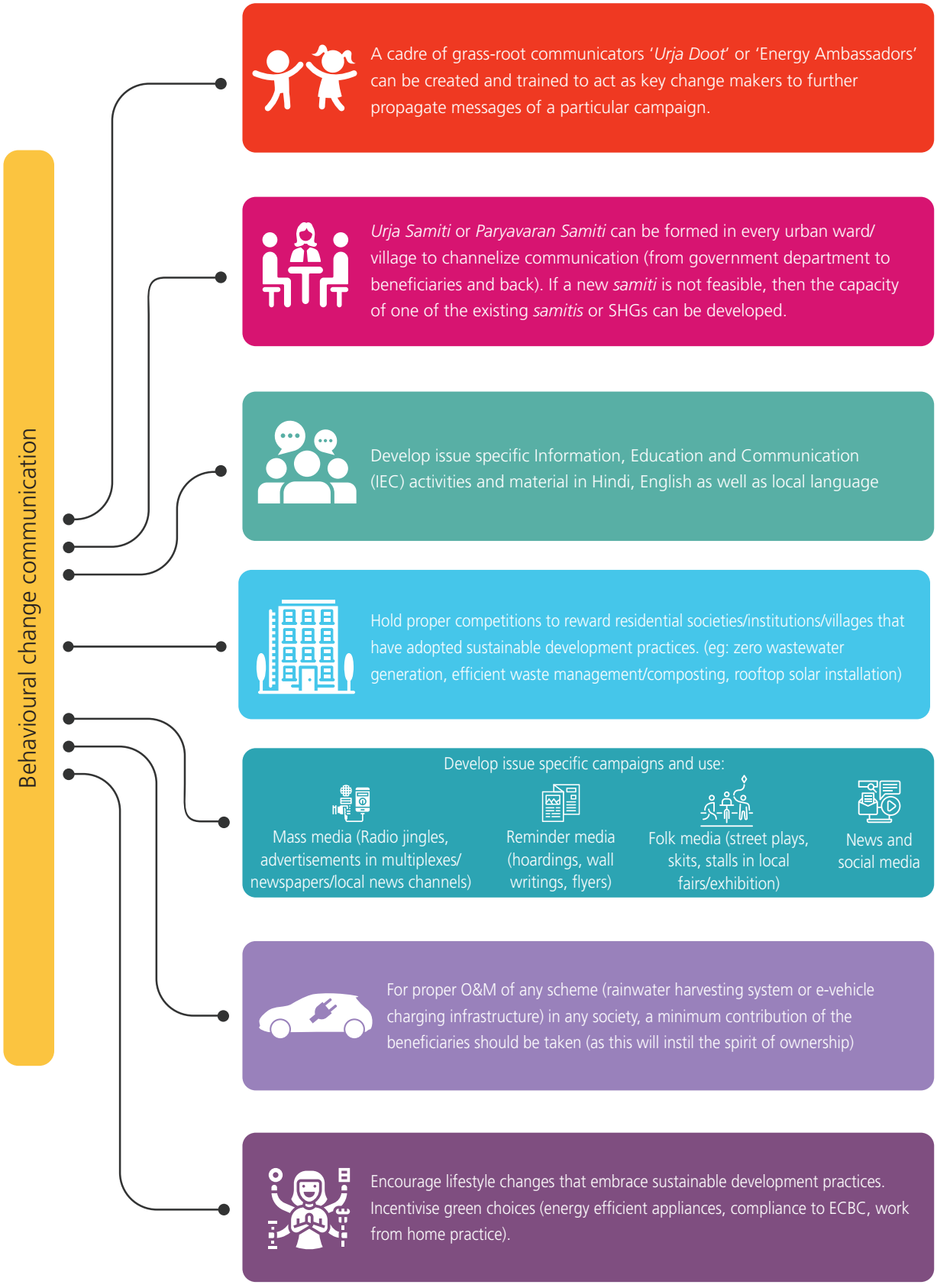
8. Shift to clean, non-petroleum fuels such as electricity to power vehicles



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



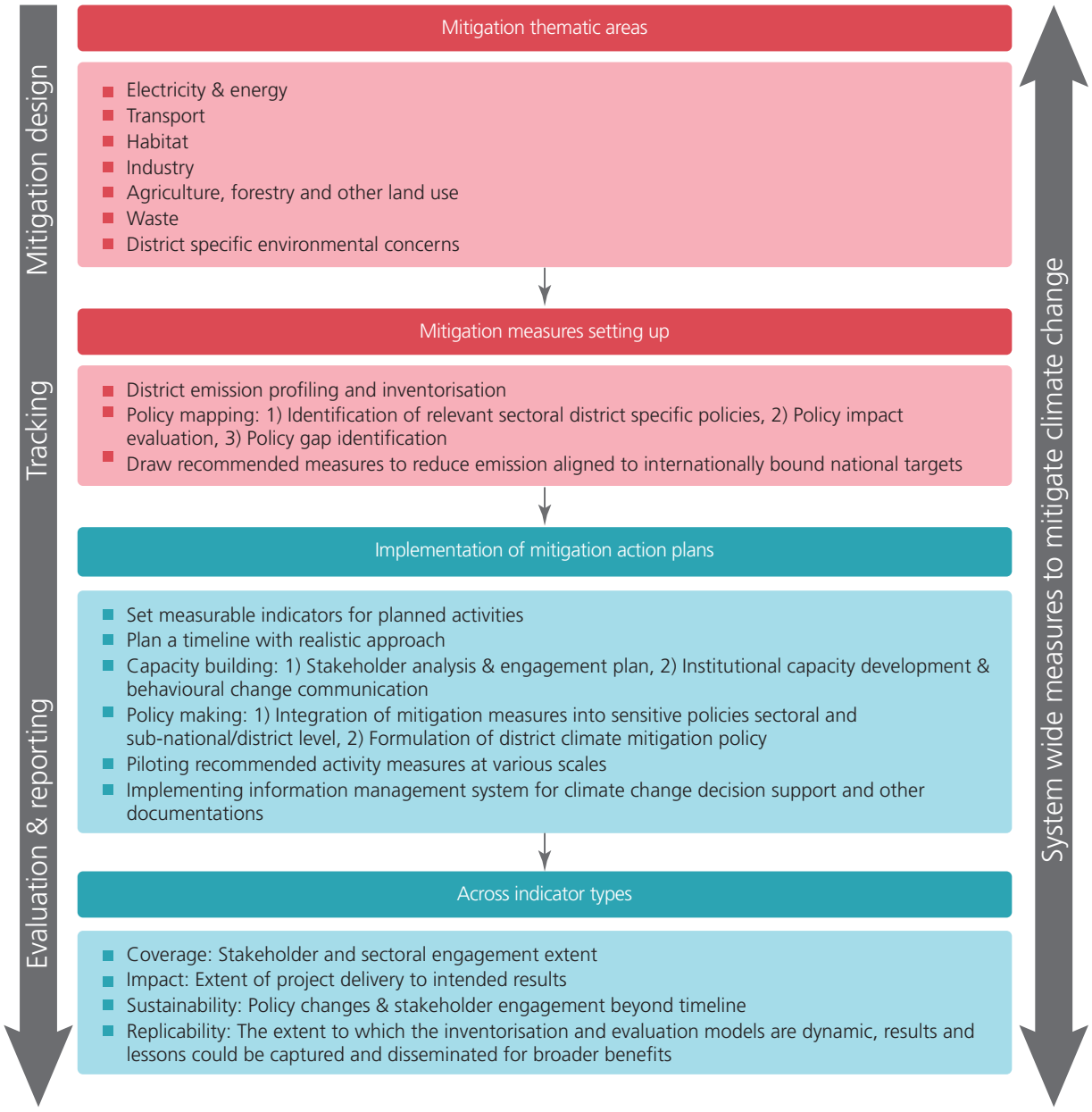
MONITORING AND EVALUATION PLAN

Stakeholder consultation for CCEAP Ahmedabad chaired by the Ahmedabad collector, Shri. Sandip J. Sagale, IAS

7. MONITORING AND EVALUATION PLAN

7.1 Framework for monitoring and evaluation

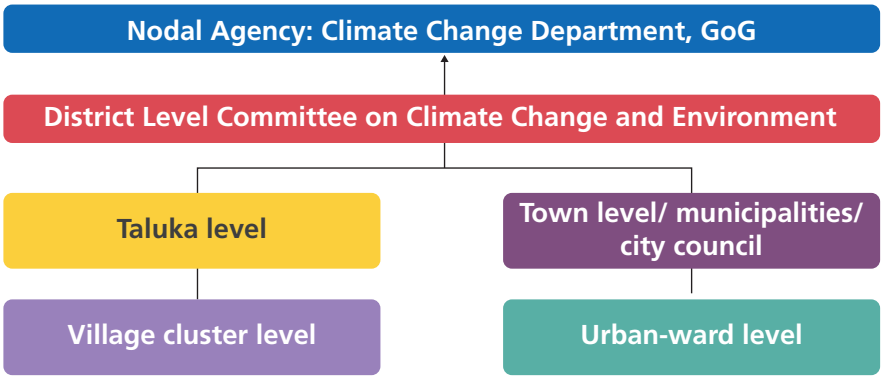
This section describes the planning for monitoring and evaluation (M&E) of the climate change mitigation measures that the district may adopt for the sectors identified in the report. M&E is crucial to realise the achievement and track the effectiveness of results envisaged in order to compliment the national endeavours to attain nationally determined contributions. The framework proposes to incorporate: a) district-level mitigation profiling, b) planning for mitigation measures, c) tracking of implementation and integration to the national mitigation response, and d) evaluation of relevance and effectivity.[37]



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

7.2 Proposed institutional set-up

As a central authority or body to steer the wheels of climate mitigation, it is recommended to formulate a district climate cell/committee or include the perspective of climate change in the existing District Environment Committee.[38] The committee shall assign tasks according to stakeholder analysis and engagement as outlined in the following model. This monitoring and evaluation committee shall comprise of representatives from concerned administrative bodies, sectoral experts, civil society organisations and civic/other associations (as applicable) and shall similarly be formed at block, ULB, cluster and ward level. The committee shall oversee implementation of deliverables following the prescribed recommendations/framework and the outputs. A proposed set-up of the committee at each of the levels is as follows:



District level committee

Chairman: District Collector

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

Taluka level

Chairman: Mamlatdar/Taluka Development Officer

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

Town level/municipalities

Chairman: Head of Municipality/Nagarpalika

Members: Town level representatives of the departments mentioned above

Village cluster level

Chairman: Deputy Mamlatdar

Members: Sarpanch and other PRI members, Self-help group members, head of women committee, Village Water and Sanitation Committee (VWSC), grassroot communicators

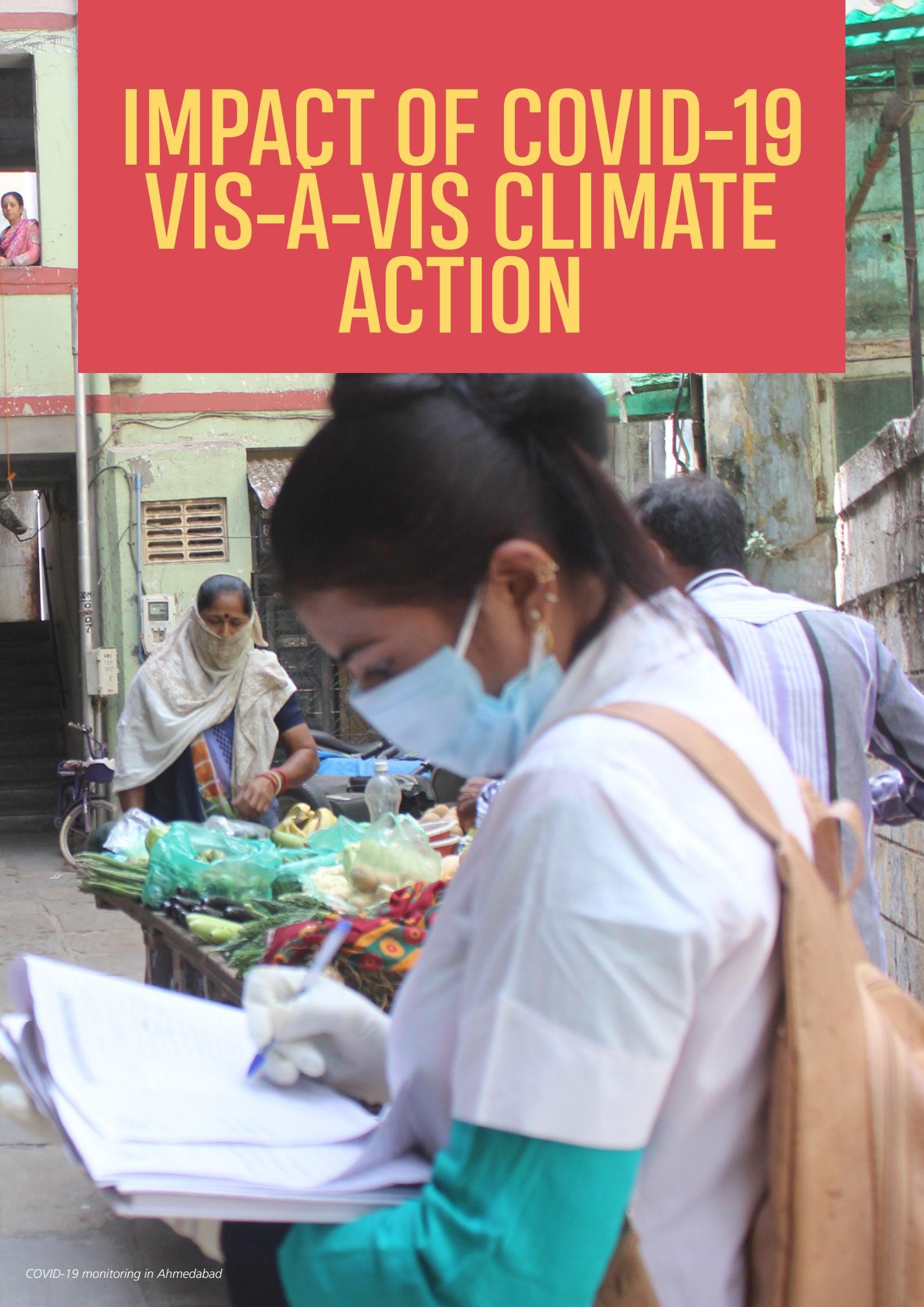
Urban-ward level

Chairman: Ward Representatives

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

38 As per the Hon'ble NGT order in O.A. No. 710-713/2017 dated 15.07.2015

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



COVID-19 monitoring in Ahmedabad

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

8.1 Introduction

The ongoing COVID-19 pandemic has gravely affected the country. Ahmedabad district reported 2,38,213 (as of September, 2021), accounting for 28.8 percent of the state's total case-load (Covid19 India, 2021). This has affected management of climate crisis.

Positive impacts: Lockdowns have had several positive impacts on the environment. For the first time in nearly four decades, India saw a reduction in CO_2 emissions by 30 million tonnes CO_2 (1.4 percent) in FY 2019-20 due to economic slowdown and restricted activities (Lauri & Dahiya, 2020). In April 2020, aerosol levels were at a 20-year low in north India one of the most polluted regions of the world (NASA, 2020). Ahmedabad too saw decreased turbidity levels in Sabarmati River (16.8 percent drop in average suspended particulate matter/SPM than the previous year) and a significant drop in atmospheric pollution level (NO_2, $PM_{2.5}$ and PM_{10}) resulting out of restricted industrial production and pollutant generation (Aman & Yunus, 2020).

However, the economic and social (both direct and indirect) costs of the pandemic are likely to take priority over climate goals and commitments. The following are some likely impacts of COVID-19 *vis-à-vis* climate action, inferred from observations across the country and drawn for the district of Ahmedabad.

8.2 Energy consumption

8.2.1 Electricity demand

Coal-based power generation reduced by 26 percent in just two weeks after the lockdown, a significantly larger drop as compared to 6 percent globally (Pillay, 2020). India's power consumption shrunk by 22.7 percent in April and increased by 14.16 percent in May with relaxations in lockdown norms (The Economic Times, 2020). At the national level, while the fuel consumption took a dip of around 70 percent as compared with pre-COVID levels, electricity demand fell by 20 to 25 percent during the strict lockdown.

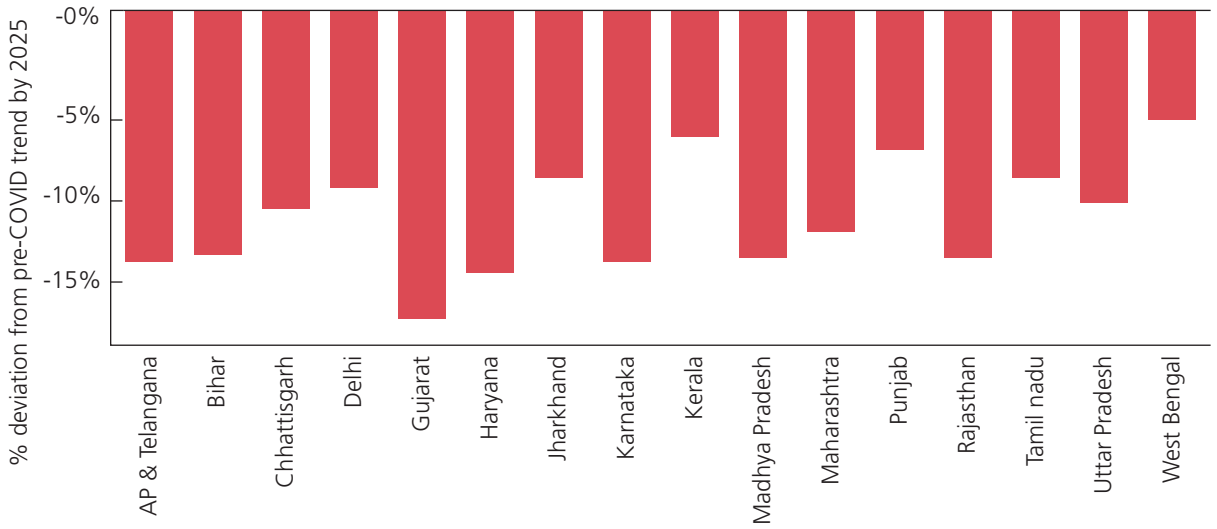


Figure 45: 2025 deviation of electricity demand from pre-COVID trends projected from major Indian states

India's electricity demand is projected to be 7 to 17 percent lower by 2025 due to the downward revision of its GDP growth, partly due to the COVID-19 economic shock (Spencer, 2020).[39]

39 However, as per Central Electricity Authority's Power Supply Report, the national energy requirement in August, 2021 was 128,519 MU, recording a 14 percent rise in comparison to the same month in 2019.

Outlook for Ahmedabad

As a consequence of lower demand, electricity generation at the Sabarmati Thermal Power Plant reduced by 63 percent between January and August 2020. The greatest dip in generation was witnessed during May and June 2020 by 78 percent and 69 percent, respectively (Figure 46).

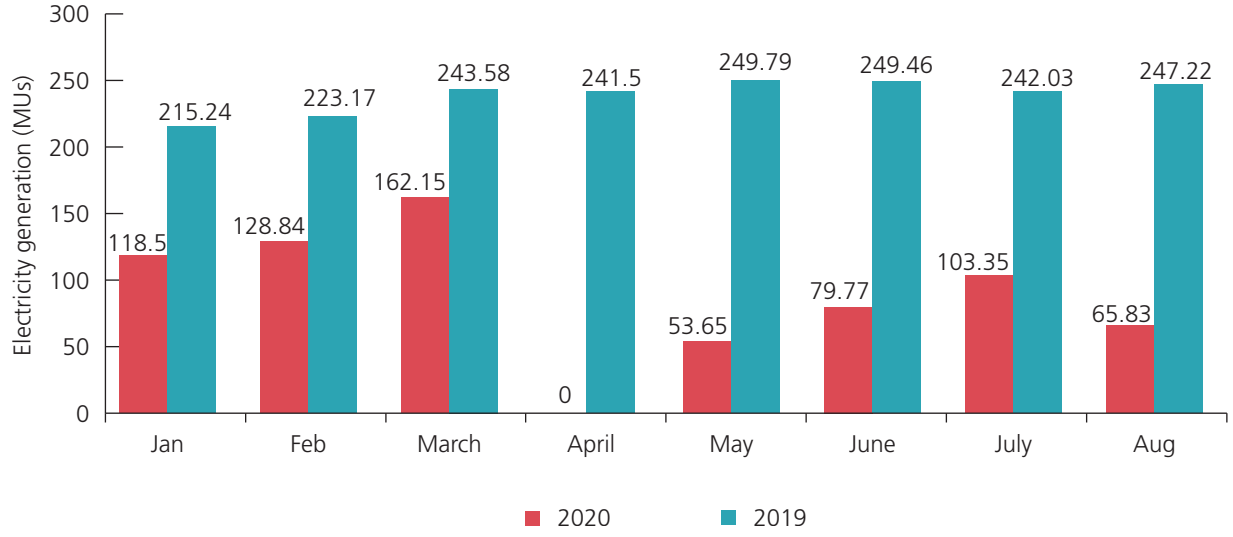


Figure 46: Month-wise comparison of electricity generation (MUs) by Sabaramati TPP in 2020 vs. in 2019

Table 23 and Figure 47 illustrate changes in electricity demand for the district of Ahmedabad (as per UGVCL) during the pre-COVID, lockdown and unlock period with respect to 2019.

Table 23: Impact of COVID-19 on electricity demand-UGVCL

UGVCL	2020	Actual electricity consumption (MU)	Change in electricity consumption (w.r.t 2019) (%)
Pre-COVID	JAN	1439.92	2.99
	FEB	1485.72	4.54
	MAR	1470.80	6.42
Lockdown	APR	1153.00	-16.95
	MAY	398.81	-74.24
Un-lock period	JUN	1928.79	18.53
	JUL	1733.21	8.53
	AUG	1465.38	-2.72
	SEP	1364.77	-1.20

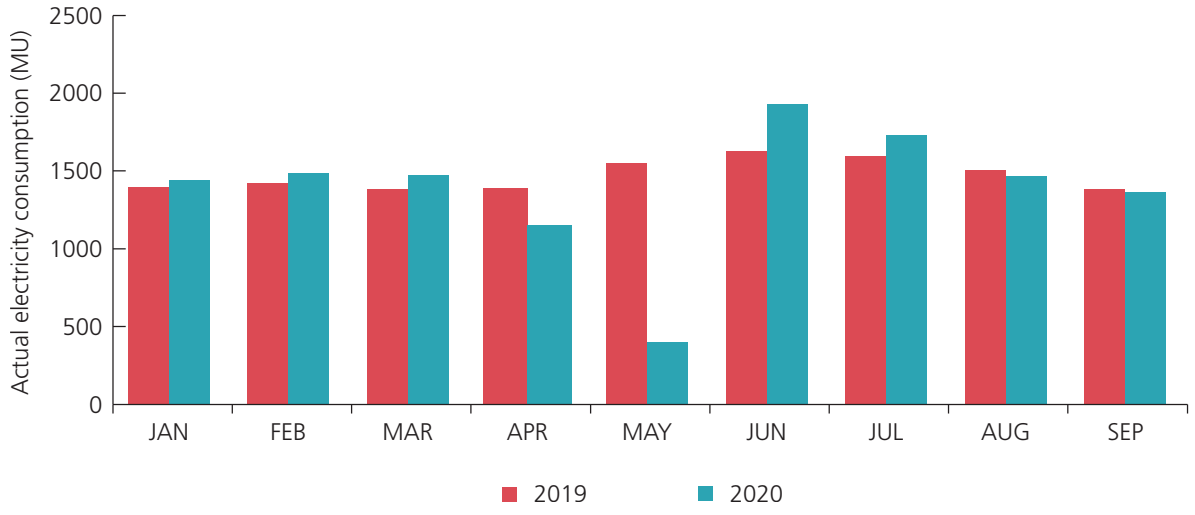


Figure 47: Impact of COVID-19 on electricity demand-UGVCL

Some states have reduced coal power generation to compensate for lower demand. The contribution of coal in total power generation in India fell from an average of 72.5 percent in March 2020 to 65.6 percent in April 2020, since renewable energy sources have a 'must run' status and the running cost of RE plants is lower than thermal power plants (Surya, 2020). This presents an opportunity to increase focus on RE production and strengthen its integration into the grid. Ahmedabad district can contribute to Gujarat's RE generation capacity by encouraging projects such as solar rooftops, biogas and solar pumps for agriculture.

8.2.2 Fuel consumption

India's fuel consumption fell 45.8 percent to 9.929 million tonnes in April, down from 18.32 million tonnes consumed in the same month a year back (Business Standard, 2020). The only fuel that showed growth was LPG as the government dole of free cooking gas cylinders to poor households fired up consumption by 12.2 percent to 2.13 million tonnes in April, 2020.

Outlook for Ahmedabad

As of September 2020, the sale of petrol and diesel were at 70 percent of the pre-COVID levels. This was due to reduced movement of private vehicles as most people were staying home to prevent the spread of the disease (The Times of India, 2020). In such a time, dependence on fossil fuels was clearly decreasing. This provides an opportunity to bring about a paradigm shift in the transport system towards e-mobility. The district needs to take up planning and phase-wise implementation of e-mobility infrastructure and incentives on a priority basis.

8.3 Agriculture

COVID-19 caused disruption to agriculture and its supply chains. Inability to hire harvesters and other machinery interrupted harvesting activities for wheat and pulses. The closure of hotels, restaurants, sweet shops and tea shops during the lockdown caused a depression in milk sales. Shortage of staff at cold storage and food processing units also impacted milk and milk products' supply chain. Meanwhile, poultry farmers were badly hit due to misinformation on social media.

While lockdown impacted availability of seeds, machinery and irrigation equipment, reverse migration proved beneficial for *kharif* (monsoon) crops. Across the nation, as of July 2020, kharif crops were sown on a total 691.86 lakh ha area, against 570.86 lakh ha area during the corresponding period last year, an increase of 21.20 percent (WBCSD, 2020) (PIB, 2020).

Overall, sowing in Gujarat went up by 35 percent for summer crop 2020 (as reported by the State Agricultural Department) – highest since 2016. The Saurashtra region, which includes parts of Ahmedabad district, reported the highest spike (165 percent) in sowing (TOI, 2020). A likely impact of COVID-19 was seen on agricultural transactions in Gujarat. Between March and May 2020, 16.35 lakh farmers across Gujarat sold produce worth ₹ 5,400 crore to the Agriculture Produce Market Committees, which is significantly lower than the corresponding period in 2019 (Indian Express, 2020).

Outlook for Ahmedabad

To prevent loss of yield, the district administration must ensure availability of irrigation facilities, composts, seeds, farming machines during sowing and harvesting periods and provide support where necessary, in consultation with farmer bodies. Small farmers must be prioritised while provisioning facilities. Further, the prices paid to farmers must be regulated to ensure steady income.

8.4 Migration

India witnessed a national migrant crisis resulting from the nationwide lockdown, leading to widespread job loss, particularly for daily wage labourers. The huge migrant exodus from cities to villages added pressure on energy, food and water resources in rural areas, thereby increasing waste footprint. In Gujarat, 6.72 lakh workers exited the major urban centres by special trains and many travelled by road and on foot (The Indian Express , 2020).

Outlook for Ahmedabad

The district administrator must understand the migration pattern in Ahmedabad district, and plan allocation and management of resources accordingly. Agriculture sector schemes, MGNREGS and state employment guarantee programmes can be used to fast-track incorporation of these migrants into the state roll and open employment opportunities for them. To ensure safety of immigrants, the district should continue rapid testing and have adequate isolation centres.

8.5 Waste management

The pandemic has a tremendous impact on the waste sector. Grappled with an already burdened healthcare and municipal waste management system, Indian states and district level administrations are going to face serious environmental governance challenges, leading to the risk of higher emission from this sector. The waste sector is facing the following challenges:

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

8.6 Air pollution[40]

The term "PM" refers to particulate matter i.e., tiny particles suspended in air in the form of either solid or liquid droplets. They comprise of various organic and inorganic components including acids, ammonia, black carbon, water, mineral dust, etc. The major sources of particulate matter are vehicular, industrial, domestic fuel burning, construction, natural sources including soil dust (re-suspended) and other anthropogenic sources.

PM can be primary – mechanically generated including carbonaceous fly-ash particles produced from high temperature combustion of fossil fuels in coal power plants – and secondary, formed in the atmosphere through reactions of primary gaseous pollutants (NO_2, NH_3, SO_2, Non-methane volatile organic compounds). The size of these particles is critical in defining their potential for causing health problems. Particles less than 10µm in diameter penetrate deep into the lungs causing serious health concerns and reduce visibility (cause haze). Of this, particles having diameter less than 2.5µm ($PM_{2.5}$) pose greater risk to respiratory and cardiovascular mobility and mortality over the long term.

Comparison of 24-hour average of $PM_{2.5}$ over Ahmedabad district between Jan and May for the years 2019 and 2020 shows that $PM_{2.5}$ concentration reduced significantly during the lockdown months (Figures 48 and 49) in 2020 (remaining well below 60 µg/m^3, which is in the good category according to Indian standards) than that of 2019. A similar reduction in PM_{10} concentration was observed during these months in 2020 (Figures 50 and 51). PM_{10} concentration was also found to be below 100 µg/m^3 keeping the air quality mostly in 'good' category ($PM_{2.5}$: 0-30; PM_{10}: 0-50).

40 The $PM_{2.5}$ and PM_{10} modal forecast data obtained from European Centre for Medium-Range Weather Forecasts (ECMWF) and analysed at GIS platform for mapping of monthly mean values.
The data can be accessed from https://apps.ecmwf.int/datasets/data/cams-nrealtime/levtype=sfc/
For the mapping of NO_2 and SO_2 the data were obtained from following URLs.
https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S5P_OFFL_L3_NO2
https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S5P_OFFL_L3_SO2

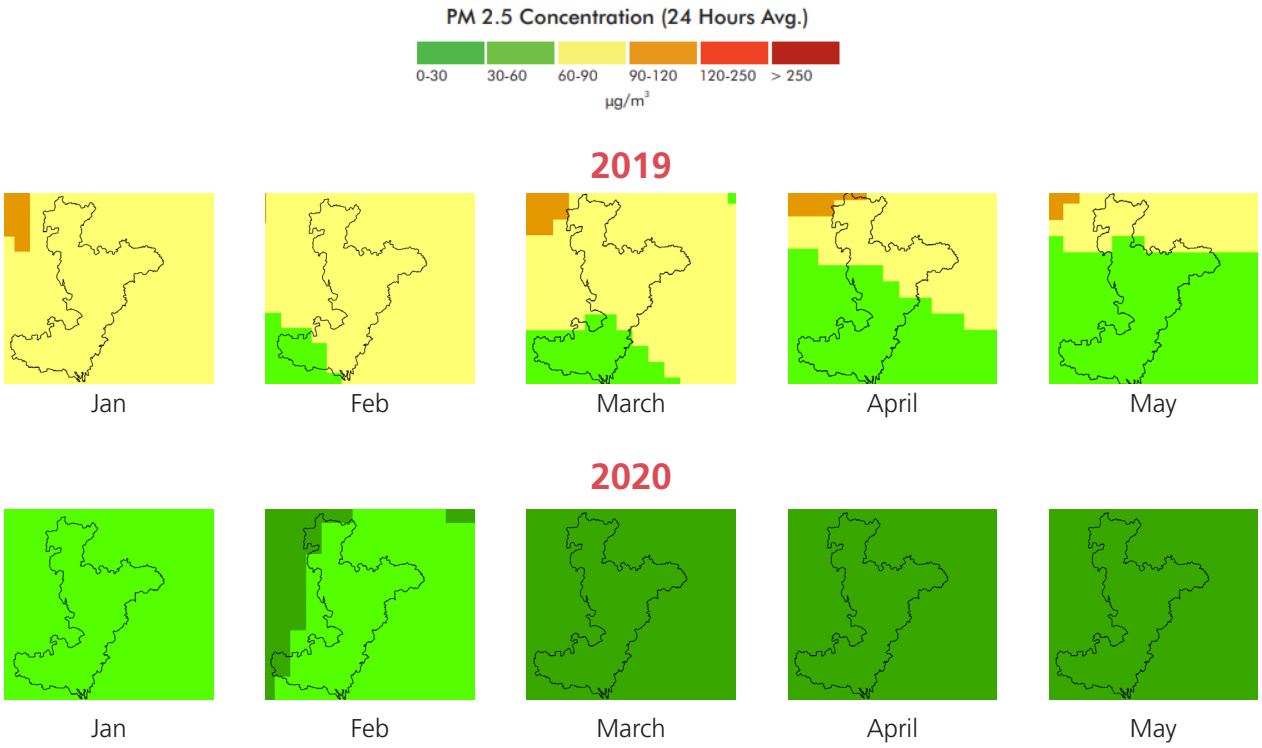


Figure 48: $PM_{2.5}$ concentration in Ahmedabad during Jan-May, 2019 vs. 2020

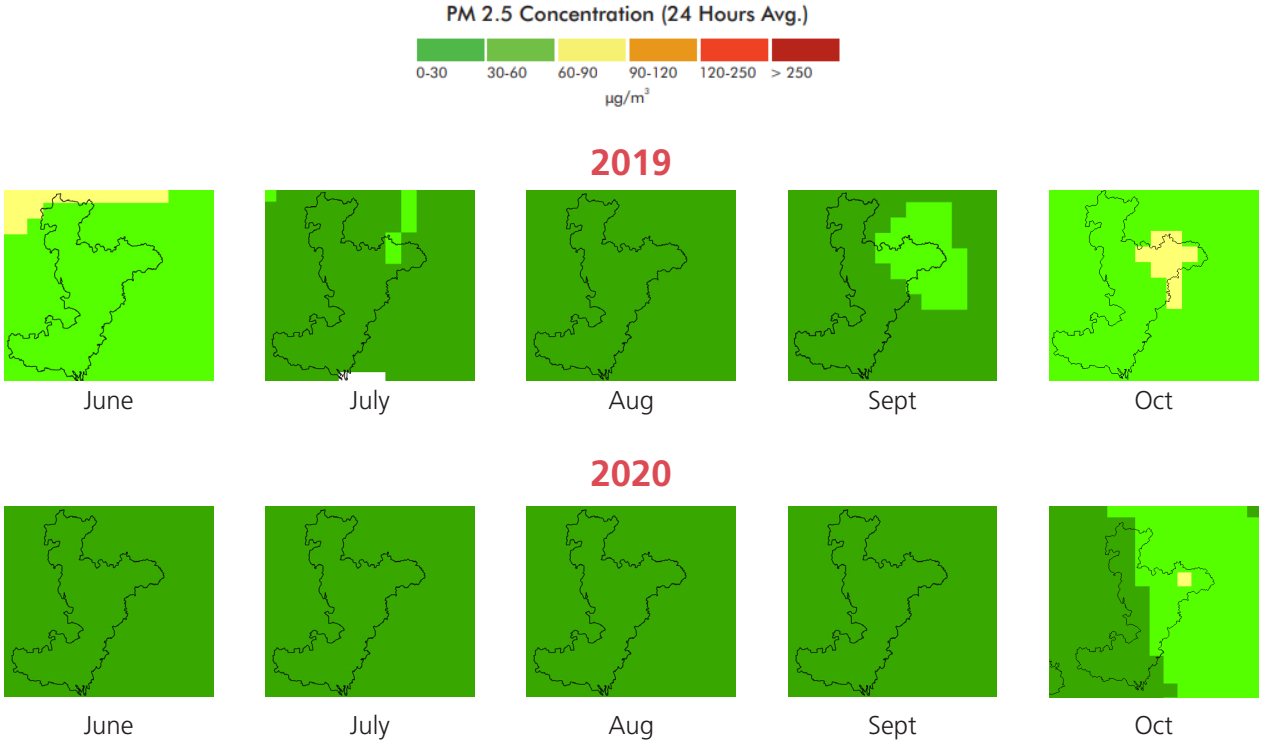


Figure 49: $PM_{2.5}$ concentration in Ahmedabad during June-October, 2019 vs. 2020

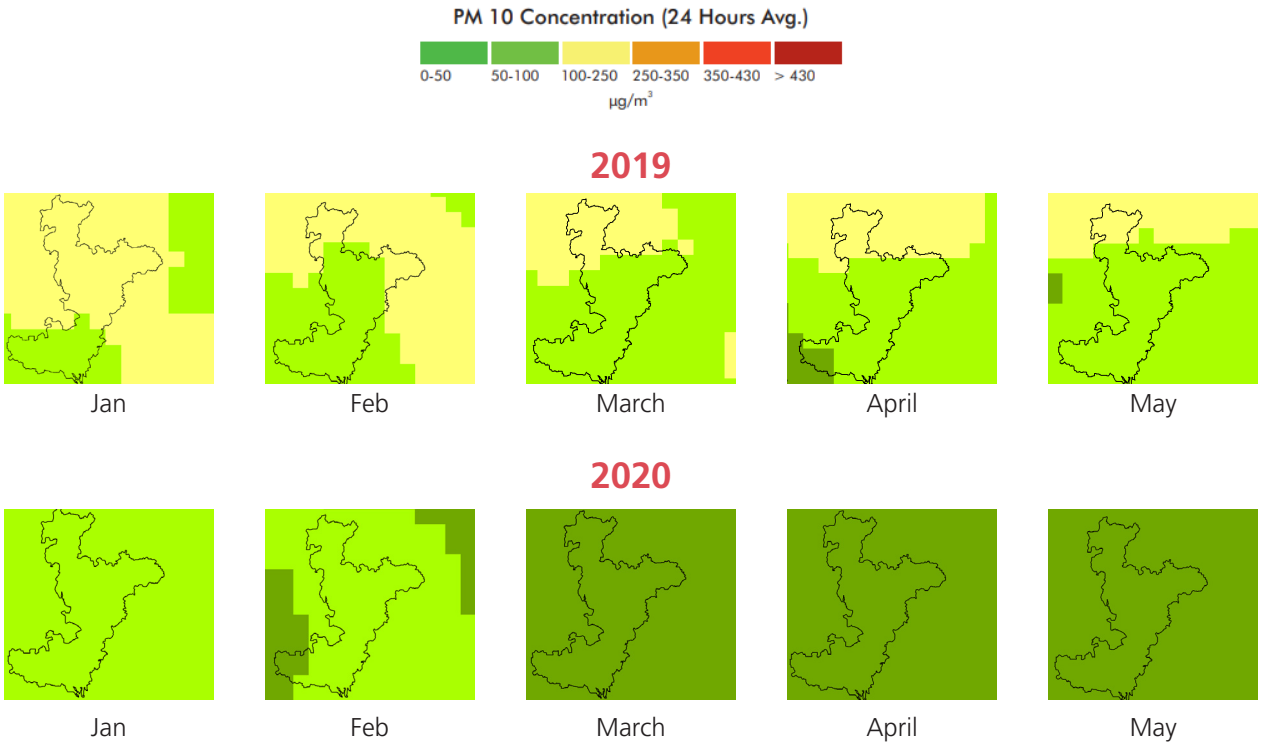


Figure 50: PM_{10} concentration in Ahmedabad during Jan-May, 2019 vs. 2020

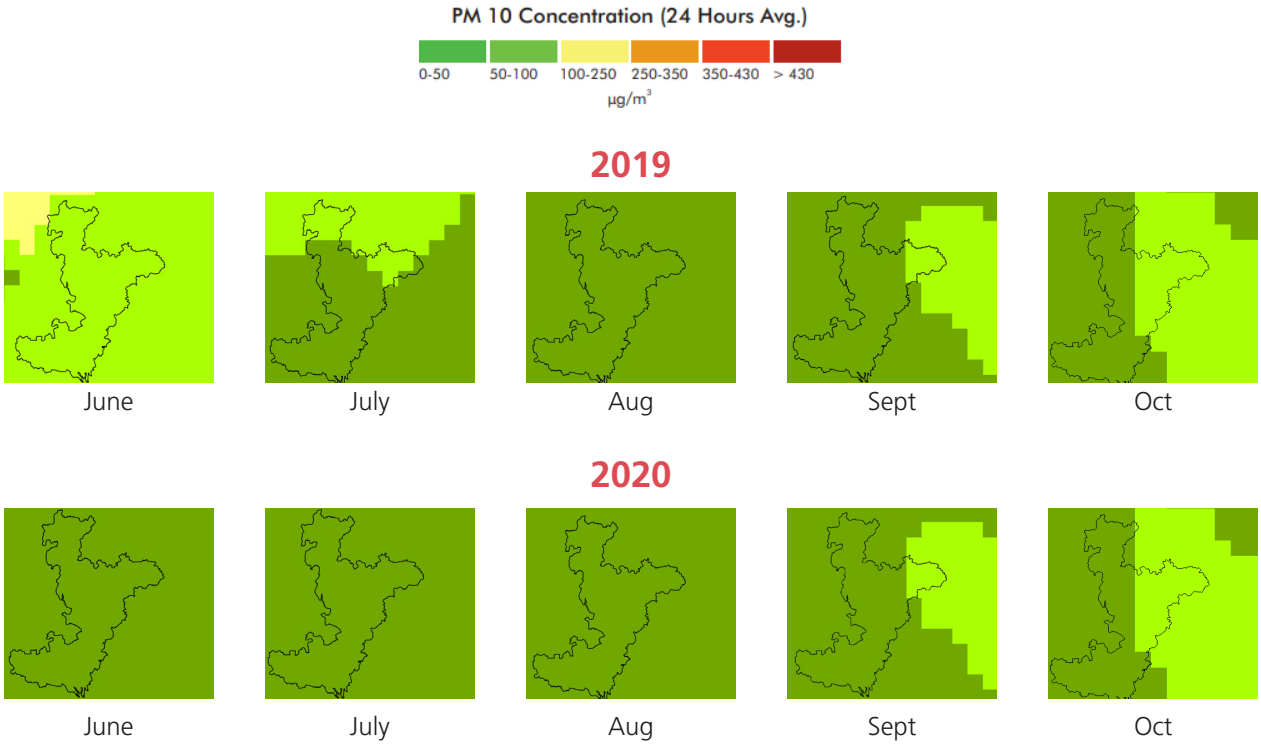


Figure 51: PM_{10} concentration in Ahmedabad during June-October, 2019 vs. 2020

During the lockdown, most anthropogenic activities came to a standstill or were limited. Therefore, the NO_2 concentration over Ahmedabad city (upper eastern region) reduced significantly during March-September 2020, as compared to 2019. However, a rise in NO_2 emissions was observed again from October with the lifting of restrictions. From a range of 114-142 µmole/m² in 2019, the concentration values decreased to 28-57 µmole/m² during the lockdown in 2020 (Figures 52 and 53).

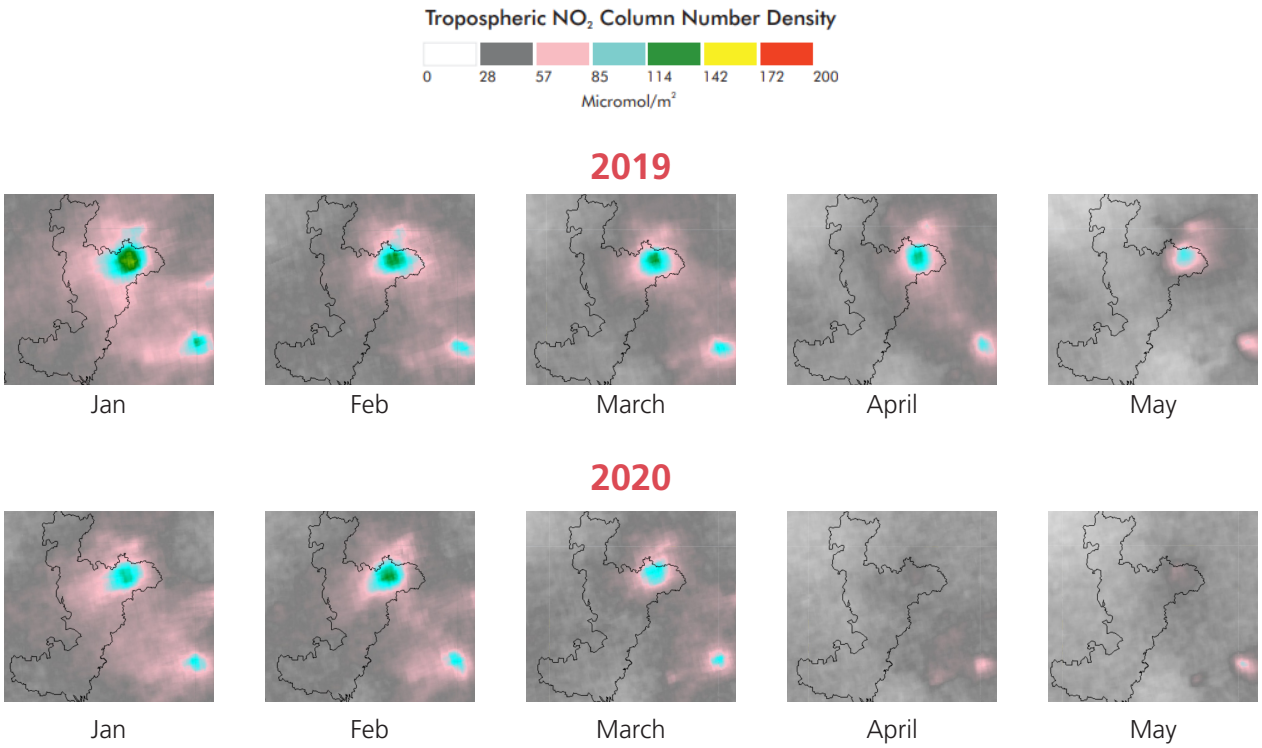


Figure 52: NO_2 concentration in Ahmedabad during Jan-May 2019 vs. 2020

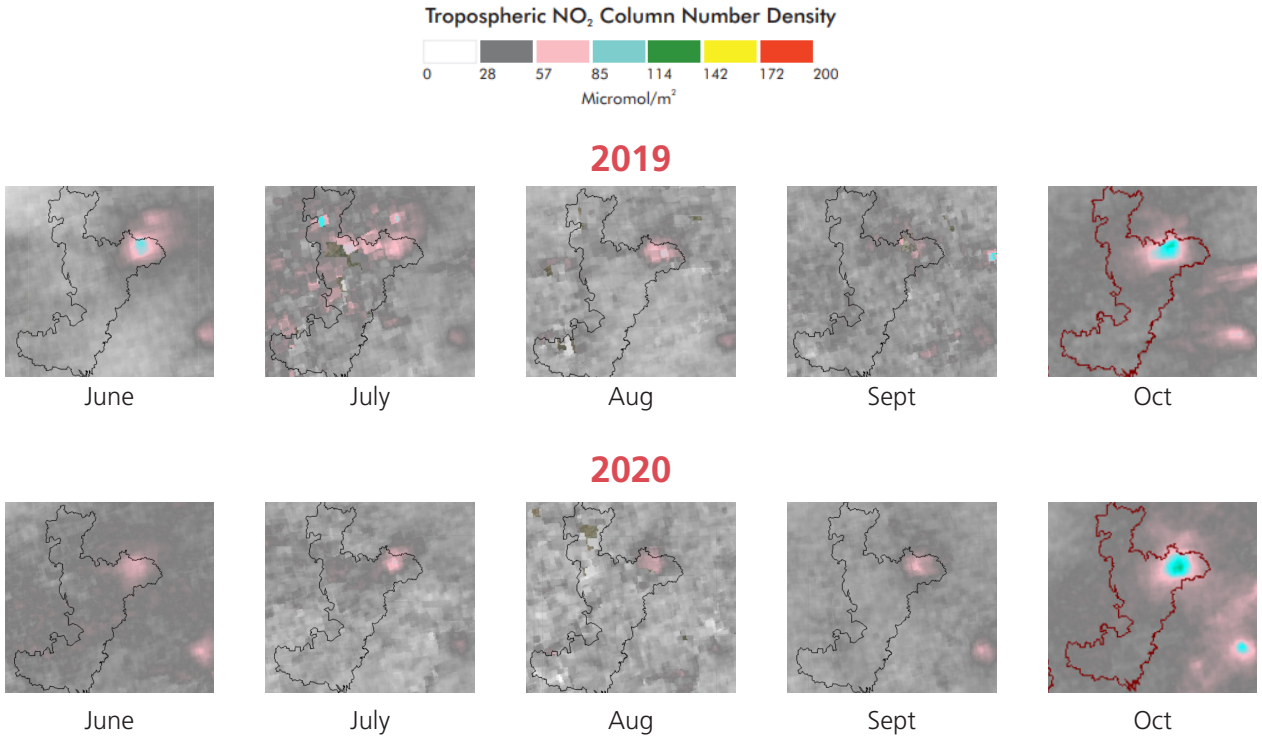


Figure 53: NO_2 concentration in Ahmedabad during June-October, 2019 vs. 2020

Similar effect was observed on the SO_2 concentration over Ahmedabad with a sharp decline in April and May 2020 from its usual high of 350-420 µmole/m^2 to 0-280 µmole/m^2. Patches of SO_2 were observed over the entire district and were particularly dense near urban agglomerations (Figures 54 and 55).

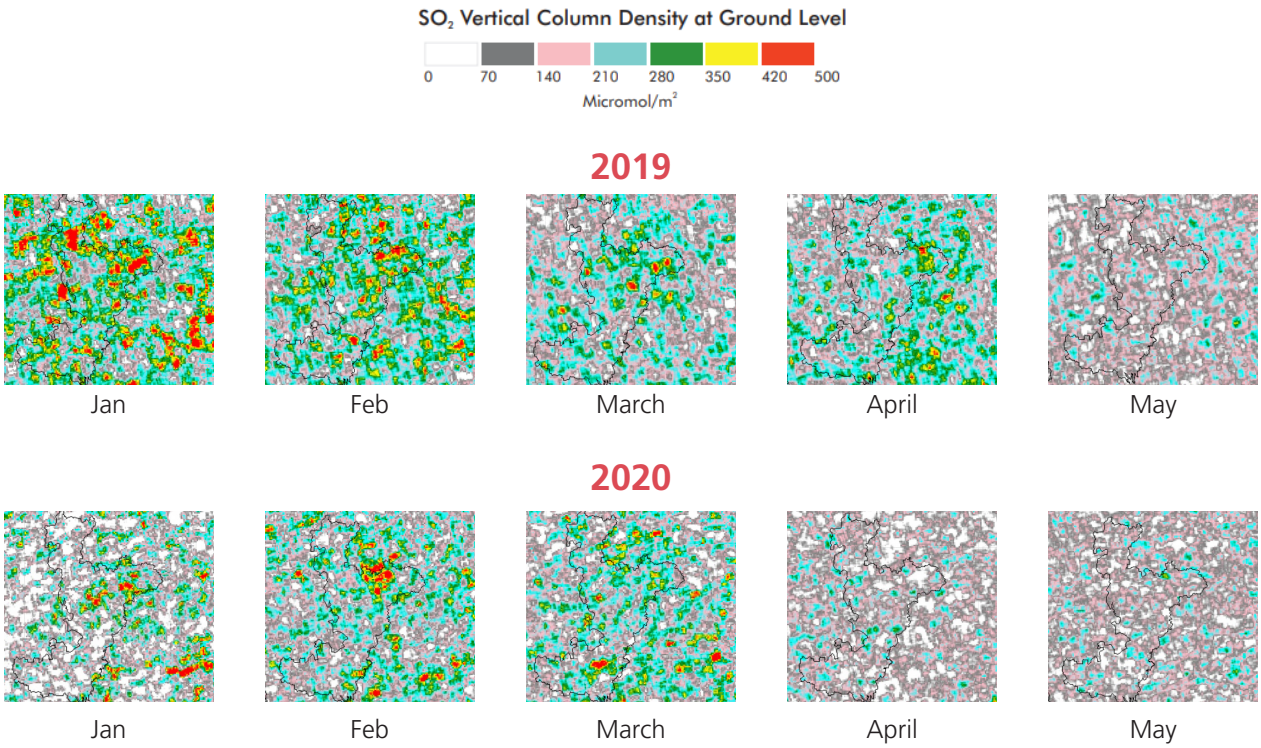


Figure 54: SO_2 concentration in Ahmedabad during Jan-May, 2019 vs. 2020

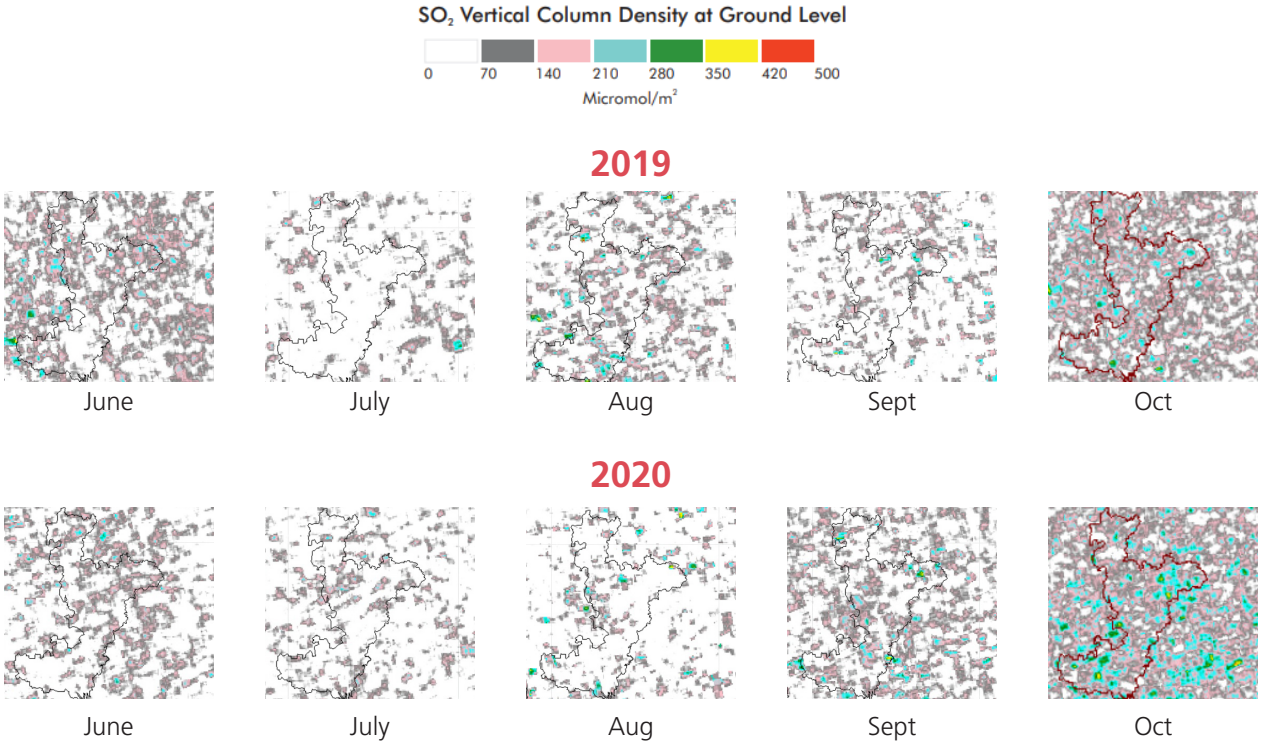


Figure 55: SO_2 concentration in Ahmedabad during June-October, 2019 vs. 2020

Outlook for Ahmedabad

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

THE WAY FORWARD

Rooftop Solar PV Plant SVPI Airport Ahmedabad

THE WAY FORWARD

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

Ahmedabad district has displayed its commitment towards mitigating climate change. The district has been a pioneer in undertaking several measures to address climate change. For instance, Ahmedabad was one of the first cities in India to introduce a Bus Rapid Transit System (BRTS). Together with the Ahmedabad Metro (which was launched in March 2019) and improvement in last-mile connectivity, the district has the potential to emerge as a leader in public transport connectivity in India. It was one of the first cities in India to introduce a Heat Action Plan that strengthens response towards heat stress conditions in the city. For enhancing energy efficiency, the UGVCL became the first DISCOM in the country to commence the smart grid pilot project at Naroda, Ahmedabad, in Feb 2019. In terms of promoting e-mobility, Gujarat already has a scheme in place that provides subsidy to women, students and self-employed persons for procurement of electric two- and three-wheelers.

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

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

Rapid clean technology enabled e-Toilet in Ahmedabad

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

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

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

Climate Change Department
Government of Gujarat

The Climate Change Department, established in 2009, acts as a bridge within the Government, and between the Government and the Society to address Climate Change. Gujarat is the first and only State in India, the first in Asia and fourth in the world to form an independent department for Climate Change. 'Enabling a low carbon pathway for Gujarat's economic growth that would meet people's aspirations with equity and inclusiveness' is among the department's key objectives. The Department works to address the concerns of Climate Change at State Level by following a multi-pronged strategy, while suitably factoring in National Action Plan on Climate Change (NAPCC), Nationally Determined Contributions (NDCs), Sustainable Development Goals (SDGs), State Action Plan on Climate Change (SAPCC).

Gujarat Ecological Education and Research (GEER) Foundation is an autonomous organization set up in 1982 by the Forests and Environment Department, Government of Gujarat. The Foundation undertakes scientific research and studies on various aspects of ecology and nature conservation, including - wildlife, forests, biodiversity and climate change, together with ecological education and extension. The ecological studies and research carried out by the Foundation have created an important source of scientific information and decision making for the Government and other stakeholders. GEER Foundation is also the designated State Center on Climate Change of Gujarat under the aegis of the DST, MoST, GoI.

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